BUILD UP Skills – Finland

Analysis of the national status quo

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0. Executive summary

- **Number of current workforce in the building sector**

In 2009, the real estate and building sector employed approximately 20% of the workforce, or every fifth Finn. The sector provided jobs for 510,000 persons, when the multiplicative effects of production are taken into account. Of the employed, approximately one-third, or 141,800, worked in the building sector.

- **Current energy consumption in the country and in the building sector**

The total energy consumption in Finland in 2011 was approximately 1 389 PJ (petajoules) or 386 TWh (terawatt hours). The use, maintenance, and construction of buildings consumed 40% of the energy. The heating of buildings accounted for 26% of the energy's end use.

In 2005, renewable energy accounted for approximately 28.5% of Finland's primary energy production. Of the renewable forms of energy used in Finland, the most important are bioenergy, particularly wood and wood-based fuels, water power, wind power, geothermal heat, and solar energy. The forest industry's wood-based by-products account for 70% or renewable energy.

- **2020 energy targets for the country + expected contribution of the building sector**

From the standpoint of improved energy efficiency, the real estate and building sector is an essential field. Finland is committed to the EU energy savings targets. The year 2007 energy package specified a greenhouse gas emission reduction target of 20% compared to the year 1990 as well as an energy efficiency improvement target of 20% by 2020 according to a straight-line development scenario.

The European Union's target is to increase the percentage of renewable energy to 20% of energy end-use consumption by 2020. According to the Commission's proposal, Finland will increase the share of renewable energy to 38% of end-use consumption, representing an obligatory increase of 9.5 percentage units.

The vision is that by the year 2050, the share of renewable energy sources in Finland would be approximately 60%.

- **Number of building workers to be trained in each sub-sector/profession to each skill level to achieve the 2020 energy targets**

During the Build Up Skills Finland project, it has been observed that in practice almost all employees in the building sector must be at some level

brought within the sphere of further training. Energy skills must be included in basic and further education as a cross-cutting objective in all content.

According to the findings of this report, the construction sector's level of professional skills must be raised, particularly with respect to structural physics, heat insulation, buildings' airtightness, moisture control, piping installations, and renewable energy. With respect to the control of the overall entity at the construction site, the main concerns that became apparent are deficiencies in basic skills and the challenges posed by renovation construction.

- **Qualification needs**

From the standpoint of the development of training in the building sector, it is essential that basic vocational education be separated from the further and supplementary education aimed at persons who have already earned qualifications. From the standpoint of training implementation, the challenges and expedients, as well as the target groups and training methods, are highly diverse.

Further training must take into account all the measures supporting energy-efficient construction. What is needed is carefully planned short-term training that also clearly benefits companies. Further training must reach more students, and educational institutions require additional competent trainers as the population ages and trainers retire.

Within the building sector, the vocational qualification, first degree system is seen as workable in terms of its structure. Depending on the duration of qualification-oriented education, those earning qualifications will only be entering working life 5-8 years from the time decisions were made concerning the changes in training supply. The development of basic vocational education must be heading with further education towards the same goal, the attainment of the 2020 energy efficiency targets. Teaching must be focused more efficiently and teaching materials must be developed.

1. Introduction

Build Up Skills Finland is an *Intelligent Energy Europe* funded project aiming at improving the energy efficiency competence of construction workers in different phases of the building process. Reliable information, a skilled workforce, and competent implementations will facilitate the practical realization of energy efficiency in buildings, whose reduced energy consumption will play a key role in the fulfilment of European and national energy efficiency targets.

At this stage, similar projects are being implemented in a total of 30 European countries. In November 2011, European countries formed their own national teams and began the work: The Netherlands, Belgium, Bulgaria, Spain, Ireland, Great Britain, Italy, Austria, Cyprus, Latvia, Norway, Portugal, Poland, Romania, Sweden, Germany, Slovenia, Finland, Denmark, Hungary, and Estonia. In the summer of 2012, nine more countries – Greece, Croatia, Lithuania, Luxemburg, Macedonia, Malta, France, Slovakia and the Czech Republic – joined the project.

The first part of the Build Up Skills project, specifying the project's national operational frameworks and the development of national roadmaps, began in November 2011 and will continue to the end of 2013. Each country has first prepared a detailed analysis of the national status quo. The objective has been to specify the construction sector's skilled workforce's need and demands for the year 2020 and beyond, as well as to identify skills deficiencies and obstacles with respect to every group of professionals.

1.1. Project's targets and progress In Finland

The objective of the Build Up Skills Finland project is to increase the number of the skilled construction workers, thus facilitating the attainment of ambitious energy efficiency targets on Finland's construction sites. New know-how is required, on job sites for new buildings as well as in the renovation construction sector.

The first phase of the project has included this analysis report, prepared as an assessment of the current national status quo, the current vocational qualification and skills level of the construction sector's workforce, as well as the role of energy issues in the construction sector's basic vocational education, supplementary training, and further education. The report will serve as the basis for wide-ranging discussions among stakeholder groups regarding the construction sector's current situation. In workshops conducted during the project period, practical experiences, as well as the target groups' own views regarding practices in the construction sector and development needs in Finland, have been discussed. After the analysis phase, the project's more important stakeholder groups will be invited to jointly plan a roadmap for the project that will assemble training needs and targets, plan training content, and submit proposals for the organisation of training. The resulting solutions will then be used to attain the construction sector's 2020 targets.

Build Up Skills Finland is exchanging experiences during the production of the National Status Quo Report with projects from Austria and Slovenia. Throughout the entire duration of the initiative, regular exchange activities are being organised at the EU level to underline the European dimension of this initiative. Besides providing opportunities for the exchange of opinions among different countries, the events will also foster educational interaction.

1.2. Analysis of national status quo

The initiative has analysed the status quo in Finland regarding the need for qualified workers in the building sector by 2020. This has been carried out by analysing the present situation in the education of the construction workforce, the demands of energy and climate policies placed on buildings and the

skills required, and then identifying the discrepancies between the desired targets and the present situation.

The project then initiates Finnish national qualification platforms that bring together stakeholders to discuss the findings of the analysis of the status quo, and to identify issues for the roadmap. Next the project drafts the Finnish qualification roadmap. The stakeholders are again invited to assess this draft and to prioritise the necessary courses of action. Stakeholder groups broadly represent the construction industry, training, research, and public authorities.

1.3 Project's implementers In Finland

Motiva Oy functions as the coordinator of the Build Up Skills project commissioned by the Ministry of Employment and the Economy and the Ministry of the Environment. The consortium implementing the project has included TS (Work Efficiency Institute), responsible for the analysis of the current situation, as well as RATEKO and Amiedu.

Participant name	Short name	Profile of organisation*	Main role in Consortium**
Motiva Services Oy	Motiva	Expert and service organisation in energy and material efficiency	Management, communication, moderation, energy expertise
Work Efficiency Institute	TTS	Research, development, and training institute	Energy and building expertise, analysis, lifelong learning
Ami Foundation	Amiedu	Training body	Life-long learning
Training Centre for the Construction Industries RATEKO	RATE-KO	Training body	Construction expertise, lifelong learning

Organisations committed to the project:

Name of organisation	Type of organisation	Role in process
Ministry of the Environment	Public authority (national)	Energy efficiency of buildings Strategic Advisory Group
Ministry of Employment and the Economy	Public authority (national)	Energy efficiency and renewable energy strategies and actions Strategic Advisory Group
The Finnish National Board of Education	Public authority (national)	Vocational and adult education and training, competence-based qualifications, accreditation and certification Strategic Advisory Group
Confederation of Finnish Construction Industries RT	Construction and building industry interest organisation	Social partner, construction expertise Strategic Advisory Group

The Finnish Construction Trade Union RL	Trade union	Social partner Strategic advisory group
AEL	Provider of technical training	Training expertise
Siikaranta-opisto (attached to the Finnish Construction Trade Union)	Training body	Training expertise, construction expertise
KIINKO Real Estate Education	Education in all aspects of the real estate business	Training expertise, real estate business expertise
The HVAC Association of Finland SuLVI	Building technology association	Building technology expertise
Finnish Refrigeration Enterprises Association (FREA)	Building equipment interest organisation	Building equipment expertise
The Electrical Contractors' Association of Finland STUL	Industry interest organisation	Industry expertise in electrical work
Finnish Association of HPAC Technical Contractors FAHTC	Business association of HVAC contractors	HVAC expertise
Finnish Association of Mechanical Building Services Industry FAMBSI	Industry association of mechanical building services	HVAC industry expertise
Pientaloteollisuus PTT ry	Business association of prefabricated home builders	Industry expertise in prefabricated homes
The Association of Finnish Construction Engineers and Architects RIA	Professional association of construction engineers and architects	Planning expertise
RIL – Finnish Association of Civil Engineers	Professional association of civil engineers	Planning expertise
Rakennustarkastusyhdistys RTY	Professional association of building inspectors	Building quality and inspection expertise

(Source: http://buildupskills.eu/national-project/finland, http://buildupskills.eu/en/national_projects)

2. Objectives and methodology

This report forms a common point of departure for the consideration of current discontinuities in the Finnish construction sector's training practices, as well as the future needs and priorities related to the year 2020's energy efficiency targets. The goal of the report is to describe the construction sector's current situation; this includes its economic importance, the building stock, the construction sector's training system, and the nature of the workforce In Finland. The report also includes information on the objectives and courses of action outlined in national energy policies and strategies aimed at increasing energy efficiency and reducing emissions in the construction sector. The purpose of analysing the difference between the construction sector's current situation and the 2020 targets is to assess change needs as they relate to the workforce's skills in energy- and eco-efficient building, training content, and the quantity of trainers. Another objective is to identify possible obstacles and discrepancies between the targets and the current situation.

The national status quo has been mapped by literature clarifications, Internet searches, interviews with specialists, questionnaires and workshop activities. The interviews with specialists were conducted by e-mail as well as face-to-face.

In March-April 2012, an electronic questionnaire focusing on building's energy efficiency and use of renewable energy was implemented to solicit opinions regarding the knowledge and skills of professionals working on construction sites. TTS drew up the questionnaire in cooperation with the project's other partners Motiva, Amiedu, and RATEKO, and a draft of the questionnaire was sent to the project's stakeholder groups for comments. TTS managed the questionnaire's technical implementation and Motiva was responsible for the distribution of the questionnaire to the stakeholder groups. The questionnaire was sent to several building companies, private construction site supervisors, and representatives of the construction sector's trade organisations. The questionnaire's analysis forms, together with the mapping of the current training system and statistical analysis, formed the basis for the mapping of future skills needs and the project's next stage.

During the spring of 2012, the Build Up Skills project organised four workshops, in Helsinki 24 April and 6 June, in Oulu 15 May, and in Tampere 24 May 2012. The questionnaire's preliminary results were presented at the workshops and an analysis the report's subject matter was also discussed with the representatives of stakeholder groups. The objective of the workshops was to gather the construction sector's various parties around the same table to form the basis for the development of a roadmap for the training of construction workers. The workshops included presentations and platforms regarding the current situation and development of energy efficiency in the construction sector, as well as working group activities from different points of view. Important materials for the analysis report were also obtained at the workshops. The impressions of the members of stakeholder groups and the construction sector's professional representatives participating in the workshops were significant, particularly in the assembling of content for Section *7.* Skills gaps between current situation and targets for 2020 and 8. Obstacles. Amiedu and Motiva were the workshops' main organisers.

TTS has been responsible for the implementation of the *Analysis of the national status quo* section. Motiva, Amiedu, and RATEKO have also participated in the supply of information, and drafts of the report have been discussed at the consortium's meetings. The representatives of several stakeholder groups and other organisations committed to the project also commented on a circulating report draft and its sections.

3. Characterisation of the building sector

Picture1: Finland's northern location is challenging from the standpoint of energy efficiency.

3.1. Finland's special characteristics

3.1.1 Construction history

Finland has long been a thinly populated country. The buildings of the 1800s were for the most part log cabins or otherwise made of wood. Other traditional building materials were brick, particularly in cities, natural stone, used in agricultural buildings, as well as clay, now nearly extinct as a building material. The industrialisation and urbanisation taking place in the Finland of the early 1900s required a great deal of new construction. At that time, new concrete technology and a developing steel industry began to increase the popularity of concrete construction. The Functionalist architectural style representing a "new age" became highly fashionable, particularly in public buildings and growing suburban areas.

Rapid economic growth followed the Second World War. Populations displaced from areas lost in the war were resettled in different parts of the country, and the result was the creation of a new type of detached dwelling, the timber-framed war veteran's house that, it was assumed, every man could build for his family. Wood continues to be the most important building material in Finland, mainly due to the prevalence of detached houses.

During the 1960s, the countryside began to empty as a result of the structural changes taking place in Finnish society, and the Helsinki Metropolitan Area exhibited strong growth. A substantial number of large-scale apartment building complexes were built, many rapidly and with a concrete element technology that subsequently proved problematic. The renovation of these suburban areas has become one of the main problems requiring solutions in the 2000s. Parallel to the urbanisation trend, the quantity of Finnish summer cottages and leisure-time houses has increased.

3.1.2 Northern location

Finland's northern location poses challenges for energy-efficient construction. The heating of dwellings is a significant cost factor with respect to other living expenses, and the building regulations aiming at passive construction require thick insulation layers and a detailed knowledge of structural physics. Climate conditions fluctuate widely within the country because the distance between the country's southernmost and northernmost municipalities is 1,157 km. In Northern Finland the average daily

temperature is on average less than 0 °C for half a year; the equivalent figure in Southern Finland is approximately 3 months. The ground's permanent snow cover ranges from 3 months in Southern Finland to 7 months in Northern Finland (Statistics Finland 2012, Finnish Meteorological Institute 2012).

Frost is a significant stress factor for structures, particularly facades. The maximum frost stress occurs when water penetrating into the structure freezes and melts repeatedly. Temperature fluctuations resulting from climate change are also increasing the frequency of the freezing and melting cycles. Snow also poses its own challenges for building design, when it is necessary to take into account the stresses placed by snow loads on roof structures, as well as the building up of snow against the lower sections of exterior walls.

In winter, snow and rain, as well as fluctuating frost conditions during the building period, hinder many construction work stages, and require shielding and heating measures. Excavation works, concrete casting, and masonry works are particularly demanding tasks in winter conditions. Structural components and materials must be kept dry to avoid moisture and quality problems, and this has become even more challenging when new building regulations have increased the thicknesses of structures.

3.2. Relation to the national economy

3.2.1 Economic significance for Finland

Finland's national wealth is approximately EUR 770 billion, of which the value of the built environment is approximately EUR 560 billion. Nearly three-quarters of Finland's national wealth is therefore tied to buildings, thoroughfares, and networks; approximately EUR 20 billion is used for their maintenance, repair, and renewal annually (Kirafoorumi 2012a). Buildings account for 47% of the national wealth (Roti 2011). Approximately 10% of the gross national product is used in construction, and over 60% of the investments made in Finland are in construction. Approximately one per cent of the building stock is renewed per year (Rakennuslehti 2011). The construction sector is an extremely job-rich sector whose effects are felt throughout all of society; 40% of the money invested in it is returned to the community in the form of various types of taxes and payments (The Confederation of Finnish Construction Industries 2010).

A specific characteristic of the Finnish living is the large quantity of owner-occupied dwellings; two-thirds of households live in owner-occupied swellings (Roti 2011). A dwelling is the basic factor of Finnish well-being and its greatest asset. After personnel, business premises are companies' and other communities' most important resource. Their share is 5–15% of companies' and the public sector's expenses (Kiinteistö- & rakentamisfoorumi 2011).

3.2.2 Employment effect

The real estate and building sector employs 20% of the workforce, or every fifth Finn. The sector provides jobs for 510,000 persons, when multiplicative effects of production are taken into account. Of the employed, approximately one-third work in the real estate business, one-third on construction sites, and one-third in sector-related industrial and service fields (Kirafoorumi 2012b).

House-building employment equals a work contribution of approximately 180,000 man-years, of which a work contribution of 140,000 persons is generated from new construction and from 40,000 persons as a result of renovation construction. In that case, the work contribution also includes other lines of business, such as the construction industry, the retail trade, and other service industries where an employment effect has been created (Kirafoorumi 2012b).

3.3 Markets' stakeholder groups

Everyone uses the built environment: people, companies and other communities, and society. The markets' stakeholder groups include the government, municipalities, builders, owners, investors, users, employees, educational institutions, research institutes, as well as various associations in the real estate and building sector. The users of the built environment form communities such as housing corporations, companies, as well as municipal and government organisations.

The public sector controls a significant portion of the built environment and its procurements have a substantial impact on the sector's markets (Building Information 2009). In Finland there are approximately 2.8 million dwellings, 1.6 million of which are owner-occupied, and the number of rental units exceeds 800,000. There are also approximately half a million leisure-time dwellings and approximately 80,000 housing corporations. Other influential owners of the built environment are companies and various organisations. The roles played by municipalities and provinces in town planning, and their consequential effect on the placement and construction of the building stock, are also substantial in Finland (Kiinteistö- & rakentamisfoorumi 2011).

3.4 Main operators in the construction sector's supply chain

A building project is implemented through networks that include, besides the main contractor, materials and component suppliers, companies belonging to the distribution chain, and service providers. Within the building industry, the logistics process affects the main contractor as well as other participants in the construction process (Sundström et al. 2008).

Building construction combines the products and services generated by many lines of business for clients' buildings. The acquisition of products and services, organisation of deliveries to the construction site, as well as the site's logistical planning and maintenance, are an integral part of a building project's administration, and they essentially affect the construction's productivity, profitability, and quality of the end result (The Confederation of Finnish Construction Industries 2009).

3.5 Market trends, future forecasts, and main factors in the sector's transformation

3.5.1 Strengthening of renovation construction and new construction

Finland's building stock is one of the youngest in Europe. Most of our buildings, housing areas, and infrastructure network need basic repairs and improvements. Increasing emphasis is being placed on the importance of preventive real estate management and maintenance (Kiinteistö- & rakentamisfoorumi 2011). The repair debt will be a significant factor in the future. Finland has been built up primarily during the 1960s and 1970s. The dwellings' repair need is weighted towards the suburbs, built at that time, where pipe and facade renovations will be inevitable during the coming years and decades. No renovations have been carried out at most of the properties. The expert group estimated the building stock's repair debt in 2009 as EUR 30–50 billion. The ageing of the population will also mean the construction of additional lifts in buildings (Kiinteistö- & rakentamisfoorumi 2011, Roti 2011).

Compared to the current situation, in which 10,000 pipe renovations are carried annually at dwellings, the need will increase during the next few decades to 25,000-30,000 dwellings per year. At the moment 100,000 persons 65 and older live in apartment buildings without lifts, but the quantity will increase rapidly. Increasingly stringent energy efficiency regulations will also raise the cost of repairs. The carrying out of important renovations, with respect to the buildings' value and owners' ability to

pay, will be inhibited by the large repair costs. The demolition of deteriorated and difficultly repaired buildings will increase (Kiinteistö- & rakentamisfoorumi 2011, Roti 2011).

The need to build new housing in Finland fairly substantial compared to the other Nordic countries, at least 30,000 new dwellings per year. This residential construction need will continue at this level in Finland for another 10–20 years (Roti 2011).

3.5.2 Decreasing quantity of business premises

Although, by international standards, considerable investments have been made in business premises in Finland, approximately 10-15% of the country's office space is vacant. The main reason is that working methods have changed rapidly to the point that the facilities no longer meet the relevant technical requirements (Kiinteistö- & rakentamisfoorumi 2011).

At the same time that the continuous influx to growth centres is leaving business premises vacant in areas experiencing population outflows, and antiquated business premises are unable to attract tenants, additional state-of-the-art business premises are being built, primarily along cities' traffic routes and at intersections. Boosted space use efficiency is an important reason that new facilities are being sought (Roti 2011).

The merging of municipalities in the public sector will eliminate duplicated functions and thus release business premises. Internal leases will boost the efficiency of space use. The public sector has become aware of the oversupply and has begun to sell off their properties and/or convert them to new uses (Roti 2011).

3.5.3 Energy and eco-efficiency

The real estate and building sector is in the process of adapting to increasingly stringent energy efficiency requirements. Substantial changes can be expected regarding products, implementation methods, and services. The next major changes in sight will be the updating of energy certificates resulting from new regulations, as well as buildings' energy efficiency requirements for renovation construction required by the energy efficiency directive. Current development investments have for the most part focused on new construction. Subsequently, new solutions must be sought for the existing building stock's improved energy efficiency, appropriate functional usages, and maintenance (Roti 2011).

3.5.4 Internationalisation and urbanisation

Globalisation is accelerating. The economic dependencies among different nations are intensifying. Business operations related to the built environment are also internationalising at an accelerating rate. Urbanisation is an international megatrend. In Finland as well, nearly 70% of the population already lives in cities. In the future the pace of urbanisation will only accelerate in different parts of the world, and regional disparities will become more pronounced (Kiinteistö- & rakentamisfoorumi 2011).

One-quarter of the housing stock in Finland is located in areas that are expected to empty as a result of structural changes. Economic frame conditions affecting municipalities and the entire public sector are also becoming tighter. To safeguard services, municipal structures will change significantly. A better balance must be found for living, traffic, and public services. Suburban renewal is a major city planning challenge. The repair and renewal of properties, prevention of alienation, and the preservation and improvement of the service structure are more demanding efforts than the construction of suburbs was at its time (Kiinteistö- & rakentamisfoorumi 2011).

3.6 Foreign workforce

Every fifth worker on a Finnish building construction site is a foreigner. In Uusimaa, foreigners already account for one-third of the workforce. The quantity of foreign workers has grown in recent years at the same rate in Southern Finland as in the entire country; the number has tripled since the autumn of 2007 (The Confederation of Finnish Construction Industries 2011).

3.7 Black economy

According to a survey commissioned by the Finnish Parliament, a clear structural change in the construction sector's black economy has taken place during the 2000s. The main problem in the building sector is its high subcontracting degree. Forged receipts continue to be the construction sector's core problem. According to studies, forged receipts are used chiefly by small and medium-sized companies that use subcontracting. One of the most common uses of forged receipts is that they can be used to withdraw financial assets from a company to pay, for example, undeclared wages.

The key figures referring to the use of forged receipts and one-off companies have more than doubled during the period 2001–2008. At the same time, however, the computational quantity of the domestic grey workforce has decreased by 40%. The contradiction is for the most part explained by the strong increase in the quantity of work hours performed by the foreign workforce after the EU's expansion. The extent of the construction sector's black economy has taken an upturn in recent years, and now causes annual damages totalling EUR 400-500 million in the building sector. The construction sector's deficiencies are not only taxation-related. The Occupational Safety and Health Administration has also observed negligence. According to control statistics compiled for 2010 by the Occupational Safety and Health Administration, the clarifications required by The Act on Contractor's Obligations and Liability when Work is Contracted Out were inadequate at almost 60% of the inspected locations (Tax Administration 2011a and 2011b).

4. National policies and strategies contributing to EU 2020 energy targets in buildings

Picture 2: Finland is committed to the EU's targets for greenhouse gas emissions, energy efficiency improvements, and the end-use consumption of renewable energy sources.

4.1 EU's joint targets

Improved energy efficiency and the adoption of renewable energy sources are also related to global, societal, and market-driven pressures. Within the EU, all new buildings must be nearly zero energy buildings by 2020. The building stock's energy use must be reduced by 30% by the year 2030. The EU has set an objective to limit global warming to no more than 2°C above the temperature in pre-industrial times. The year 2007 energy package specified a greenhouse gas emission reduction target of 20% compared to the year 1990, a 20% share target for the use of renewable energy sources in the EU's energy end consumption, as well as an energy efficiency improvement target of 20% by 2020 according to a straight-line development scenario (Ministry of the Environment 2011).

To implement the energy efficiency objective, the Energy Efficiency Action Plan (EEAP) was published within the EU. This action plan assembles the main courses of action required for the promotion of energy efficiency. According to the plan half of the savings targets can be achieved already before the coming into effect of the legal enforcements outlined in the action plan. The second part will require new courses of action. The action plan is being implemented with EU directives.

The National Renewable Energy Action Plan approved at the EU level in 2010 contains detailed time schedules and operational instructions explaining how each Member State will be able to achieve its year 2020 targets regarding the end use of renewable energy (Wikipedia NREAP).

Parallel to new construction, the renovation construction sector, and its need to improve its energy efficiency, is significant in the entire EU region. The European Regional Development Fund supports innovation projects, aiming at improved living-related energy efficiency, as well as the increased use of renewable energy sources through renovation construction, carried out by municipalities, non-profit organisations, R&D institutes, and private companies. The EU's energy efficiency directive for buildings obligates Member States to provide and publish laws, statutes and administrative regulations concerning renovation construction by 9 July 2012 (SITRA 2011, KIRA 2011).

4.2 National energy policy and courses of action

4.2.1 Government programme

The improvement of energy efficiency in construction is a target in the 2011 government programme. According to the government programme, energy efficiency in construction will be improved by law and other guidance mechanisms, as well as by the creation of incentives. A roadmap concerning the statutes governing buildings' energy efficiencies is in preparation. Another objective of the government

programme is to improve the quality of construction and design work by emphasising designers' competencies and boosting the training efficiency of the sector's operators. Research activities will also be stepped up in the sector (Katainen 2011).

4.2.2 Long term Climate and Energy Strategy

A new Long-term Climate and Energy Strategy was approved in the Council of State on 6 November 2008. The strategy treats climate and energy policies' courses of action in fairly specific detail to 2020 and indicatively until 2050. An updated climate and energy strategy will be completed by the end of 2012 (FISE 2012).

Table 1: IMPACTS OF THE FINNISH LONG-TERM CLIMATE AND ENERGY STRATEGY IN 2020 (Ministry of the Environment 2008).

		Target	Policy	Economic result	Change of employment
	EU Emission Trading Scheme (ETS)	No specific CO2 target, CO2 allowances can be bought or sold according to needs (Common European target in trading sector)	Market mechanisms	GDP: '-0.5 per cent from baseline (in 2020) (assumed allowance price € 30 per tCO2)	-0.05 per cent from baseline
	Renewable Energy Sources (RES)	38% from final energy consumption in 2020	Financial support, feed-in tariffs, ETS	*GDP: '-0.25 per cent from baseline (in 2020)*	+0.02 per cent from baseline
	Biofuels	10% from transport fuel consumption	Command and control	X	Positive impact
Non-EU ETS measures	**Buildings**	Energy performance of buildings - new buildings use 20 - 30% less energy	*Mandatory building codes*	*GDP: -0.05 per cent from baseline (in 2020)*	*+0.03 per cent from baseline*
	Eco-design (energy-related products)	Common energy end-use target (310 TWh/a) will be divided among sectors when new Action Plan for Energy Efficiency is provided by Government	*Implementation of EU directives + education of stakeholders and information to customers*		
	Eco-labelling	Common energy end-use target (310 TWh/a) will be divided among sectors when new Action Plan for Energy Efficiency is provided by Government	*Implementation of EU directives + education of stakeholders and information to customers*		
	Automotive	Target for transport sector: -17% in 2020 compared to BAU	*Differentiated car tax according to vehicle-specific emissions (CO2/km)*	x	x

4.2.3 National Energy Efficiency Action Plan: measure categories (1-8) and examples of energy efficiency measures

Finland's second National Energy Efficiency Action Plan (NEEAP-2) presents a computational estimate of the energy savings implemented in 2010 as well as a savings estimate for the years 2016 and 2012. Finland delivered the first action plan (NEEAP-1) to the Commission in June of 2007.

In Finland's NEEAP-2, the energy savings effects have been calculated with a total of 36 quantified measures relating to energy efficiency. Besides these, the plan has also assembled approximately 50 other quantified measures relating to energy efficiency. In the energy end use area covered by the ESD, the calculated energy savings for the year 2010 is 12.1 TWh. According to the directive's calculation formula, this represents a 6.1% energy savings. By 2016, the estimated energy savings achieved through these measures is expected to rise to a nearly 13% level, clearly exceeding the 9% target, and by 2020 over the 17% level (Motiva a).

As a separate field, the real estate and building sector is highly influential. The following list includes other issues besides the courses of action and examples aiming at the development of the construction sector.

1 Statutes and regulations
- Building codes
- Statutes concerning traffic
  Public procurements
- Energy markings on household appliances
- Ecodesign directive

2 Economic guidance mechanisms
- Taxation instructions
- Supports

3 Energy reviews
- Energy reviews and analyses of industrial, service, and energy sectors
- Energy reviews of apartment buildings and terraced houses
- Farms' energy plans and energy reviews

4 Energy efficiency agreements
- Commercial energy efficiency agreement
- Municipal energy efficiency agreement and energy programme
- Real estate sector energy efficiency agreement – housing and business premises
- Oil industry energy efficiency agreement
  Traffic energy efficiency agreements
- Farms' energy programme

5 Training
- Energy efficiency at different training grades
- Energy reviewer training
- Energy certificate preparers' competency
- Farms' energy designers' training

6 Communications and guidance
- Procurements
- Regional energy offices
- Motiva
- Consumers' energy guidance
- Companies' energy guidance
- Renovation construction communications and guidance
- Tools and network services
- Established communications mechanisms and campaigns

7 Research, development, and innovation operations

- Tekes, Academy of Finland, and Sitra, several programmes whose common theme is energy efficiency
- Strategic Centres for Science, Technology and Innovation (SHOK)
- Centre of Expertise Programme (OSKE)
- TransEco research programme

8 Community planning and town planning

- National and regional co-operation
- Assessment methods for social structure's energy efficiency
- Energy-effective pilot projects for regional construction

(NEEAP-2 2011)

4.2.4 Energy subsidies

The existing building stock's energy efficiency is furthered with repair and energy subsidies intended for detached houses, apartment buildings, and terraced houses. Energy subsidies for the improvement of buildings' energy economy can be sought from the Housing Fund of Finland or municipalities. Energy repairs for detached houses are primarily supported by more favourable terms for tax deductions for home improvements; with respect to lower-income individuals, these are supplemented with means-tested energy assistance. The renewal supports projects that improve detached houses' energy efficiency, and encourage more environmentally friendly heating practices. The European Regional Development Fund supports innovation projects, aiming at improved living-related energy efficiency, as well as the increased use of renewable energy sources through renovation construction, carried out by municipalities, non-profit organisations, R&D institutes, and private companies (Ministry of the Environment 2012, Council of State 2008, Ministry of the Environment 2010b).

4.2.5 Voluntary energy efficiency agreements

Voluntary energy efficiency agreements are being implemented as a part of the national energy and climate strategy. The agreements also ensure the attainment of the targets specified in the EU's Energy Efficiency Directive and End-use Efficiency and Energy Services Directive. One example is the new real estate sector energy efficiency agreement for the years 2010–2016 signed by the Ministry of the Environment, Ministry of Employment, and The Finnish Association of Building Owners and Construction Clients (RAKLI) in December 2009 (Ministry of the Environment 2012).

4.2.6 Environmental certificates for construction

The Ministry of the Environment is a partial sponsor in several development projects aimed at enhancing a building's energy efficiency. Energy efficiency is also an essential component of the (PromisE) environmental classification for buildings, developed jointly with the real estate and building sector, whose purpose is to provide a user-friendly tool for the setting of a building's environmental targets and the assessment of its environmental characteristics. Environmental certificates are becoming increasingly important in public building. Other environmental classifications used in Finland are the internationally utilised BREEAM and LEED (Green Building Council Finland 2012).

4.2.7 ERA17 for an Energy-Smart Built Environment 2017

The ERA17 programme assembled a diversified group of specialists to map the best ways to promote smart energy. This work resulted in the creation of the operational programme ERA17 for an Energy-Smart Built Environment 2017. ERA17 encourages Finland to achieve the emissions targets set for 2020 in advance, in time for Finland's 100th anniversary in 2017. The programme mapped the most

effective ways to improve the energy efficiency of the built environment. Led by the Ministry of the Environment, Sitra, and Tekes, the group's experts represented business, research, and public administration. The results are 31 proposals for courses of action that treat energy-efficient land use, decentralised energy production, construction guidance, properties' use and ownership, and the development of skills.

According to the ERA17 working group's final report, the main courses of action include, for example, a mapping of the development of building regulations during the next 10-year period, as well as guidelines governing renovation construction. Instead of controlling after the fact, building supervision should be proactive and advisory. Properties should be provided with environmental classifications, limits should be set on the growth of urban regions, and there should be a feed-in tariff for solar electricity. According to a preliminary life cycle impact assessment, the courses of action will reduce the built environment's energy consumption by approximately 20–35% and greenhouse gas emissions by 10–35% by 2050 compared to the present situation. Renovation construction is at the core of energy efficiency development: Over half of the building stock in 2050 already exists.

The implementation of the action programme during the years 2011–17 will be promoted by a monitoring group whose task will be to support and co-ordinate different organisations in the implementation of the programme's courses of action while avoiding overlap (Ministry of the Environment 2010, ERA17 2011).

4.3 Implementation of Energy Performance in Buildings Directive (EPBD), planned courses of action in Finland

4.3.1 Energy regulations for new construction 2012

The construction industry's, building operations', and building stock's share of heating and electricity consumption exceeds 40% of the primary energy generated in Finland. Buildings also generate approximately 40% of greenhouse gas emissions. The real estate and building sector is, from the standpoint of improved energy efficiency, of central importance. During this decade, the development of guidance mechanisms affecting buildings' energy efficiency will be the main change factor in the real estate and building sector's operational environment. Finland, following the EU directive, will be switching to nearly zero energy construction for new buildings by 2020 (Ministry of the Environment 2010c).

The Ministry of the Environment will specify the basic requirement level for the energy efficiency of new buildings in building codes. Building permit applications must demonstrate that the designed building complies with the building codes' requirements. The regulations will apply to new construction as well as to most aspects of renovation construction.

Energy efficiency-related building regulations have been renewed and new regulations (D3 Building's energy efficiency) went into effect 1 July 2012. New construction will now require an overall energy assessment that takes into account all the energy used in the building, a coefficient for the form of energy, and the building type. The objective of the new regulations is to improve buildings' energy efficiency by 20% compared to the present situation, as well as promote the increased use of renewable forms of energy use and design freedom. The change facilitates a phased transition to the nearly zero energy construction required by the EU directive.

A building's energy efficiency will be assessed with a new E-number. In the overall energy assessment, all purchased energy consumption taking place in the building is added together. This includes heating, ventilation equipment, the production of heated service water, lighting, and household appliances. This is then divided by the building's net floor area, which includes all heated

spaces. The E-number is the building type-specific upper limit. The upper limit of a detached house's E-number will also depend on the house's floor area; the requirements are more relaxed for detached houses (Ministry of the Environment 2012 Rakentajan ekolaskuri 2012).

When calculating the E-number, the production form of the purchased energy used in the building is also taken into account. The forms of energy have been assigned a coefficient that is applied to the quantity of energy used in the building. The regulations favour renewable forms of energy and district heating. Purchased energy means all energy procured for the building's use, for example electrical and district heating, as well as fuels such as oil, pellets, and wood, but not from the building itself, for example renewable energy exploited with solar power, wind power, or heat pumps. A separate requirement for the use of renewable forms of energy, designed for the National Building Code of Finland, has been removed from use owing to its difficulty and will be included in future code revisions (Rakennuslehti 2011).

4.3.2 Nearly-zero energy construction target for new construction

All new public buildings will have to be nearly zero energy buildings beginning in 2019 and all new buildings nearly zero energy buildings beginning in 2021. Finland will prepare a national plan to increase the quantity of nearly zero energy buildings. A roadmap spelling out improved energy efficiency in new buildings will be part of the national plan. Currently there are no separate existing or planned funding mechanisms aiming at the increase of the quantity of nearly zero energy buildings. The need and/or possible implementation of funding mechanisms are being considered as part of the national plan's preparation (NEEAP-2 2011).

In conjunction with the development of building codes, a roadmap or estimate will be drawn up to determine how the changing regulations affecting buildings will change during the following 10-year period, and how the changes will be linked to national strategies and the EU's energy policy. The roadmap facilitates the anticipation of increasingly stringent statutes and regulations concerning energy efficiency. The Ministry of the Environment is preparing the road map during 2012 in cooperation with the main operators in the municipal, real estate, and construction sectors. The course of action is also part of the government programme published in the summer of (ERA17 2012).

4.3.3 Renovation construction energy regulations 2013

Over the long term, renovation construction will play a decisive role in Finland's energy consumption. A law applying to energy efficiency regulations renovation construction has been sent for comments in June of 2012. Future renovation construction subject to licence will require, also at the schematic design stage, the taking into account of energy efficiency, but renovation construction involvement will remain voluntary. The regulations would be applicable to the kinds of renovation construction where energy efficiency could be improved as a part of repairs or restoration works resulting from other reasons; the intent would be to have these statutes come into effect in early 2013. Minimum requirements will be set for energy efficiency when it is a question of a buildings renovation construction subject to licence, a change in functional purpose, or the repair of technical systems. These kinds of repairs include, for example, extensive renovations, repairs to a building's outer skin, and the updating of technical systems. Courses of action improving energy efficiency do not have to be implemented if they are not technically, functionally, or economically feasible (Rakennuslehti 2012). The new scenario calculations will assume that heating energy consumption has been halved, and that electricity consumption will remain the same in the renovations of residential buildings (ROTI 2011).

4.3.4 Energy certificate and E-number

An energy certificate is a tool that can be used to compare and improve a building's energy efficiency. It has been used in Finland since 2008 in new construction as well as large buildings (Ministry of the Environment 2012).

In its legislative proposal concerning the renewal of the energy certificate, the Ministry of the Environment has proposed that building's energy efficiency be defined in the energy certificate with a calculated E-number, and correspondingly in the new energy regulations governing new buildings. A point of departure for a building's energy efficiency classifications, the E-number is based on an overall energy assessment that takes into account all energy consumption taking place in the building. The E-number is made up of a building's annual calculated consumption of purchased energy weighted with various types of energy coefficients. The smaller coefficients are for renewable energy and district heating. The selection of the heating system will have the greatest impact on the E-number. (Rakennuslehti 1 June 2012). The renewal prepared by the Ministry of the Environment is part of the national implementation specified in the EU's updated Energy Efficiency Directive. The renewal is also based on energy regulations for new buildings that went into effect 1 July 2012.

With the energy certificate's renewal, existing detached houses would also be gradually brought within the sphere of the energy certificate. In the future, the energy certificate would be required in existing detached houses, as well as in other buildings, in connection with the sale of a building or apartment, or on connection with rentals, as well as in new construction. The energy certificate would also contain recommendations for the improvement of energy efficiency for the buildings in question (Ministry of the Environment 2012b).

4.4. Renewable energy use targets

4.4.1 Renewable energy directive (RES Directive)

The European Union's target is to increase the percentage of renewable energy to 20% of energy end-use consumption by 2020. Renewable energy sources include solar energy, hydroelectric power, wind power, wood energy, biomass, biopower, and heat pumps. The Renewable energy directive specifies the individual energy targets for each Member State; the countries themselves then deciding on the courses of action necessary to attain the objectives set. The RES Directive also includes a general target, set for all Member States, to increase the share of biofuels in traffic to 10% by 2020. According to the Commission's proposal, Finland will increase the share of renewable energy to 38% of end-use consumption, representing an obligatory increase is 9.5 percentage units. (Motiva b).

4.4.2 Courses of action In Finland

The main outlines of the approach to increasing the use of renewable energy are set out in the Long-term Climate and Energy Strategy submitted as a report to the Finnish Parliament in 2008. Of the renewable forms of energy used in Finland, the most important are bioenergy, particularly wood and wood-based fuels, water power, wind power, geothermal heat, and solar energy. Currently the forest industry's wood-based by-products account for 70% or renewable energy. The increased use of renewable energy is seen as requiring, besides the forest industry's by-products, dramatically substantial increases in the use of other bioenergy (forest converted chips, pellets, field biomass, waste), hydroelectric and wind power, geothermal heating, as well as well as energy savings measures. All sub-areas of heating production contain additional possibilities for renewable energy (Motiva b).

The heating of buildings is being developed by promoting a switch from oil and electricity to replacement solutions that are superior alternatives from the standpoint of emissions. Heat pumps, the exploitation of bio-based oil and solar heating, as well as a switchover to pellet heating, will be supported; the objective will be to establish the heating of properties with renewable energy as standard practice. The adoption of solar electricity on a larger scale will take place in subsequent decades and is dependant on the results of R&D activities. The implementation of wind power targets will require effective control mechanisms and innovative structural engineering.

In Finland, a feed-in tariff system, in other words a law governing subsidies for electricity produced with renewable energy sources, was adopted in 2011. Nearly EUR 100 million has been allocated for its production support in 2012. The feed-in tariff's subsidy will grow annually; by 2015 for example, this support is expected to cost nearly EUR 200 million. Subsidies in the form of the difference between the target and market prices of electricity will be paid to wind power generators, biogas power plants, and wood-fuelled power plants approved for the feed-in tariff system. In Finland, solar energy is not yet within the sphere of the feed-in tariff system.

By the year 2050, the share of renewable energy share could be raised even higher then the targets for 2020 if the overall growth of energy use can be stemmed and turned downwards. The vision is that the share of renewable energy sources would be approximately 60% by the year 2050, by which time it should be in principle possible for Finland to switch over to a nearly emissions-free energy economy (Council of State 2008, Motiva c).

The new energy regulations for new construction that went into effect in July of 2012 include an overall energy assessment that takes into account all the energy used in the building, a coefficient for the form of energy, and the building type. The objective of the new regulations is to improve a building's energy efficiency by 20% compared to the present level, promote the use of renewable energy sources, and encourage design freedom. The regulations favour renewable forms of energy and district heating (Ministry of the Environment 2012a).

4.5 Green work, targets for the development of new vocational skills

So-called "green work"-related targets for environment-related business operations have been written into the EU's Europe 2020 Strategy document spelling out the EU's growth and employment strategy. According to the EU Commission, "green" energy may generate as many as ten million jobs during the 2010s, and it is Europe's largest potential source of new employment (Hassi 2012).

According to a study undertaken by the WWF in 2009, activities aimed at the reduction of carbon dioxide emissions employ over 3 million people throughout Europe. Economically, the sector's importance already outweighs polluting industries such as mines, electricity, gas, cement, metal, and steel. 400,000 people work now employed in renewable energy-related jobs, 2.1 million are working to boost traffic efficiency, and 900,000 are involved with the development of more energy-efficient properties and services (RES Compass 2009).

In 2010, the industrial interest group The Confederation of Finnish Industries EK issued a report "Companies at the Vanguard of the Green Economy". Solutions developed by companies have been of crucial importance in the growth of green work and green business operations. According to the Confederation of Finnish Industries, Finland has competitive expertise in areas such as energy efficiency, water resources engineering, waste management, and recycling (Elinkeinoelämän ympäristöfoorumi 2010).

Up-to-date national green employment data is not currently available. In 2009, employment in the environmental goods and services sector was approximately 5,900 man-years. The public sector and

other service sectors also include green employment, but no relevant data is available (Statistics Finland 2010).

One of the three key projects and responsibilities in the strategic plan for the implementation of the Government Programme focuses on the enhancement of sustainable economic growth, employment, and competitiveness. Government programmes and national strategies emphasise green employment and there are estimates on employment in different sectors; according to certain estimates, as many as 50,000 people may be employed in the green sector. These figures, however, have not been confirmed and thus cannot be interpreted as reliable statistical data. There are approximately 1,500 businesses working with green energy in Finland today (Council of State 2011). “Green technology” is however more than energy. In Finland, the net sales of one of the leading cleantech companies has already exceeded EUR 20 billion in 2011, and the sector registered a 10.6% growth between 2010 and 2011 (Hassi 2012, Cleantech Finland 2012).

4.6. Relationship of EU’s training policy and European Qualifications Framework (EQF) to national training policy

4.6.1 The European Qualifications Framework (EQF)

The European Qualifications Framework (EQF) consists of eight levels that cover qualifications from compulsory education to higher vocational and academic education. The EQF is based on the specification of learning results. It describes knowledge, skills and competency regardless of where in the system the qualification has been earned or the competency acquired. Within the reference framework, qualifications and skills are divided into eight reference levels. The framework covers all general educational, vocational, and university level qualifications as well as the qualifications resulting from further studies. For each level there is a separate description of what a person attaining that level knows, understands, and is able to do. Learning results are described as knowledge, skills, and competency (European Dimension).

4.6.2 The national framework for qualifications and other learning in Finland

The Finnish government has proposed the adoption of a national framework for qualifications and skills in early 2013. A framework covering the entire training system will improve the clarity and workability of the Finnish qualification system, enhance the qualifications’ domestic and international transparency and comparability, as well as promote national and international mobility. The national framework for qualifications and skills will be based on the European Qualifications Framework (EQF) (Finlex 2012).

Within the reference framework, the qualifications, syllabuses, and other wide-ranging skills entities belonging to Finland’s national training system will be divided into eight reference levels depending on the skills required.

The reference framework will facilitate the overall assessment of the Finnish training and qualification system as well as other skills. It will describe the skills required for the qualifications, syllabuses, and other wide-ranging skills entities as knowledge, skills, and competency, and will define their interrelationships. The descriptions of skills-based qualifications will support lifelong learning, improve employment, promote mobility, and narrow the gap between training and working life.

The proposal states that Finnish qualifications would be positioned according to the national reference framework’s reference levels:

- skills produced by basis education for level 3
- matriculation examination and upper secondary school’s syllabus for level 4

- vocational qualifications, first degree and vocational qualifications for level 4
- specialist vocational qualifications for level 5
- polytechnic qualifications and bachelor's degree qualifications for level 6
- master's degree qualifications and higher polytechnic qualifications for level 7
- university scientific, artistic and vocational postgraduate degree, for example licentiate qualification and Ph.D. qualification for level 8

(Finnish National Board of Education 2012b).

4.6.3 European Credit system for Vocational Education and Training (ECVET)

With the European Credit system for Vocational Education and Training (ECVET), studies or otherwise acquired expertise performed in different countries can be consistently utilised in the European area as a part of qualifications. The starting point is a system, based on learning results, in which the learning results are specified as knowledge, skills and competency. The European Qualifications Framework (EQF) will be utilised when describing the learning results and skills. Each qualification and its study entity or qualification sub-entity can be described with a quantity of learning points.

The adoption of the ECVET system in Finland is facilitated by the fact that the Finnish curricula and qualifications' basic criteria describe each qualifications target in terms of knowledge, skills, and competence. The European Commission issued an ECVET recommendation in June 2009. According to a training and research development plan covering the period 2011-2016, ECVET will be adopted in Finland in all vocational qualifications 2014. The adoption of ECVET will be undertaken as part of the vocational qualification system's development (TUTKE) (Ministry of Education and Culture).

Finland's vocational training can be considered ECVET-friendly. To a great extent, the training system conforms to the requirements governing the transfer, accumulation, and identification of learning results. According to Finland's current government programme, the specification of qualifications' skills prerequisites will be ratified for training qualifications, and the renewal of the qualification system in vocational education will continue in close co-operation with working life (Training and research 2011–2016). In connection with the development of the qualification system, the European Credit system for Vocational Education and Training (ECVET) will be adopted in all vocational qualifications in 2014 (Finnish National Board of Education 2012a).

4.6.4 FINECVET

The FINECVET project, supported by the Finnish National Board of Education, aims at piloting the application of ECVET's applicability to Finland's vocational qualifications, first degree, vocational qualifications, and specialist qualifications. The FINECVET project was launched in Finland as a pilot already in 2004. During the project's first two stages, the ECVET system has been tested with a total of nine vocational qualifications, first degree. The project's third stage expanded the experimental activities to include vocational and specialist qualifications; testing was continued in eight basic qualifications, four vocational qualifications, and three 3 specialist qualifications. Regarding the real estate and building sector's qualifications, the vocational qualification and specialist qualification for property manager have been included in the project. The three-stage project's final phase began in the autumn of 2009 and concluded in December 2011 (Finnish National Board of Education 2012a).

5. Statistics on building and energy sectors

5.1 Statistical information on the building sector

5.1.1 Building stock

At the end of 2010 there were 1,446,000 buildings in Finland (excluding free-time residences and agricultural buildings). Residential buildings, most of which are detached houses, accounted for 85% of the entire building stock. Of the residential buildings, nearly 60% were constructed in 1970 or afterwards: detached houses 54% and apartment buildings 64% (Statistics Finland 2011a).

The gross floor area of the building stock totalled approximately 434 million square metres. The average gross floor area of all buildings was approximately 307 square metres; in non-residential buildings the average gross floor area was approximately 811 square metres. Residential buildings accounted for 63% of the total gross floor area (Statistics Finland 2011a).

The building stock grew by 12,000 from the previous year. The number of buildings has increased by 284,000, or by approximately 24%, from 1990. There are approximately 77,000 old buildings completed before 1921, representing 5% of the building stock. Three-quarters of the building stock were detached houses. Blocks of flats and terraced houses accounted for 10% of the total number of buildings. Blocks of flats accounted for about one-third of the total gross floor area of all residential buildings (Statistics Finland 2011a).

Table 2. Number of buildings by intended use.

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	2008		2009		2010	
	Buildings	Per cent of total buildings (%)	Buildings	Per cent of total buildings (%)	Buildings	Per cent of total buildings (%)
BUILDINGS TOTAL	1 421 188	100,0	1 433 980	100,0	1 446 096	100,0
Residential buildings	1 213 545	85,4	1 224 209	85,4	1234602	85,4
Detached houses	1 082 511	76,2	1 092 363	76,2	1101707	76,2
Attached houses	75 109	5,3	75 618	5,3	76241	5,3
Blocks of flats	55 925	3,9	56 228	3,9	56654	3,9
Other buildings	207 643	14,6	209 771	14,6	211494	14,6
Commercial buildings	41 419	2,9	41 697	2,9	41961	2,9
Office buildings	10 732	0,8	10 748	0,7	10835	0,7
Traffic buildings	54 134	3,8	54 535	3,8	54716	3,8
Institutional buildings	7 835	0,6	7 993	0,6	8058	0,6
Buildings for assembly	13 418	0,9	13 432	0,9	13509	0,9
Educational buildings	8 885	0,6	8 868	0,6	8903	0,6

	2008		2009		2010	
	Buildings	Per cent of total buildings (%)	Buildings	Per cent of total buildings (%)	Buildings	Per cent of total buildings (%)
Industrial buildings	39 581	2,8	40 173	2,8	40629	2,8
Warehouses	25 964	1,8	26 712	1,9	27170	1,9
Other buildings	5 675	0,4	5 613	0,4	5713	0,4

(Statistics Finland 2009a, 2010a and 2011a).

Finland's building stock is one of Europe's youngest; most buildings in Finland were constructed during the 1970s and 1980s. The number of buildings completed before 1921 was approximately 77,000, or 5% of the building stock.

Table 3. Buildings 2011 by year of construction.

	Number of buildings	Gross floor area, m^2
Total	1 459 705	441 801 608
-1920	77 189	17 460 454
1921-1939	77 899	19 209 306
1940-1959	264 498	50 998 172
1960-1969	139 994	50 742 849
1970-1979	203 462	81 856 787
1980-1989	271 770	86 989 704
1990-1999	181 946	57 104 319
2000-2009	176 635	58 875 645
2010-2011	28 684	9 925 039
Unknown	37 628	8 639 333

(Statistics Finland 2012a).

67% of the building stock consists of one-storey buildings. One and two-storey buildings account for 95% of the total building stock. A total of 3.6 million, or 69%, of the population in Finland live in buildings with one or two storeys. There are 26,000 buildings with four storeys or more, inhabited by 1,104,000 Finns. Buildings with ten or more storeys are relatively rare. There are approximately 300 such high-rise "landmarks" in Finland, 200 of them blocks of flats (Statistics Finland 2011a).

Over 80% of all buildings in Finland are constructed of wood. In the 1970s, the figure exceeded 90%. Stone as a construction material has increased gradually.

Table 4. Number of buildings by construction material 1960-2011.

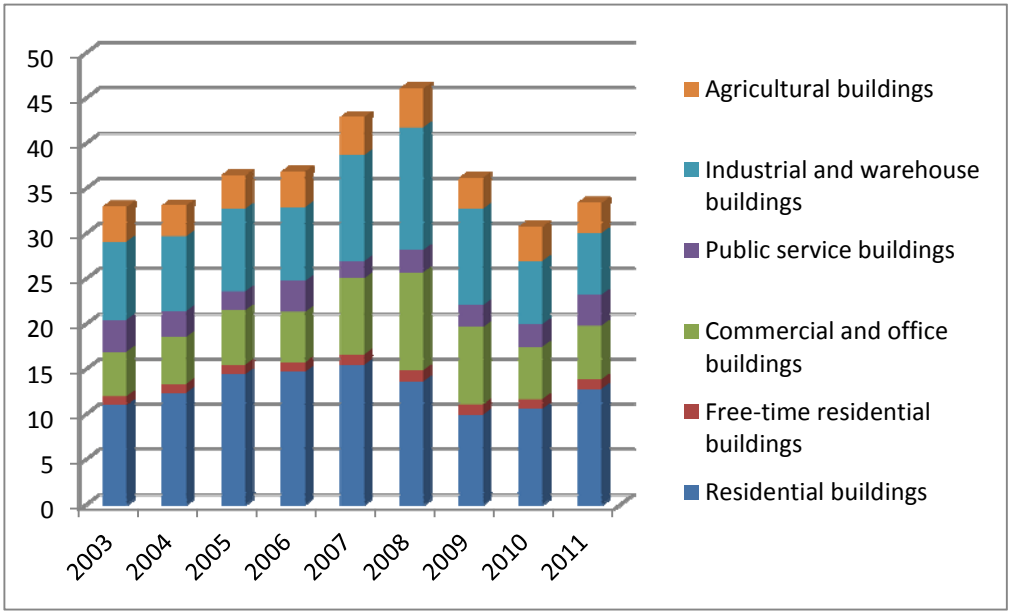
Type of building	Construction material							
	Total	%	Stone	%	Wood	%	Other, unknown	%

Type of building		Construction material							
		Total	%	Stone	%	Wood	%	Other, unknown	%
Buildings total	1960	832 460	100,0	55 008	6,6	777 452	93,4	..	..
	1970	837 948	100,0	83 125	9,9	754 823	90,1	..	..
	1980	934 845	100,0	120 608	12,9	814 237	87,1	..	..
	1990	1 162 410	100,0	168 818	14,5	956 626	82,3	36 966	3,2
	2000	1 299 624	100,0	194 725	15,0	1 040 189	80,0	64 710	5,0
	2009	1 433 980	100,0	194 725	15,0	1 040 189	80,0	54 690	3,8
	2010	1 446 096	100,0	229 311	15,9	1 163 138	80,4	53 647	3,7
	2011	1 459 705	100,0	232 530	15,9	1 174 714	80,5	52 461	3,6
Residential buildings	1960	725 932	100,0	25 586	3,5	700 346	96,5	..	..
	1970	768 204	100,0	58 287	7,6	709 917	92,4	..	..
	1980	842 662	100,0	89 490	10,6	753 172	89,4	..	..
	1990	1 004 809	100,0	121 291	12,1	870 314	86,6	13 204	1,3
	2000	1 120 714	100,0	138 357	12,3	935 928	83,5	46 429	4,1
	2009	1 224 209	100,0	157 920	12,9	1 030 004	84,1	36 285	3,0
	2010	1 234 602	100,0	159 441	12,9	1 039 706	84,2	35 455	3,7
	2011	1 245 671	100,0	161 374	13,0	1 049 698	84,3	34 599	2,8
Other buildings	1960	106 528	100,0	29 422	27,6	77 106	72,4	..	..
	1970	69 744	100,0	24 838	35,6	44 906	64,4	..	..
	1980	92 183	100,0	31 118	33,8	61 065	66,2	..	..
	1990	150 249	100,0	47 394	31,5	82 661	55,0	20 194	13,4
	2000	178 910	100,0	56 368	31,5	104 261	58,3	18 281	10,2
	2009	209 771	100,0	69 021	32,9	122 345	58,3	18 405	8,8
	2010	211 494	100,0	69 870	33,0	123 432	58,4	18 182	8,6
	2011	214 034	100,0	71 156	33,3	125 016	58,4	17 862	8,4

(Statistics Finland 2010b and 2012b).

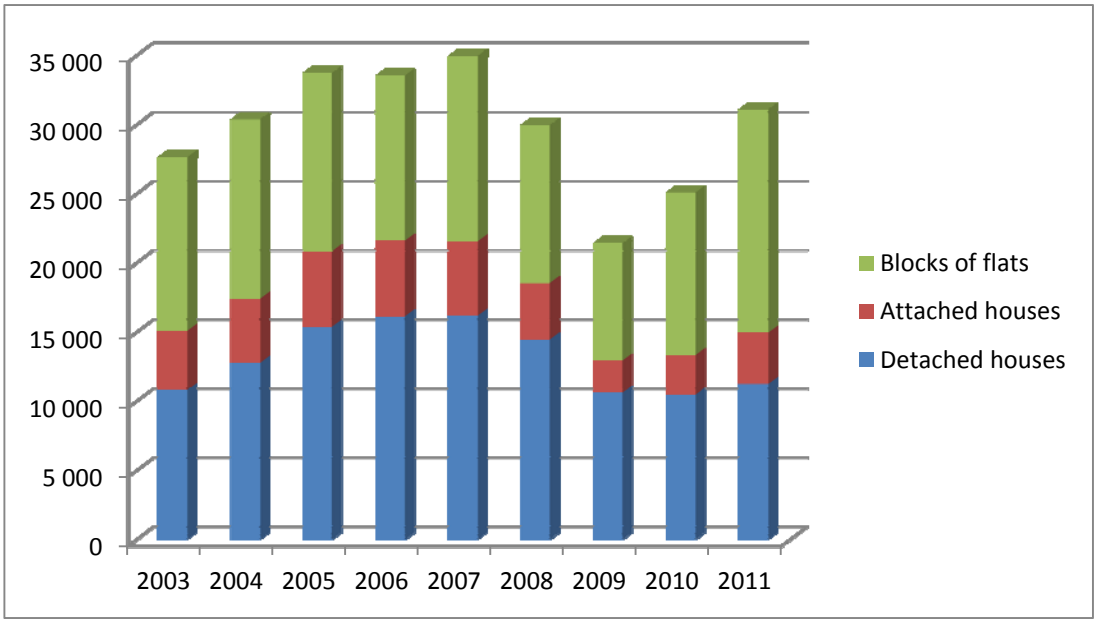
5.1.2 Annual rate of new construction and renovation

In 2011, buildings with a total volume of 35.9 million cubic metres were completed, an 8.9% increase compared to the year 2010. Measured by cubic volume, 20.8% more residential buildings were completed compared to the previous year. The quantity of public service buildings' cubic volume grew by 36.7%. During the first quarter of 2012, buildings with a total volume of 8.2 million cubic metres were completed, a growth of 1.9% compared to January-March 2011. In January-March 2012, residential buildings totalling 2.5 million cubic metres were completed, 14.5% less than the equivalent period of the previous year (Statistics Finland 2012c).



Picture 3. Completed buildings, million m^3 (Statistics Finland 2012c).

During the first quarter of 2012, 6,235 dwellings were completed, 13.2% less than January-March 2011. The quantity of terraced houses and attached house decreased the most, 33.5%. 18.8% less detached houses, and 7.1% less apartment building dwellings were completed compared to January-March 2011 (Statistics Finland 2012c).



Picture 4. Housing production by building type 2003-2011 (Statistics Finland 2012c).

In March 2012, the constant-price value or the volume of ongoing building production was down by 3.1% year-on-year. The volume of residential building construction contracted by 5.3 per cent from March 2011 (Statistics Finland 2012c).

The volume of residential building construction has been decreasing since autumn 2011. The volume of detached house construction has been decreasing since the spring of last year. In March, the volume of construction of detached houses decreased by 8.2% from the previous year. At the same time, the volume of construction of residential blocks of flats decreased by 1.4% and that of terraced

houses by 2.5%. The volume of non-residential building construction contracted by one per cent (Statistics Finland 2012c).

The volume of construction of industrial and warehouse buildings decreased by one per cent and that of commercial and office buildings by 1.9% from the previous year. In March, the maximum year-on-year decrease of 11.6% was seen in the volume of construction (Statistics Finland 2012c).

Table 5. Volume index of new construction, 2005=100.

Year and quarter		All buildings	Residential buildings	Free-time residential buildings	Commercial and office buildings	Public service buildings	Industrial and warehouse buildings	Agricultural buildings
2003		86,8	84,4	82,7	93,2	115,5	75,4	94,1
2004		93,0	96,2	88,8	93,8	104,2	79,4	85,3
2005		100,0	100,0	100,0	100,0	100,0	100,0	100,0
2006		103,9	104,6	101,1	112,9	93,1	101,6	99,9
2007		115,7	101,7	113,2	179,0	77,3	134,3	111,7
2008		113,4	85,5	112,8	194,7	97,7	157,4	93,3
2009		85,7	62,9	96,5	131,8	110,0	102,7	95,2
2010		96,9	91,4	112,1	119,1	118,7	75,0	94,7
2011		104,0	97,7	102,2	126,6	110,2	102,1	95,8
	I	96,8	92,1	86,1	126,4	117,9	93,2	85,0
	II	93,9	85,0	76,9	122,9	110,0	96,3	73,8
	III	111,3	103,7	123,9	127,4	105,6	107,3	108,4
	IV	113,9	109,7	122,0	129,5	107,5	111,6	116,2
2012*	I	95,3	88,1	86,3	126,2	103,1	99,5	84,8

(Statistics Finland 2012c).

The turnover from renovation construction carried out by building construction enterprises with at least 10 employees totalled EUR 4.4 billion in 2010. Renovation construction remained close to the 2009 level, registering a 3% increase on the previous year. The total turnover of all construction enterprises with at least 10 employees totalled EUR 13.3 billion in 2010 (Statistics Finland 2011b).

New construction generated 68% and renovation construction 32% of the turnover of construction enterprises. Enterprises in the construction industry generated 48%, and enterprises in specialised construction, or building installation and completion, 52% of the turnover from renovations. Renovations of non-residential buildings accounted for approximately 57% of the turnover from renovations. Turnover from renovations of residential buildings accounted for 42% of the total (Statistics Finland 2011b).

Table 6. Turnover from construction of largest building construction enterprises in 2000-2010 [1)].

Turnover (EUR million.)		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010 [2)]
New construction	Construction of buildings	3561	3634	3518	3564	3874	4120	4926	5560	4874	5822	5981
	Specialised	851	881	850	864	815	993	1191	1291	1591	2242	2998

Turnover (EUR million.)		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010 2)
	construction activities											
	Total	4412	4515	4368	4428	4689	5114	6117	6851	6465	8064	8979
Renovation construction	Construction of buildings	940	959	975	925	986	1043	1269	1253	1647	2034	1928
	Specialised construction activities	565	556	674	750	938	1137	1129	1311	1409	2227	2469
	Total	1505	1515	1649	1675	1924	2180	2398	2564	3056	4261	4397
Total	Construction of buildings	4501	4593	4493	4489	4860	5164	6195	6813	6520	7856	7909
	Specialised construction activities	1416	1437	1525	1614	1753	2130	2320	2602	3000	4469	5467
	Total	5917	6030	6017	6103	6614	7294	8515	9415	9521	12325	13376

1) The data for 2009 and 2010 are not comparable with data concerning previous years.
2) Preliminary
(Statistics Finland 2011b)

Table 7. Turnover from renovation building of largest building construction enterprises by target in 2000-2010 [1)].

Turnover (EUR million)		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010 2)
Construction of buildings (41), TOL 2008	Total	948	934	977	926	986	1043	1269	1253	1647	2034	1928
	Residential buildings	286	232	300	313	349	373	498	466	585	915	786
	Other buildings	662	702	677	613	637	670	770	787	1118	1062	1142
Specialised construction activities (43), TOL 2008	Total	550	602	673	745	938	1137	1129	1311	1410	2223	2469
	Residential buildings	159	110	155	186	191	330	356	434	465	1102	1092
	Other buildings	391	492	518	559	747	807	773	877	945	1125	1377
Total (41 and 43), TOL 2008	Total	1498	1536	1650	1671	1859	2180	2398	2564	3057	4261	4397
	Residential buildings	445	342	455	499	537	703	855	900	1050	2018	1879
	Other buildings	1053	1194	1195	1172	1384	1477	1543	1664	2007	2243	2519

1) The data for 2009 and 2010 are not comparable with data concerning previous years.
2) Preliminary
(Statistics Finland. 2011b)

In 2010, housing companies and state-subsidised rental dwelling companies spent a total of EUR 1.6 billion on building repairs, a 17.8% increase compared to 2009. (Statistics Finland 2011c) Housing companies' renovations accounted for three-quarters, or a total of approximately EUR 1.2 billion, of all housing corporations' renovations. Renovations by housing companies increased by 17% from the

previous year. Annual renovations classified as housing companies' maintenance costs increased by 5.5%, and renovation costs entered into the balance sheet registered a strong growth of 48%. This strong growth primarily resulted from the high costs of renovating blocks of flats built during the 1950s and 1960s (Statistics Finland 2011c).

40% of all housing companies' renovation costs resulted from repairs to heating, plumbing, and ventilation systems. Approximately one-quarter of all renovations involved repairs to outdoor structures such as exterior walls, roofs, windows, entrance doors, and balconies. Repairs to buildings' interior structures accounted for approximately 10% of housing companies' total renovation costs. The remaining renovation costs related to outdoor areas, foundation structures, individual dwellings, electrical systems, and other remedial measures (Statistics Finland 2011c).

The cost of renovations carried out for state-subsidised rental dwellings totalled approximately EUR 410 million, representing a 19% increase over the previous year. Renovation activity was particularly strong for subsidised rental dwelling companies' buildings the Helsinki Metropolitan Area, where their value increased by nearly one-third from the previous year (Statistics Finland 2011c).

5.1.3 Low energy construction and quantity of energy-efficient repairs

Definitions of low-energy, passive, nearly zero energy, and plus energy buildings in Finland

In Finland there are no official definitions for low-energy, passive, nearly zero energy, and plus energy buildings.

According to generally established usage, a **low energy building** is defined as a building whose heating consumes 85% of the energy needs of an equivalent structure meeting minimum norms. Since early 2010, a low energy building is defined as a building whose heating consumes 85% of the energy needs of an equivalent structure meeting minimum norms. A low energy building consumes less than 60 kWh/m² of heating energy annually in Southern Finland and less than 90 kWh/m² of heating energy annually in Northern Finland (Motiva 2011).

A **passive building** is even more energy-efficient than the above; its heating energy need is only approximately one-fifth of an ordinary house built in the early 2010s. The building is for the most part heated by the home's lighting, as well as the "waste heat" released by people, and only during cold weather is there a need for additional heating. The energy efficiency of a passive building is based on high-quality insulation, airtightness, and effective heat recovery linked with ventilation.

Finland's climate still prohibits the attainment of a cost-effective level where no heating would be required. Attempts to apply international passive building definition criteria (heating energy need under 15 kWh/ m² per year) in Europe's northernmost regions would, in terms of their costs and dimensioning, lead to unreasonable construction solutions and window area limitations, particularly in small buildings. For this reason Sweden, Norway, and Finland have formulated their own national passive building specifications that aim at taking the challenges of the northern climate into account. As part of the Intelligent Energy Europe Programme (IEE), the VTT's researchers prepared the *Promotion of European Passive Houses (PEP)* project, a proposal for the definition of Finnish passive buildings. According to VTT's definition, a passive building in Southern Finland requires approximately 20 kWh/m² heating energy per year and in Northern Finland approximately 30 kWh/m² per year (www.passiivi.info).

A **zero energy building**, or *nearly zero energy building,* is extremely energy-efficient, and it also has its own energy production systems utilising, for example, solar or wind power. A zero energy building generates at least as much renewable energy as the non-renewable energy it consumes. Because the production of energy is uneven, the building occasionally "deposits" surplus electricity with the national

power grid, and occasionally for its part “borrows” current from the network. The difference in the electricity traffic is zero.

It is also possible to implement a nearly zero energy building in Finland; students from the Aalto University’s Department of Energy Technology designed and built the first experimental house in 2010. In Finland, new public buildings will have to be nearly zero energy buildings beginning in 2019 and all new buildings nearly zero energy buildings beginning in 2021.

A **plus energy building** is a building whose energy production exceeds its own needs. Surplus electricity is supplied to the national power grid. In the system, the electricity bill is determined by the difference in the outflow and inflow of energy (Motiva 2011, Hänninen & Association of Finnish Building Inspectors 2012).

Statistics have not been gathered on the quantity of low energy buildings in Finland. According to experts’ estimates, their assessment is difficult because the method generally utilised is tied to the minimum requirements specified in building codes. For that reason it is somewhat unclear as to how low energy buildings will be defined as regulations are updated. At the same time, obtaining a reliable estimate of the number of passive buildings is difficult because three different definitions have been used in Finland. (Lylykangas 2012)

5.1.4 Energy-efficient renovation construction

Owing to the age structure of Finland’s building stock, renovations and improvements, such as piping and facade renovations, are becoming increasingly timely at many properties. Naturally, improving a property’s energy efficiency in connection with the repair projects also makes sense. According to a study carried out by the Aalto University, the energy consumption of half the detached houses built during the previous millennium can be reduced by as much as 60-70% using reasonably simple measures (Teeparannus.fi).

Means-tested energy assistance for equipment and materials investments that improve a dwelling’s energy economy, reduce energy-generated emissions, and encourage the adoption of renewable forms of energy can be granted to the owners (private persons) of detached houses. Subsidies are also provided for the replacement of electrical and oil heating with primary heating systems exploiting renewable energy (Ara 2012).

Table 8. Energy subsidies granted during the years 2007-2008.

	2007			2008		
	EUR	Dwellings	Locations	EUR	Dwellings	Locations
Detached houses	3 998 736	3 851	3 697	5 714 425	5 514	5 286
Other houses	369 859	15 206	283	12 800 454	55 217	2 547
TOTAL	4 368 595	19 957	3 980	18 514 879	60 731	7 833

(ARA 2010).

5.1.5 Companies operating in building sector

Table 9. Confederation of Finnish Construction Industries’ member companies, building construction sector, by turnover.

Turnover	quantity	%

over EUR 500 million	4	1
EUR 100 – 500 million	5	2
EUR 20-50 million	27	8
EUR 5-20 million	72	23
EUR 1-5 million	137	43
EUR 0-1 million	74	23
TOTAL	319	100

(The Confederation of Finnish Construction Industries 2012).

5.2 Statistics on the current workforce in the building sector

In 2009 the entire construction sector employed 141,800 persons. The number of persons decreased by approximately 9,000, or 6%, from the year 2008. During the period 2007-2009, the number of persons in construction decreased by nearly 6,000 persons (Statistics Finland 2011d).

In 2009, firms whose main business area and speciality is construction were the largest employer. The percentage share of persons in the business area was 54% of the entire construction workforce, compared to 53% in 2008. The second largest employer was building construction, whose share was nearly 34%. The house-building share decreased by a couple of percentage points. A smaller sector was earthworks and water construction, whose share accounted for only 11% of all construction-related personnel (Statistics Finland 2011d).

Table 10. Construction personnel by main business area 2007-2009 and personnel change 2008 and 2009.

				Change %	
	2007	2008	2009	07/08	08/09
F Construction	147 696	150 885	141 762	2.2	-6.0
41 Building construction	52 902	54 084	48 815	2.2	-9.7
42 Earthworks and water construction	15 771	16 669	16 032	5.7	-3.8
43 Specialised building operations	79 023	80 132	76 915	1.4	-4.0

(Statistics Finland 2011d).

5.2.1 Number of workers by occupations and skills levels

The table below present the sector's employment distribution by training level in 2007. The largest group consists of professional employees (approximately 110,000 persons) with secondary or lower educations. The second largest group are construction managers (17,500 persons) and polytechnic and B.Sc. engineers (total 12,000 persons) who have received their educations in the traditional training structure. Graduate engineers total 6,900, architects 3,600, and construction architects approximately 1,000 (RIL 2008).

Table 11. Construction sector employees, training distribution 2007.

Professional employees	109 000
Construction managers	17 500

Construction architects	1 000
Polytechnic and B.Sc. engineers	12000
Graduate engineers	6 900
Architects	3 600

(RIL 2008)

Of the professional employees, the largest group is carpenters (40,000) and construction workers (35,000). The number of painters and plumbers is about the same, approximately 12,000. Masons total 6,500 and steel fixers 2,500. The largest groups employed in the infrastructure sector are the approximately 18,000-20,000 drivers of various types of earthmoving machinery (RIL 2008).

Polytechnic and B.Sc. engineers' major task areas are design and construction. Approximately 23%, or 2,800 polytechnic and B.Sc. engineers, are involved in design work. Nearly as many of them are employed in the building sector: 21% of the polytechnic and B.Sc. engineers, or approximately 2,500. Of the construction architects, 73%, or approximately 700, are involved with design tasks. Of the construction managers, approximately one-quarter are in building tasks, and one-quarter in construction management, construction management consulting, or supervisory tasks (RIL 2008).

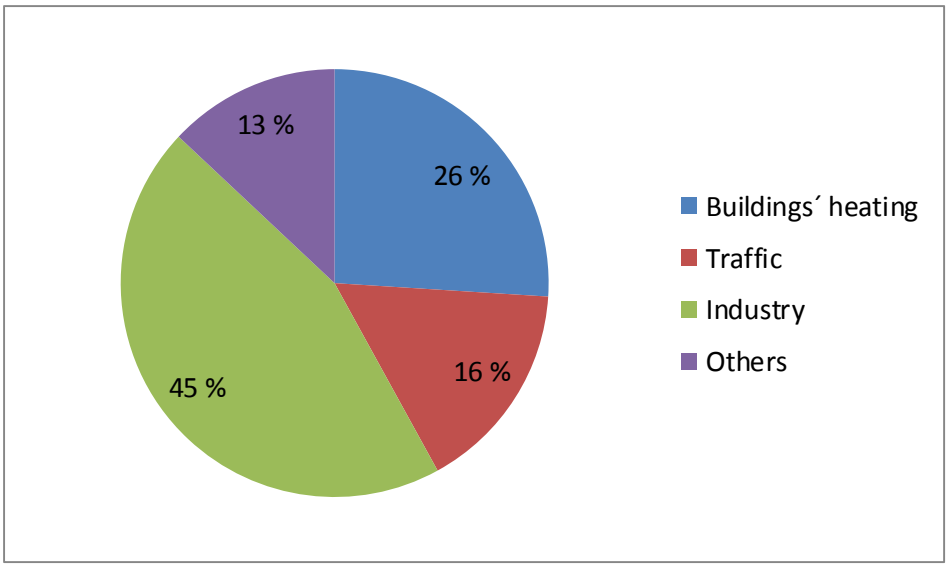
The major task areas of graduate engineers involved with structural engineering and environmental technology are design and management; approximately 1,400 (26%) of them work in design tasks. Approximately 1,300, or 25% of the graduate engineers with qualifications in structural engineering and environmental technology, are employed in administrative an executive tasks. In surveying and real estate management, graduate engineers' major task areas relate to the activities of public agencies, where approximately 330 are employed; another approximately 320 are engaged in administrative and executive tasks. Of the architects, nearly all, 89% or 3,200 employees, are involved in planning tasks. This subdivides into construction design (approximately 74%) and town planning (approximately 15%) (RIL 2008).

A consequence of the real estate and building cluster's diversity is that it includes at least several hundred individual skills profiles. Their precise definition concentratedly would be a challenging task that lies outside the scope of this analysis report.

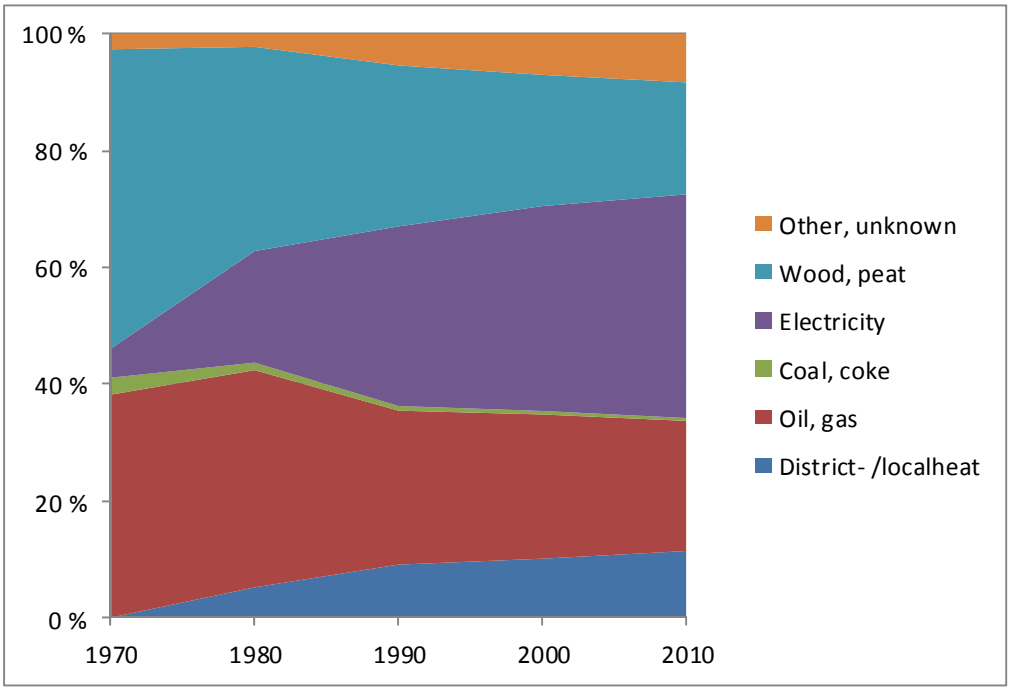
5.3 Statistics for energy consumption and renewable energy in buildings

The total energy consumption in Finland in 2011 was approximately 1 389 PJ (petajoules) or 386 TWh (terawatt hours), over 5% less than in 2010. The highest decreases in energy consumption were registered in industry, as a consequence of reduced industrial production, and in the heating of buildings, the result of a warm winter in 2011. The heating of buildings accounted for slightly less than one-quarter of the energy's end use (Motiva 2012 b).

According to the targets of the climate and energy strategy, the intent will be to increase the use of renewable energy compared to the present level. The objective is that their share of Finland's energy production would increase by 9.5% from the 2005 level by 2020, at which time they would account for 38% of Finland's energy consumption. In 2005, renewable energy accounted for approximately 28.5% of Finland's primary energy production (Motiva 2012a).



Picture 5. Distribution of energy end-use consumption by sector 2011.



Picture 6. Number of buildings by heating fuel 1970-2010 (Statistics Finland 2009b, 2010d, 2011f & 2012d).

Table 12. Heating of buildings.

	TWh
2007	66.8
2008	67.5
2009	73.1
2010	82.9
2011*	74.3

* Advance information.
(Statistics Finland 2011e).

Table 13. Renewable energy sources 2007-2010, TJ.

	Hydro	Small-scale combustion of wood	Black liquor and other concentrated liquors	Wood fuels in industry and energy production	Heat pumps	Recovered fuels (bio-fraction)	Other biofuels
2007	50 366	55 900	153 060	93 224	3 830	5 002	3 624
2008	60 874	58 080	143 746	103 671	6 700	5 918	7 839
2009	45 263	61 400	110 157	97 704	9 540	5 604	12 120
2010	45 875	67 880	135 682	116 101	10 990	6 089	12 560

(Statistics Finland 2011g).

Table 14. Renewable energy sources as primary energy in 2005 and estimate for 2020.

Renewable energy sources as primary energy	**2005** (TWh)	**2020** (TWh)	**Change (TWh/%-unit) 2005 => 2020**
Spent liquors	37	38	1.1
Industrial wood waste	20	19	-1.8
Hydroelectric power (normalised)	13.6	14	0.6
Wind power	0	6	5.8
Forest processed chips	6	25	18.9
Small-scale wood use	13	12	-0.5
Heat pumps	2	8	6.1
Biofuels for traffic	0	7	6.5
Biogas	0	1	0.7
Pellets	0	2	1.6
Recycling fuels, RES portion	2	2	0.0
Other renewable, such as solar electricity, etc.	0.4	0.4	0.0
Total	94	134	39.2
Renewable share of end consumption, implemented / estimate	28.5%	38%	9.5%

(Motiva 2012).

6. Existing VET provisions

Picture 7. In Finland, 94 vocational institutes provide basic training in the building sector. The basic vocational training takes three years. The length of the training for adults varies, depending on previous education and work experience.

In the picture students practice the handling of asbestos, an important task in renovation construction.

6.1.1 Responsible authorities

The Finnish National Board of Education, the highest authority in Finland responsible for education, monitors and supports the organisers of education as well as the educational network's adaptation to changes in Finnish society. The Finnish National Board of Education thus aims at the creation of prerequisites for a sufficient and nationally comprehensive training supply and an appropriate educational network. The organisation of vocational education has been legally defined in the Vocational Education Act (630/1998) as well as Council of State's Decree on Vocational Education (811/1998) (Finnish National Board of Education 2012, a).

6.1.2 Education providers and implementing organisations

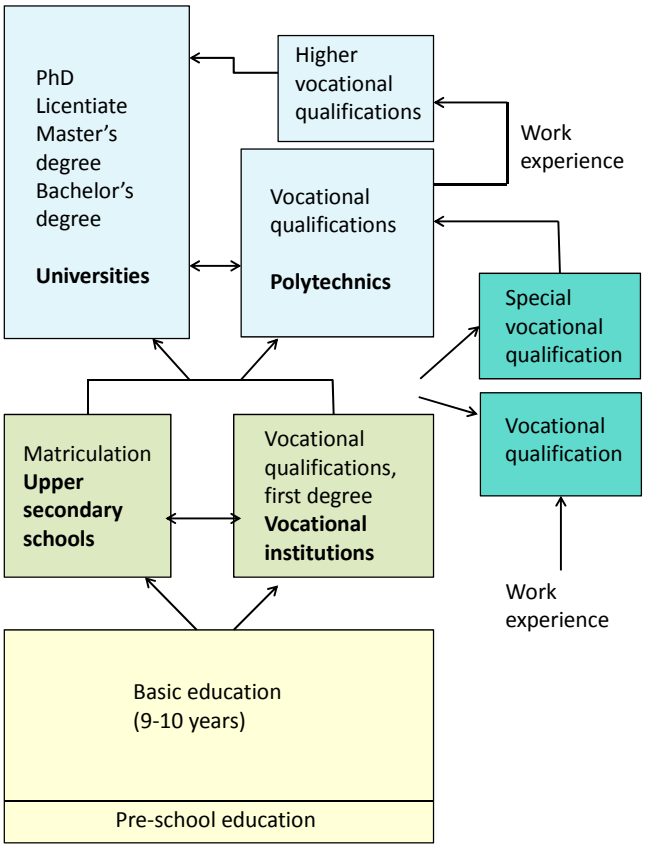
One strength of the Finnish school system has been that decisions affecting the organisation of education can be to a large extent decided at the local level. Changes in the operational environment, however, have set increasingly formidable challenges for the organisation and guidance of the education system. In the future it will become increasingly important how the organisers of education will be guided nationally, how the guidance will affect teachers and students, and how the workability of the various guidance mechanisms can be improved (Finnish National Board of Education 2012, a).

In Finland there are several ways to become educated for the construction sector: vocation-oriented education, apprenticeship training, and further education. Additionally, for example, the construction sector's associations and federations organise supplementary training courses on timely subjects, including short courses on energy efficiency (Rakentaja.fi, a).

6.1.2.1 Vocation-oriented training

The construction sector's vocational qualifications can be earned at vocational institutes, polytechnics, universities of applied sciences, and universities. Vocational educational institutions offer the construction sector's basic training: building technology, real estate services and the construction sector's basic qualifications. At polytechnics, one can study to be a site supervisor, construction manager, or civil engineer. Universities of applied sciences offer educational programmes for graduate engineers (Rakentaja.fi, a).

Picture 8: Finland's training system grouped by training degree. Generally only those completing lower grade studies can study at the higher educational levels in training. Educational targets for each training sector are defined in legislation. (OPH training and qualifications).



Vocational education

The construction sector's vocational education consists of vocational qualifications, first degree and vocational and specialist vocational qualifications earned through further training. Vocational supplementary and further education is possible at different career stages. Basic vocational education and further training is qualification-oriented training.

Progress can be made while earning a basic vocational degree with working life skills examinations as well as further studies at polytechnics and universities of applied sciences. A vocational qualification or specialist vocational qualification can be earned after a basic vocational degree, but also without the preceding vocational basic training.

In specialist vocational qualifications, professional skills are acquired for the sectors more demanding work tasks. Often the purpose of specialist qualifications is to qualify a person for work supervision tasks (Finnish National Board of Education 2012, h).

Skills examinations

Oriented particularly towards adults, a skills examination is a flexible way to earn a qualification. In skills examinations, the skills gained in working life are demonstrated. These skills may have been acquired through working experience, studies, or other activities. All construction sector-related vocational qualifications, first degree, vocational qualifications, and specialist vocational qualifications can be earned with skills examinations.

A skills examination is performed by demonstrating the skills, required in the qualification's prerequisites, gained primarily in production and service situations related to genuine working life. A candidate for a skills examination may participate in preparatory training. A person possessing the requisite skills may perform a skills examination without participating in schooling. Skills examinations can be performed as a vocational qualification, first degree, vocational qualification, and specialist qualification (Finnish National Board of Education 2012, i).

Apprenticeship training

Apprenticeship training is vocational training based on a fixed-term employment relationship supplemented by studies at a vocational institution and/or theory-oriented courses at an adult education centre. Apprenticeship training is associated with a personal study programme in which the student's previous job experience and training can be taken into account. Training compensation is paid to the employer, and the student receives collective labour agreement-compliant wages during the apprenticeship training period, as well as financial support during the period of theoretical studies. A student generally arranges the apprenticeship training contract location personally by contacting the employer directly (Rakentaja.fi, b; Finnish National Board of Education 2012, b).

6.1.2.2 Further education alternatives

Courses ordered by employers are employee-oriented courses related to the enhancement and improvement of professional skills as well as workplace well-being. Most of these courses are implemented at specialised vocational institutes. Employers also order training from vocational adult education centres, fitness training centres, polytechnics, and vocational institutions.

In open polytechnics one can take courses related to polytechnic qualifications, but the entire qualification cannot be earned. The same applies at an open university, where one can stake courses related to university studies.

6.1.3 Quantity of courses and students

In Finland, 94 vocational institutes provide basic training in the building sector. The basic vocational training takes three years (scope 120 study weeks). The length of the training for adults varies, depending on previous education and work experience. Qualifications for young people include an on-the-job learning period lasting at least 20 study weeks. On-the-job learning is directed and goal-oriented study performed at the workplace; its objective is that a portion of the professional skills required by the qualification will be learned during that period. After earning a vocational qualification, first degree, a student can seek further studies at a polytechnic (for example an engineer qualification) or at a university of applied sciences (for example a graduate engineer qualification). There are currently 89 organisers of apprenticeship training in different parts of Finland.

Table 15 presents the quantity of construction sector's students and qualification earners in 2010. At that time a total of 4,762 students graduated from educational institutes and apprenticeship training.

Table 15. Quantity of construction sector's students and qualification earners in 2010.

Educational institute-type training

	Students	Qualification earners
Building technology vocational qualification, first degree	5120	1456
Real estate services vocational qualification, first degree	408	-
Construction sector vocational qualification, first degree	10294	2692

Survey vocational qualification, first degree	286	58
Total	**16108**	**4206**

Apprenticeship training

	Students	Qualification earners
Building technology vocational qualification, first degree	1119	285
Real estate services vocational qualification, first degree	207	-
Construction sector vocational qualification, first degree	1036	234
Survey sector vocational qualification, first degree	95	37
Total	**2457**	**556**

(Statistics Finland 2012).

6.1.4 Educational content and executable qualifications

6.1.4.1 Vocational institutions

Building technology vocational qualification, first degree

Vocational qualification parts, 90 credits. The qualification parts include on-the-job learning at least 20 credits, entrepreneurship at least 5 credits, and diploma work, at least 2 credits.

Pipe installation training programme, plumber
- Heating systems' installation, 20 credits
- Pipe system welding, 20 credits
- Service water and sanitary systems' installation, 20 credits

Additionally 30 credits of other qualification parts must be selected

Pipe installation training programme, heating equipment installer
- Heating systems' installation, 20 credits
- Pipe system welding, 20 credits
- Firing equipment installation, 10 credits
- Building-technical components' electrification, 20 credits

Additionally 20 credits of other qualification parts must be selected

Ventilation installation training programme, ventilation installer
- Sheet metal works, 10 credits
- Ventilation systems' installation, 20 credits
- Duct sections' fabrication, 10 credits
- Ventilation systems' measurements and balancing, 10 credits

Additionally 40 credits of other qualification parts must be selected

Insulation and sheet metal installation training programme, technical insulation installer

- Sheet metal works, 10 credits
- Industrial insulation, 20 credits
- Building-technical insulation, 10 credits
- Cold-technical insulation, 10 credits

Additionally 40 credits of other qualification parts must be selected

Insulation and sheet metal installation training programme, sheet metal worker

- Sheet metal works, 10 credits
- Felt, tile and corrugated roofing sheet metal works, 10 credits
- Seamed roofing sheet metal works, 20 credits
- Facade cladding installation, 10 credits

Additionally 40 credits of other qualification parts must be selected

Cold installation training programme, cold installer

- Cold components' and piping installation, 20 credits
- Cooling plants' start-up, 20 credits
- Cold equipment servicing, 10 credits
- Building-technical components' electrification, 20 credits

Additionally 20 credits of other qualification parts must be selected

Elective qualification parts for all

- HPAC renovation construction, 10 credits
- Fire extinguishing systems' installation, 10 credits
- Heating systems' measurements and balancing, 10 credits
- Heating and piping systems' servicing, 10 credits
- Municipal pipe system installation, 10 credits
- Ventilation systems' cleaning, 10 credits
- IV machines' servicing, 10 credits
- Chimney sweeping, 10 credits
- HPAC design, 10 credits
- Small cooling equipment installation, 10 credits
- Sheet metal works, 10 credits
- Qualification's part of vocational qualification, first degree, 10 credits
- Qualification's part of vocational qualification
- Qualification's part of specialist vocational qualification
- Locally provided qualification's parts in basic vocational training, 0–10 credits

(Finnish National Board of Education 2012, c).

Real estate services vocational qualification, first degree

Vocational qualification's parts, 90 credits. The qualification's parts include on-the-job learning at least 20 credits, entrepreneurship at least 5 credits, and diploma work at least 2 credits.

Mandatory qualification parts for all

- Production of customer-oriented real estate services, 10 credits

Property management training programme or skills area, property manager

- General property management and supervision, 20 credits
- HPAC systems' management, 20 credits

Additionally 40 credits of other qualification parts must be selected

Business premises services training programme or skills area, business premises caretaker

- Maintenance cleaning, 20 credits
- Basic cleaning, 20 credits

Additionally 40 credits of other qualification parts must be selected

Elective qualification parts for all

- Ventilation equipment servicing, 10 credits
- Assessment of property's working order, 10 credits
- Construction period sanitation, 10 credits
- Office services, 10 credits
- Use of property automation, 10 credits
- Construction-technical repair works, 10 credits
- Residential properties' sanitation, 10 credits
- Maintenance of outdoor areas, 10 credits
- Machinery handling, 10 credits
- Wet spaces' sanitation, 10 credits
- Industrial facilities' sanitation, 10 credits
- Heating and piping systems' servicing, 10 credits
- Chimney sweeping, 10 credits
- Traffic equipment sanitation, 10 credits
- Shops' and commercial facilities' sanitation, 10 credits
- Ventilation systems' cleaning, 10 credits

(Finnish National Board of Education 2012, d)

Construction sector's vocational qualification, first degree

There are four training programmes: earthworks, operation of earthmoving machinery, house-building, and the stone industry. Environmental awareness, lifecycle thinking, and responsibility for the built environment are emphasised in today's building. The work also includes renovation construction and building maintenance.

Vocational qualification's parts, 90 credits. The qualification's parts include, on-the-job learning, at least 20 credits, entrepreneurship, at least 5 credits, and diploma work, at least 2 credits.

Mandatory qualification parts for all

- Foundation works, 15 credits

House-building training programme, house-builder

- Frame stage works, 35 credits

Earthworks training programme, earthworks builder

- Earthworks, 35 credits

Earthworks transport training programme, earthmoving machinery driver

- Use of earthworks machines, 35 credits

Stone sector training programme, stone builder

- Stone products and installation, 35 credits

Elective qualification parts for all, total of 40 credits must be selected

- Interior manufacturing phase works, 10 credits
- Cladding and roofing works, 10 credits
- Masonry, 10 credits
- Tiling, 10 credits
- Reinforcing and concreting, 10 credits
- Plastering, 10 credits
- Shuttering, 10 credits

- Steel construction, 10 credits
- Sheet metal construction, 10 credits
- Log construction, 10 credits
- Renovation construction, 10 credits
- Scaffolding construction, 10 credits
- Window works, 10 credits
- Water construction, 10 credits
- Waterproofing, 10 credits
- Use of traffic areas' maintenance machinery, 10 credits
- Transport of earth materials, 10 credits
- Processing or earth and rock materials, 10 credits
- Rock construction, 10 credits
- Pile foundation construction, 10 credits
- Asphalting, 10 credits
- Servicing of earthmoving machinery, 10 credits
- Use of earthmoving machinery, 10 credits
- 3D control of earthmoving machinery, 10 credits
- Soil investigations, 10 credits
- Yard construction, 10 credits
- Building stone's mortar installation, 10 credits
- Building stone's mechanical fastening, 10 credits
- Paving installation, 10 credits
- Environmental stone installation, 10 credits
- Soapstone production technology, 10 credits
- Hard stone production technology, 10 credits
- Natural stone industry, automation and production processes, 10 credits
- Natural stone shaping, 10 credits
- Fabrication of monument products, 10 credits
- Construction of natural stone fireplace, 10 credits
- Excavation of natural stone, 10 credits
- Measuring, 10 credits
- Building services, 10 credits
- Transport sector basic level vocational qualification, 10 credits
- Qualification's part of vocational qualification, first degree, 10 credits
- Qualification's part of vocational qualification
- Qualification's part of specialist vocational qualification
- Locally provided qualification's parts, 0–10 credits

Expertise is supplemented by the qualification's parts in basic vocational training (joint studies). Mandatory qualification's parts: mother tongue, second domestic language, foreign language, mathematics, physics, chemistry, societal, corporate, and working life knowledge, physical education, health education, art and culture (Finnish National Board of Education 2012 e).

Electrical and automation technology vocational qualification, first degree

Vocational qualification's parts, 90 credits. The qualification's parts include on-the-job learning at least 20 credits, entrepreneurship at least 5 credits, and diploma work at least 2 credits.
Mandatory qualification parts for all

- Electrical and automation technology, basic skills, 30 credits
- Electrical and automation installations, 20 credits

Electrical and automation technology training programme, electrical installer

- Electrical and energy technology, 20 credits

Electrical and automation technology training programme, automation installer

One elective must be chosen from the following qualification's part:

- Piece goods, 20 credits, tai
- Process automation, 20 credits

Elective qualification parts for all, 10–20 credits

- Property automation and information systems, 20 credits
- Electricity network installations 20 credits
- Qualification's part of vocational qualification, first degree, 0–20 credits
- Qualification's part of vocational qualification
- Qualification's part specialist vocational qualification
- Locally provided qualification's parts, 0–20 credits

(Finnish National Board of Education 2012, f)

Master painter specialist qualification

Qualification's parts
Obtaining a qualification certificate for a master painter's specialised vocational qualification requires a total of five approved performances.
Mandatory part:

- Master painter's general skills

Depending on the orientation, at least one part must be selected from the following:

- Painting of new buildings
- Painting of repaired buildings
- Repair and painting of facades

Depending on the above orientation, at least one part must be selected from the following:

- Demanding building painting
- Facade renovation
- Work organisation and management

Additionally, parts must be selected from the following according to the need:

- Painting sector's profitability and cost management
- Operational design
- Building's restoration painting
- Demanding pattern painting
- Gilding works
- Decorative gypsum works
- Furniture restoration
- Special wallpapering
- Classical decorative painting

(Finnish National Board of Education 2012, g)

Skills examinations

Besides the vocational qualifications, first degree, one can study the following vocational and specialist vocational qualifications as skills examinations:

Construction sector's vocational qualifications:
Earthworks sector, building production, construction product sector, house-building sector, ventilation installer, ventilation systems' cleaner, district heating installer, cold installer, heating equipment installer, piping installer, technical insulation installer, sheet metal worker, floor covering installer, environmental property manager, surveying, water service sector, automation installer, electrical installer, electrical network installer, painter, stonemason, and chimney sweep vocational qualifications.

Construction sector's specialist vocational qualifications:
Earthworks sector, construction sector's construction site manager, house-building sector, ventilation installer, senior district heating installer, cold master, piping installer, master sheet metal worker, floor master, senior automation installer, electrical network sector, senior electrical installer, master painter, property manager, environmental sector, master chimney sweep, and security supervision specialist vocational qualifications (Pekkala 10.8.2012).

6.1.4.2 Polytechnics

Polytechnics are fairly independent and the subjects' head teachers are in a fairly decisive position regarding the matters that are emphasised in teaching.

Construction manager, polytechnic

Nine polytechnics currently offer construction manager training in Finland. Studies concentrate on the construction sector's vocational studies that include A-class work supervisor competency-compliant theory studies and practical applications. An important part of the studies are construction site technology, construction project cost management, supervisory tasks, and contract practices. The qualification includes its own job task-related on-the-job learning and diploma work. The technology sector's mathematics, physics, communications, information technology, and structural technology are also studied as basic subjects. A portion of the studies are performed as project work by exploiting practical construction projects. The scope of the qualification is 3.5 years, or 210 study credits (Construction Manager 2012, Saimaa University of Applied Sciences 2012, a).

Civil engineer

Besides basic engineering studies (mathematics, physics, languages and communications), the civil engineer qualification also includes, among others, the following vocational studies: concrete technology, structural mechanics, structural technology, geoconstruction, foundation construction, construction economy and production technology, as well as the command of the construction sector's EDP applications.

Those selecting infrastructure technology and rock construction will also gain a familiarity with earthworks technology, excavation technology, road and traffic technology, water and waste management and environmental construction. The studies of those selecting house-building technology (structural design and production) will concentrate on structural technology and structural physics, house-building technology and renovation construction. The scope of the qualification is 4 years, or 240 study credits, of which the share of on-the-job learning is 30 study credits (Saimaa University of Applied Sciences 2012, b).

6.1.4.3 Supplementary training in the energy efficiency sector, selected examples

Training Centre for the Construction Industries RATEKO - Building's energy efficiency
- Effects of new energy efficiency requirements on construction site

New regulations affecting a building's heat insulation and energy consumption have made the airtightness of the building's outer skin an increasingly important factor in the achievement of structural performance, reduced energy consumption, and good living comfort. The training takes the airtightness of the building's outer skin into account with calculations of the building's heat insulation and energy consumption, the verification of the building skin's airtightness, the effects of sealing requirements on the building process, the quality control of structures and workmanship,

measurements of the building skin's air leaks, and special instructions affecting different types of buildings (RATEKO 2012).

Finnish Construction Managers and Engineers AMK RKL – Building expert training 2012 – Energy certificate

Trainees learn how to prepare energy certificates for existing and new residential building, in other words the determination of a building's energy efficiency class, manually and with commercial software. The training also focuses on the new heat insulation regulations that came into effect in 2012, as well as low energy and passive building applications.

Finnish Construction Managers and Engineers AMK RKL – Building expert training 2012 - Passive building construction

In the first phase of the training, the emphasis is on the determination of passive buildings, as well as examples of passive buildings implemented in Finland, structural solutions, and heating energy production methods. As planned by the Ministry of the Environment, changing building regulations will require that by 2015, portions of detached houses' energy needs must come from locally generated renewable energy sources or fuels. The second phase of the training focuses on renewable energy sources and fuels as well as their utilisation during the period of the detached house's use (RKL 2012).

6.1.5 Certificates earned in the building sector

Separate card and certificate competencies are required in many of the construction sector's job tasks. The purpose of the cards is to improve occupational safety and guarantee professional expertise. The certification confirms that a person is capable of performing his or her stated tasks. Certain certificates are voluntary, while others are mandatory, such as, for example, a hot work card.

6.1.5.1 VTT Personal Certification

The VTT Personal Certification confirms that a person is capable of performing his or her stated tasks, for example, the carrying out of a building's thermographic survey, or the waterproofing of wet spaces according to instructions and regulations. The VTT Personal Certification is granted first for two years and is renewed subsequently for two or five years at a time if a person meets the certification requirements.

The VTT Personal Certifications are as follows:

- Certified person for wet room waterproofing installer
- Certified person wet room works inspector
- Certified person for steel sheet roofing works
- Certified person for thermographic surveys of buildings
- Certified person for healthy building expert
- Certified person for moisture measurement of construction
- Certified person for airtightness measurements of buildings
- Certified person for asbestos and hazardous substance specialist (AHA expert)
- Certified person for fire seal installer

(VTT 2012)

6.1.5.2 Occupational safety card

Occupational safety card training is nationwide training whose objective is to improve safety at the workplace. The card can be earned at an approved course that includes information on workplace and job task risks. The card is valid for five years. The adoption of the occupational safety card at the workplace is voluntary. The objective of the occupational safety card's use is to improve practical co-operation at common workplaces between the client and the supplier companies, support work guidance at common workplaces, provide basic information regarding occupational safety, reduce the amount of overlapping training provided by various clients, foster and enhance the occupational safety expertise of one's own staff at the workplace, and attempt to reduce the frequency of accidents and near-miss situations (Työturvallisuuskortti.fi 2012).

6.1.5.3 Hot work training

A hot work operator working at a temporary hot work site must have a valid hot work card issued by the Finnish National Rescue Association (SPEK). After the performance of approved training, the operator is granted personal hot work card that is valid for five years in all Nordic countries. Another objective of the hot work course is to teach hot work operators the importance of preventive measures as a way of avoiding hot work accidents. The main applicable legislation and instructions, as well as the responsibilities of the various parties, are also taught in the course. After completing the course, the cardholder has gained an understanding of the importance of advance planning for hot work and the significance of a hot work permit, and is able to perform the work safely (Finnish National Rescue Association 2012, a).

6.1.5.4 Road safety training programme

In occupational safety legislation, work carried out in traffic areas is classified as hazardous. The danger to employees posed by traffic, as well as the danger to traffic posed by employees, requires special skills from workers and supervisors alike. Road Safety 1 is a basic course, focusing on the safety of those working on roads, developed to provide the skills required by the conditions and confirm the employee's competence. Road Safety 2 is an advanced course for persons responsible for the traffic and occupational safety of those working on public roads (Finnish National Rescue Association 2012, b).

6.1.6 Forms of educational financing

6.1.6.1 Costs of basic vocational education costs in 2010

In 2010, educational institution-type vocational basic training was provided by a total of 142 education organisers. Of these, 39 were joint municipal authorities, 15 were municipalities, and 87 were private associations or foundations. The quantity of vocational education organisers among municipalities and joint municipal authorities decreased by 6 compared to the previous year, and the number of private organisations remained the same. In 2010, EUR 1.6 billion was spent on basic vocational education, compared to EUR 1.2 billion in 2006. During that period, student-specific costs rose by 18.8%. During the previous year they increased by 2.2%. The costs are divided as follows:

- Joint municipal authorities: EUR 960 million
- Municipalities: EUR 254 million
- Private: EUR 391 million
- Government: EUR 2.5 million

6.1.6.2 Chargeable services

Besides unit pricing financing, the organisers of vocational education sought financing for their operations as chargeable services. In chargeable service operations, the organiser of education invoices the purchasers of external services for the arranged training, products sold, and other services (Finnish National Board of Education 2012, b).

6.1.7 Development of education according to energy efficiency requirements

Discussions undertaken with the Ministry of Education and Culture has resulted in, among other things, the recently implemented and wide-ranging renewals affecting the sector's training that were carried out under the Ministry of Education and Culture's direction. These have included the renewal of the vocational education qualification system and the start-up of construction manager training. Although the construction sector's attractiveness has improved as a result of the renewal, raising the level of skills to meet the needs of a rapidly developing sector remains a challenge. This educational development requires active interaction among ministries, universities, polytechnics, and other educational institutions, as well as the real estate and building sector (ERA 17 2012).

6.1.7.1 ERA17: emphasis areas for educational development

The monitoring group for the ERA17 for an Energy-Smart Built Environment 2017 action plan has proposed improvements in the real estate and building sector's training. The monitoring group proposes that the Ministry of Education and Culture invest in the development of comprehensive education in the real estate sector, as well as in the infrastructure and house-building sectors. At the same time, the monitoring group is offering to co-operate with the ministry to speed up the development of the skills and teaching serving the real estate and building sector. The proposal considers the rapid renewal of the real estate and building sector's teaching and training systems to be of the utmost importance. The intent is to systematically include the principles of sustainable development, energy-smart solutions, and the best practices in all sector-related education.

In the statement of its position, the ERA17 monitoring group stated that the development of the real estate and building sector's teaching must be diversified. The sector's professional skills level must be raised, particularly with respect to renovation construction, energy efficiency, and structural physics. Efficient energy use and reduced emissions must be a cross-cutting target in all training content. The scope of teaching and education can be expanded by emphasising interdisciplinary courses of action. Teaching must also be targeted more effectively and teaching materials must be systematically developed. The anticipation of training needs can also continue to be improved. As one course of action, the monitoring group has proposed the establishment of a professorship of environmental energy efficiency (Sitra 2012).

6.1.7.2 Programme of Moisture and Mould

Programme of Moisture and Mould is a project co-ordinated by the Ministry of the Environment that generates training and information material for new and renovation construction. The Programme of Moisture and Mould project is being implemented in wide-ranging co-operation with, for example, other ministries, public administration operators, the municipal sector, associations, and the business world. The objective of the volunteer efforts is to foster co-operation among different operators to establish a consistent training and competency path in the moisture and mould damage sector. After the performance of various training steps, a person with the sufficient experience can apply for a certificate of competency. A training and qualifications system is being formulated jointly among public administration, universities, and the construction sector's associations (Programme of Moisture and Mold 2012, a). In 2012, teaching materials dealing with condition surveys, as well as the identification

and inspection of risk-prone structures, were prepared for teachers' use (Programme of Moisture and Mould 2012, b).

6.1.7.3 Sustainable Development of Education in the Construction Sector

Underway at the Sykli Environmental School of Finland, is the "Sustainable Development of Education in the Construction Sector" project that aims at the sustainable development of training in the construction sector. The Finnish National Board of Education is financing the project.

The objective of the project is to strengthen the congruence of education in the construction sector with working life so that it support the sustainable development skills needs as well as, correspondingly, the construction sector's teaching, teachers' skills, and the development of learning environments. Coping with change requires, besides the identification of today's skills needs, the ability to anticipate the skills needs required in the future.

In the project, teaching packages on sustainable development themes are being prepared for vocational education in building technology and house-building. Besides the formulated teaching packages, the project describes the sustainable development skills needs and learning targets in the form of a sustainable development learning path leading to at least one training programme or qualification. A guidebook that includes tools and courses of action for the development of good practices on the construction site will also be prepared (Sykli 2012).

6.1.7.4 Establishment of research in education

Currently underway are several research projects and entities where solution models related to energy efficiency in construction are being developed. One example is the Tampere University of Technology's FRAME project (Future Envelope Assemblies and HVAC Solutions), where, among other issues, the new demands on structures arising from climate change, particularly from the standpoint of moisture control, are being clarified. In 2012, one of the study's objectives is to prepare design and implementation instructions for moisture-technically workable structural and jointing solutions in low energy and passive structures. These kinds of studies should be established as soon as possible in the construction sector's education (Build up Skills workshop Tampere 24 May 2012).

6.1.7.5 Renewable energy use

According to the RES Directive, a training system leading to certification or a qualification should be in place by the end of 2012. This affects solar electricity, solar heating, bio cookers, and heat pumps. In late 2012, Amiedu will organise training related to solar electricity and solar heating. EU-certified training related to heat pumps is already underway at three separate educational institutions. In Finland, an actual qualification system, including installer register, will be completed in late 2012 (Res compass 2012).

6.1.8 Monitoring of training needs

The National Project on Anticipation of Competences and Skill Needs (VOSE) implemented by the Finnish National Board of Education is developing process models to anticipate skills needs. The process will generate advance information that can be used to develop the content of vocational, polytechnic, and university education to better meet the needs of future working life.

A clarification of the future skills needs in the real estate and building sector has also been carried out in connection with the VOSE project. The sector's possible development orientations and their

required skills needs have been outlined in the project. Contributing to the sector's dynamism is its competitiveness, internationalisation, grasp of climate change, and diversity. Skills needs have been itemised for the construction sector's workers, construction managers, property managers, the construction sector's executives and specialists, as well as real estate management.

The project identified 11 of the most important dynamics related to future skills needs: Finland's competitiveness and the significance of the global economy, diversity, the building stock and infrastructure, changes in working life, the social structure, differentiated customer needs, control of climate change, the role of information and communications as a operational conversion mechanism, internationalisation, changes in the age structure and workforce's availability and changing needs, as well as innovations and technological development.

A forecast of the real estate and building sector's skills needs has been presented in the publication "Skills needs in the real estate and building sector, a qualitative summary of forecasting projects". The publication notes that according to a qualitative clarification, the basis for the competitiveness of the real estate and building sector is viewed as its well-grounded and continuously developing expertise. Co-operation among educational institutions should be stepped up, as well as the co-operation between educational institutions and working life. Greater attention than previously should also be paid to the internationalisation of education. Diversity should be taken as a cross-cutting theme across the entire sector (RIL 2012, b, VOSE 2011, 28–29).

An examination of the overall real estate and building sector reveals an extremely large number of possible career paths and required skills. For that reason, the sector's forecasts should be limited to clearer sub-entities in the future. The real estate and building sector's most sensible limit will follow the sector boundaries prevailing in the future. Predictions would include all job descriptions and all employer roles – and at the same time all training degrees – from all branches of business. Successful and relevant forecasting requires systematic and direct co-operation among the sector's operators and the civil servants responsible for teaching and education (Rakennuslehti 19.6.2012).

6.2. Construction sector's training supply, outside vocational education system, related to energy efficiency and renewable energy use

6.2.1 Training in use of renewable energy sources

Teaching related to the use of renewable energy is being offered in several universities and polytechnics. Besides education related to the vocational qualification, first degree, many educational institutions are offering individual courses or smaller teaching packages with which professionals can augment their skills (Motiva 2012).

Besides educational institutions, various associations, trade unions, construction sector companies, and the construction products industry also arrange training in the use of renewable energy sources. Equipment manufacturers organise their own training related to forms of renewable energy such as air and geothermal heat pumps, wind generators, solar collectors, and solar panels. Portions of these are study modules modelled on the sector's vocational education. For example, heating boiler installer training has been incorporated into the HPAC sector's training.

6.2.2 Bioenergy Development Centre

The Bioenergy Development Centre is a training and development environment for the production and use of biofuels; its main skills areas are wood and biomass, biogas, and bioenergy entrepreneurship.

The educational objectives are to publicise the information obtained in bioenergy-related research at the practical functional level, support companies operating in the bioenergy sector, foster the production and further development of innovations, and disseminate bioenergy-related information to the public. In the environmental technology training programme, one can study for a polytechnic-level engineering qualification. The orientation alternatives are sustainable technology and a sustainable energy economy (Motiva 2012).

6.2.3 Training for wood energy advisory services

The training for wood energy advisory services and networking, carried out alongside working, takes one year. The Central Finland-based BENET Bioenergy Network, working in co-operation with Motiva, conceived and initialised the project. Training is provided at the North Karelia University of Applied Sciences and HAMK University of Applied Sciences (Motiva 2012).

6.2.4 Postgraduate apprenticeship contract-type further education - energy-efficient building management

In the training for a building's energy-efficient management, postgraduates can seek a special qualification related to the renewed regulations affecting building design, and also enhance their expertise in the sector's supervision, implementation, and construction management organisations. The training provides each participant with new skills for energy-efficient construction required by his or her job description, as well as new skills and preparedness for the demonstration of energy-efficient calculatory skills in practice. The scope of the education is 30 study credits and it is intended for professionals in the real estate and building sector such as architects (particularly chief designers), graduate engineers, engineers, and construction managers (Metropolia 2012).

6.3. EU's development projects for training in the construction sector

The EU's **Leonardo da Vinci Programme** (LdV) for vocational education and training funds mobility and partnership projects, as well as broader development projects, so-called transfer of innovation projects. The project develops teaching materials, curricula, pedagogical techniques, teachers' and job coaches' skills, and other similar capabilities within a framework of international co-operation. The LdV programme supports projects whose objective is to develop vocational training and European co-operation. All organisations involved with the creation and dissemination of vocational education can participate in the programme (Cimo 2012).

The objective of the **Eco Construction Team** (LdV TOI Transfer of Innovation) project is to harmonise a training policy for eco construction at the European level. The construction industry in all of Europe employs approximately 26 million persons, and energy savings targets pose formidable challenges. The project will also create an eco builder certification (Ecoconstruction 2011).

The EU application period for the **New Skills Network** (Capable Future Operators) project 2012 is underway. One challenge, as well as the application's emphasis area, is the need for a new kind of green work and environmental skills resulting from climate change. The need for new kinds of vocational skills is particularly acute in the building sector, where the opportunity to influence the slowing of climate change is great (New Skills Network 2011).

In Finland as well, the **European Social Fund** is supporting many development projects, also in the building sector. ESF support improves employment, inhibits alienation, encourages the production of innovations, and enhances skills. Structural development projects, for example renewed training systems and on-the-job-learning projects affecting large groups of people over the long term, are also

funded in the programme. The projects improve the congruence between schooling and working life needs, smooth the transition from schooling to working life, and facilitate the participation of the adult population in training (Ministry of Employment and the Economy 2011).

Each year, the Ministry of Education and Culture also uses national and ESF funding to initialise projects that anticipate training needs. Support has also been allocated to projects involved with training, as well as subject entities and themes, considered necessary from the standpoint of social policy.

7. Skills gaps between current situation and targets for 2020

Picture 9: A building's airtightness is essential from the standpoint of energy efficiency. Air leak locations are observed with a thermographic camera at a Build Up Skills workshop in May 2012.

7.1 Labour force evolution and quantity of construction sector's trained workforce in 2020

7.1.1. Current situation and problems construction sector's training

Each year, approximately 4,700 persons graduate from the construction sector's educational institution- or apprenticeship contract-formed basic education in Finland (Statistics Finland 2012). At this rate, nearly 54,000 new employees will be completing basic education during the years 2013-2020. According to estimates, however, as much as 45% of the construction sector's workforce will be retiring by 2020. At the annual level, 5,000 new persons would be needed for the sector. The problem of education is not a lack of people wanting to enter the construction sector, but a scarcity of enrolment openings, particularly on the infrastructure side. Solutions must also be found for the large dropout percentages in certain training programmes (Turun Sanomat 5 February 2011, Tekes 2011).

The construction sector's sensitivity to economic fluctuations has for its part stunted the growth of the number of trained persons, and has injected an element of caution into the development of education. If skills and the needs of the job market do not match, there is the danger that a large percentage of a workforce trained for the wrong jobs will become unemployed. At the same time the workforce will not sufficiently available for new growth sectors (Ministry of Education and Culture 2009).

The current situation is already challenging on construction sites, particularly at the basic work level; finding enough sufficiently skilled employees is difficult. This has for its part opened Finland's building markets to a foreign workforce and irregular employee relationships, creating a situation in which work ethics and professional expertise are, according to some estimates, declining (Vapaavuori 2011). On the other hand, the growth in the popularity of the construction sector's training can be seen, and the sector is no longer "the last chance" for young people (Turun Sanomat 5 February 2011). The recruitment of skilled personnel from educational institutions remains an essential task, now and in the future. There are also a sizeable number of unschooled construction workers in the workforce, many of whom lack even basic training in the sector. The training of this group is of critical importance.

7.1.2 Future workforce need in the construction sector

According to a forecast of training needs made by the Association of Finnish Local and Regional Authorities in 2007, total of 1.1 million jobs, assuming 216,000 additional jobs and the attrition of 907,000 persons, would open up in Finland during the years 2005–2020.

It has been estimated that 84,350 jobs will become open in the building sector during the time period in question. The attrition has been estimated at 58,980 persons, and number of new employees at 17,700 persons. The quantity of the workforce in the construction field can therefore be estimated as growing to 153,690 persons by 2020. For the sake of comparison, the entire construction industry employed 141,800 persons in 2009 (Statistics Finland 2011d). The Association of Finnish Local and Regional Authorities' estimates of the construction sector's job openings are shown by occupation in Table 16 (Finnish National Board of Education 2007).

Table 16. Job openings in the construction sector, 2005-2020.

Occupations	Quantity
Construction workers	48 830
HPAC installers	9 040
Building painters	3 380
Construction sector's directors and specialists	23 100
Total	**84 350**

(Finnish National Board of Education 2007).

A working group set up by the Ministry of Education and Culture to anticipate and measure training supply estimated the number of job openings in the construction sector during the period 2008–2025 at 65,000 – 75,000, a slightly lower figure than the preceding estimate by the Association of Finnish Local and Regional Authorities. Here the attrition has been estimated at nearly 70,000 employees. The working group's estimates of the construction sector's job openings by occupational group are presented in Table 17. The working group also prepared proposals for the development of different sectors' annual training quantities. In 2009, the number of persons who began basic vocational education in the architectural and building fields was 4,128, and the working group's new target proposal for the number of students was 4,100. The equivalent figures in polytechnic qualifications were 1,779 and 1,700. The working group therefore continues to propose a moderate reduction in the number of enrolment openings.

In the measurement of training supply, particularly with respect to the training of young people, the time span from the beginning to the end of training is 3–7 years. Consequently, those beginning their education in 2012 will for the most part be entering the job markets during the period 2015–2019 (Ministry of Education and Culture 2009).

Table 17. Construction sector's open jobs 2008-2025.

				Basic development		Target development	
	Average age	No. of employed	Attrition	Change	Open jobs	Change	Open jobs
Occupations	**2007**	**2007**	**2008-2025**	**2008-2025**	**2008-2025**	**2008-2025**	**2008-2025**
Building employees	41	80 130	36 890	-4 390	32 500	130	37 020
HPAC	42	16 260	7 910	350	8 250	970	8 880

installers							
Building painters	43	6 140	3 160	-110	3 050	30	3 190
Construction sector's directors and specialists	46	41 080	21 780	10	21 800	4 750	26 530
Total	**43**	**143 610**	**69 740**	**-4 140**	**65 600**	**5 880**	**75 620**

(Ministry of Education and Culture 2011).

7.1.3 Popularity of the building industry

One of the construction industry's strengths is its strong localness. Building cannot be entirely switched to foreign countries, as has been the case in other industrial sectors.

In joint applications for entry to vocational institutions in 2011, the construction sector's interest increased compared to the previous year. For example, almost 8% more young people then the previous year (2010) applied for second degree schooling as their first choice in the building, earthworks and stone sectors. Certain sectors such as, for example, the surface treatment sector – including building painters – have become more "magnetic" than others.

Another extremely popular sector is polytechnic-level construction manager training, whose number of applicants for enrolment openings nearly quadrupled in 2011. The quantity of first-choice applicants increased no less than 22% from the previous year (Rakennus and kiinteistöpalvelualan vetovoima ry 2011). One reason for the popularity of construction manager training is that the vocational training for the qualification in question was discontinued for years before it was restarted in 2007 to meet the latest skill needs in working life, particularly at the practical work supervision level (Ministry of Education and Culture 2006).

Institutions offering education in popular fields have more opportunities to attract motivated applicants, and the points of departure for study and learning are often superior to those in less "magnetic" sectors.

7.2 Skills needs

7.2.1 Current skills level: questionnaire results

In connection with the project, an electronic, Webropol-based questionnaire "*Energy Efficiency Management on Construction Sites"* was implemented during March-April 2012 to solicit opinions from professionals working on construction sites regarding information and skills relating to buildings' energy efficiency and the use of renewable energy. TTS drew up the questionnaire in co-operation with the project's other partners. The questionnaire was sent to building firms of different sizes, private construction site supervisors, and representatives of the construction sector's associations. One objective was to get foremen and construction site supervisors to answer on behalf of their employees. The clarification of the workforce's changing skills needs for 2020 was the questionnaire's main objective. The analysis of the questionnaire, together with the mapping and statistical of the existing training system, forms the basis for the mapping of future skills needs.

The questions covered the construction site's basic skills and building quality, which at the same time brings a correctly implemented energy-efficient end result. The questions were intentionally selected for areas in which in which the significance of the right skills or knowledge is emphasised, particularly with respect to energy efficiency.

The questionnaire contained 36 questions that were divided into three subject areas: Construction-technical Works, Building-technical Works, Construction Site, as well as a separate question: In your opinion, what kinds of supplementary training needs related to energy-efficient construction are required to improve construction workers' skills? The Construction-technical Works and Building-technical Works category was sub-divided separately into practical know-how (skills and quality level), and theoretical awareness (knowledge level). Additionally, there was space on the form for comments and opinions after every group of questions, as well as free space at the end of the questionnaire for comments related to the open-ended themes. The respondents commented diligently, and the comments successfully augmented the preset response alternatives. The questions are in Appendix 1 at the end of this section.

For the questionnaire's first three parts, the response alternatives were: (can/knows) well – satisfactorily – adequately – slightly – non-applicable to work task – no opinion. A similar grouping is in use at the Finnish National Board of Education's website www.osaan.fi, where it is used to identify skills in different sectors, for example at the beginning of vocation-oriented studies (www.osaan.fi).

The questionnaire received 47 responses by the deadline. There was considerable variety in the job titles of the responders, the highest of these were work supervisors (9 responses). The questionnaire could be answered by an individual employee or even on behalf of a substantially large group. The final number of employees processed in the questionnaire ranged from 134 to more than 230 persons. The majority of responses were from carpenters, construction workers, and pipe fitters. The training background was most often vocational school or polytechnic (76%). Of the responses 67% were from Southern Finland; only 4% came from Northern Finland and Lapland.

7.2.1.1. Construction-technical works' skills and quality level

Energy-efficiency skills related to construction-technical works fared relatively well in the questionnaire. No question received a "slightly" response. Door and window joints and pass-throughs can be well-sealed, which from the standpoint of energy efficiency is essential for the airtightness of the building's outer skin. Other skills related to pass-through locations were assessed as being slightly weaker, but for the most part continued to be considered at least satisfactory. According to the answers, works related to heating insulation also function smoothly.

In this part of the questionnaire there is probably the greatest risk that respondents have sugar-coated the truth. In construction-technical works, it is a question of so-called basic building skills, including, on the other hand, tasks that are easily assigned to a completely unschooled workforce.

Picture 10. Construction-technical works' skills and quality level, summary of responses.

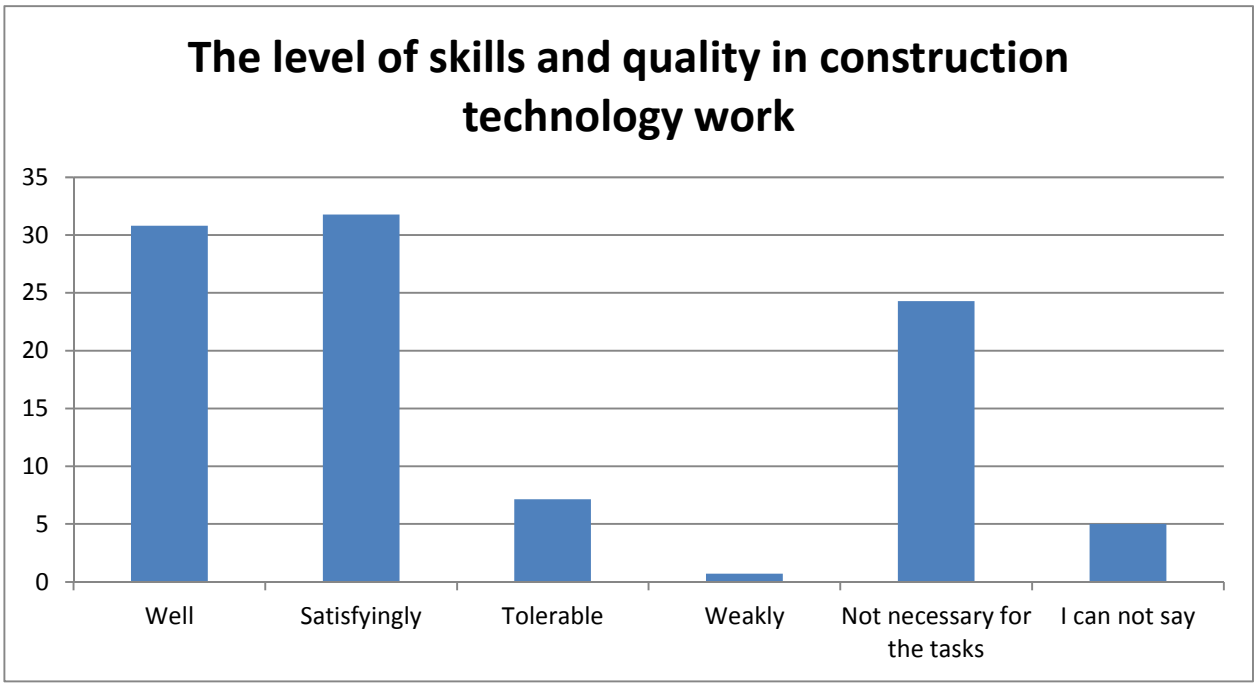


Table 18. Construction-technical works' skills and quality level, distribution of responses.

	well	**satisfactorily**	**adequately**	**slightly**	**non-applicable to work task**	**no opinion**
	%	**%**	**%**	**%**	**%**	**%**
Can make door and window joints.	40	26	9	0	20	6
Can insulate and seal other pass-throughs.	34	29	11	3	20	3
Can install a vapour barrier.	34	29	9	0	23	6
Can perform cleaning of base related to heat insulation.	37	23	11	0	23	6
Can perform cutting of wool/ selection of correct material size related to heat insulation.	29	34	6	3	23	3
Can install various types of insulation materials at foundations.	29	40	3	0	26	3
Can install various types of insulation materials for the structural frame and supplementary building components.	20	34	6	0	31	9
Can install various types of insulation materials on roofs.	23	40	3	0	29	6

7.2.1.2 Construction-technical works' knowledge level

In construction-technical theory skills, the significance of the U-value was at least at a satisfactory level for approximately 60% of the respondents. Other insulation-related matters were, according to this questionnaire, also theoretically well under control. Moisture control was mentioned in the question section's comment field; requests were made for additional training in basic structural physics, particularly concerning the principles regarding moisture transfer. Currently within the

construction sector's training, it is just these theory lessons that are being reduced as the quantity of on-the-job learning increases.

Picture 11. Construction-technical works-related knowledge level, summary.

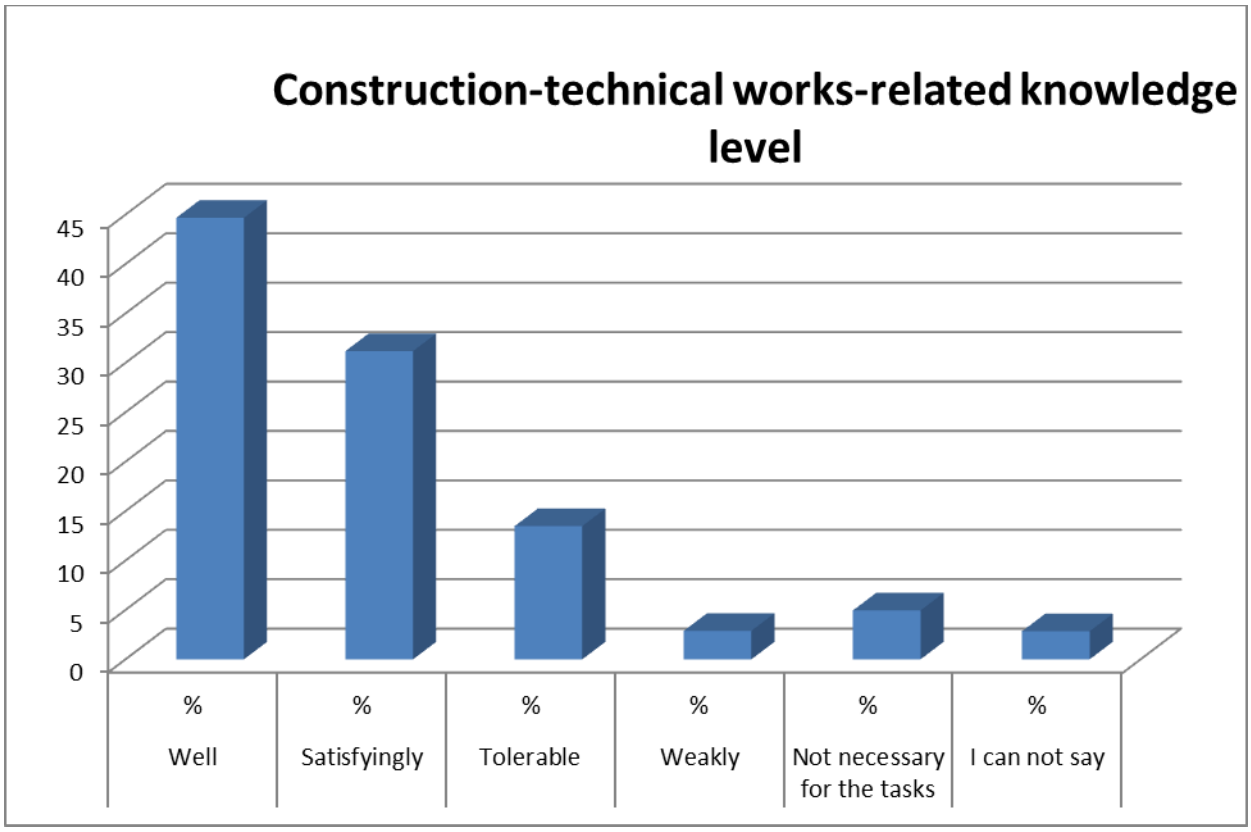


Table 19. Construction-technical works-related knowledge level, distribution of responses.

	well	**satisfactorily**	**adequately**	**slightly**	**non-applicable to work task**	**no opinion**
	%	**%**	**%**	**%**	**%**	**%**
Understands how the U-value describes a structure's heat insulation capacity.	46	20	23	3	6	3
Understands a material's heat transfer coefficient, the significance of careful installation on the heat insulation capacity, and the U-value.	42	42	8	0	6	3
Understands the importance of air leaks and structural tightness, as well as the significance of cold bridges as they affect a structure's heat insulation capacity.	47	28	14	3	6	3
Understands the principles of moisture transfer in structures and knows the meaning of"dew point".	42	35	9	6	0	3

7.2.1.3 Building-technical works' skills and quality level

According to the questionnaire's results, the energy-efficiency skills of building-technical (HPACSA) works were not quite as under control as the skills related to construction-technical works. "Satisfactorily' was clearly the most common answer at every field. The weakest skills related to the installation of heat pumps. This must be taken into account in skills training when the development trend is heading towards energy-saving building and living. There are also deficiencies related to the skills required for cooling equipment and machinery, but this may be the result of a scarcity of the technology or its newness. In the more traditional ventilation installations (roof fans, mechanical equipment installations) the taking into account of energy efficiency was on average at least satisfactory. There were also clear differences in the skills related to electrical and automation works.

Based on this section, it would appear that additional training is needed, particularly in new heating and cooling systems, as well as in electrical and automation works.

Picture 12. Building-technical works' skills and quality level, summary

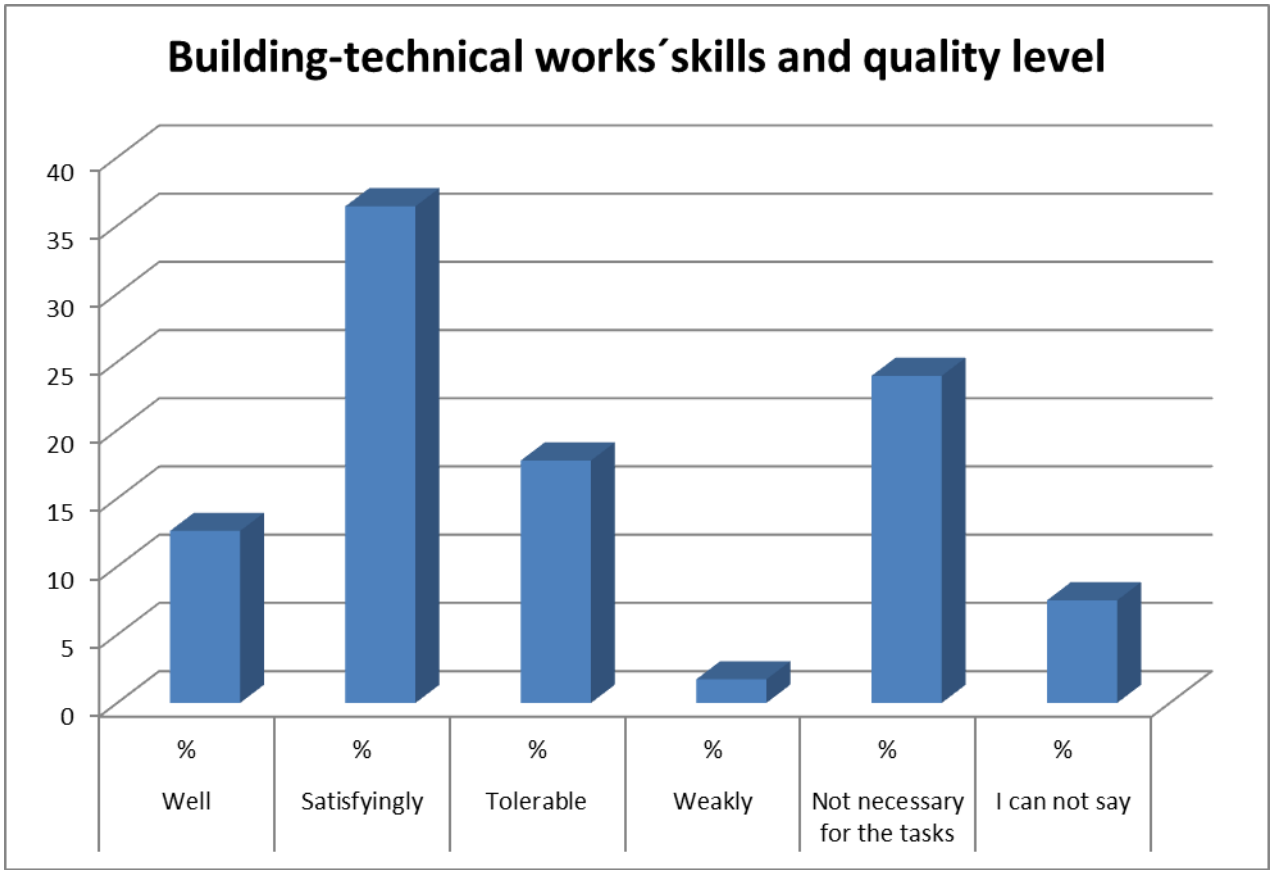


Table 20. Building-technical works' skills and quality level, distribution of responses.

	well	satisfactorily	adequately	slightly	non-applicable to work task	no opinion
	%	%	%	%	%	%
Can take into account energy efficiency in piping installations (routing, pipe fittings, valves, pressure drops, special rooms).	17	40	13	0	23	7
Can take into account energy efficiency in piping installations (pump installations, shunt circuits, sub-distribution board equipment).	10	41	14	0	28	7
Can take into account energy efficiency in piping installations (piping and tank insulation).	17	40	17	0	20	7
Can take into account energy efficiency in ventilation installations (duct installations).	20	43	13	0	17	7
Can take into account energy efficiency in ventilation installations (Mechanical equipment installations, roof fans).	25	29	18	0	21	7
Can take into account energy efficiency in ventilation installations (Duct insulation).	13	40	20	0	17	10
Can take into account energy efficiency in installation of water cooling units.	7	25	18	4	36	11
Can take into account energy efficiency in the installation of room cooling equipment (chilled beams, fan coils).	3	38	24	3	24	7
Can take into account energy efficiency in the installation of heat pumps.	3	34	21	7	28	7
Can take into account energy efficiency in electrical and automation works.	10	33	20	3	27	7

7.2.1.4 Building-technical works' knowledge level

The knowledge level related to building-technical works was on average satisfactorily under control, even better than practical building-technical skills. The relationship between a heating and cooling system's operations and the building's energy efficiency was relatively well known. The observed knowledge difficiencies in knowledge related to the systems' relevance to the E-number, as well as the use of renewable forms of energy.

Based on this section, it would also appear that additional training is required for building-technical works, particularly in matters related to the heating and cooling system's operations.

Picture 13. Knowledge level related to building-technical works, summary

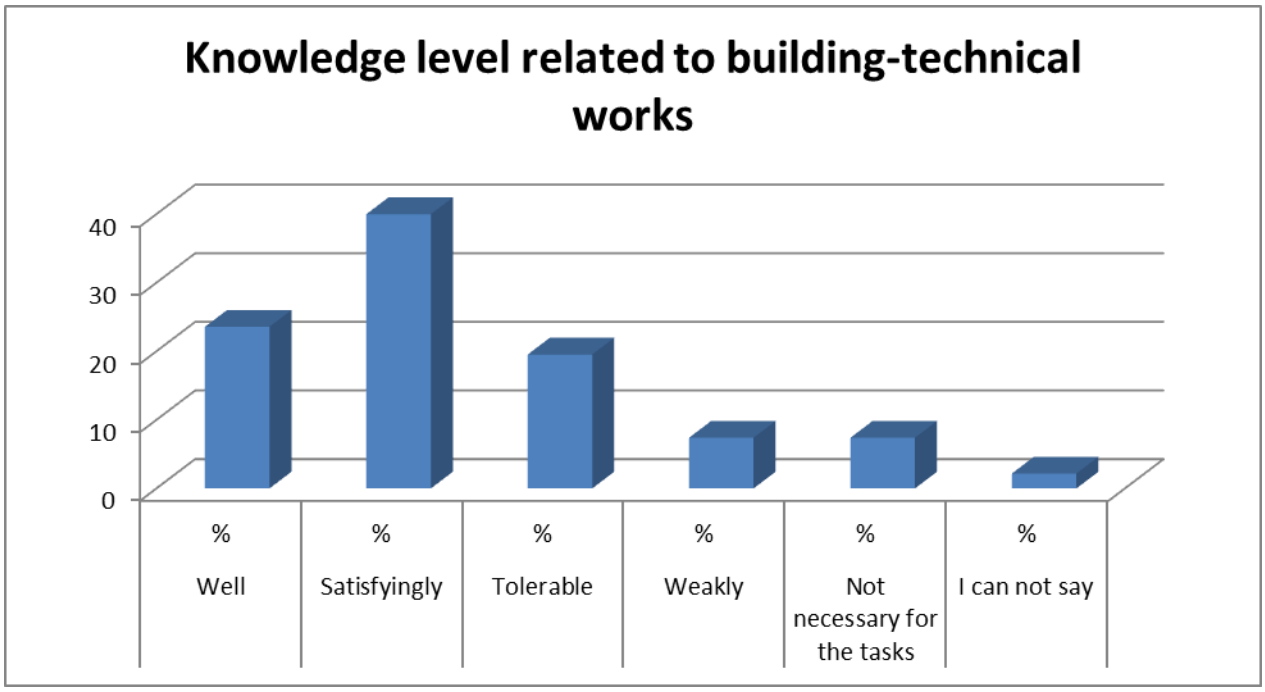


Table 21. Knowledge level related to building-technical works, distribution of responses.

	well	**satisfactorily**	**adequately**	**slightly**	**non-applicable to work task**	**no opinion**
	%	**t%**	**%**	**%**	**%**	**%**
Knows the importance of the heating and cooling system's operations in the determination of the building's energy efficiency (E-number).	14	59	10	10	7	0
Knows the importance of the ventilation system's operations in the determination of the building's energy efficiency (E-number).	28	41	17	7	7	0
Knows the proper operational prerequisites for the ventilation system's heat recovery.	32	43	11	7	7	0
Knows the issues related to the balancing and adjustability of ventilation ducts.	31	34	21	7	7	0
Knows the significance of energy-effective ventilation and the SFP license from the standpoint of installation work.	25	25	25	11	7	7
Knows the main issues related to the balancing and adjustability of fluid flow systems from the standpoint of installation work.	10	38	21	7	17	7
Knows what is meant by building-technical basic improvements.	29	43	21	4	4	0
Knows how renewable forms of energy can be utilised in buildings	20	37	30	7	3	3

7.2.1.5 Construction site practices

Regarding construction site practices, the use of tools, equipment, and scaffolding was at least at a satisfactory level. Energy-efficient winter construction was satisfactorily under control, but here there is also room for improvement. The special characteristics of Finnish construction also relate to wintertime building and the challenges it poses for energy efficiency. The quality of one's own work could be assessed at least "satisfactorily" by 81% of the respondents, but several "non-applicable to work task" responses were also given for this question, which is alarming from the standpoint of the overall entity and quality control.

There were deficiencies in being able to grasp the construction site and building work as an overall entity. Communications were difficult, particularly according to the freeform comments, although interaction was considered at least satisfactory 80% by of the questionnaire's respondents, and the overall entity and the perception of one's own work as a part of the overall entity was considered at least satisfactory by as much as 91% of the respondents.

Picture 14. Construction site practices, summary.

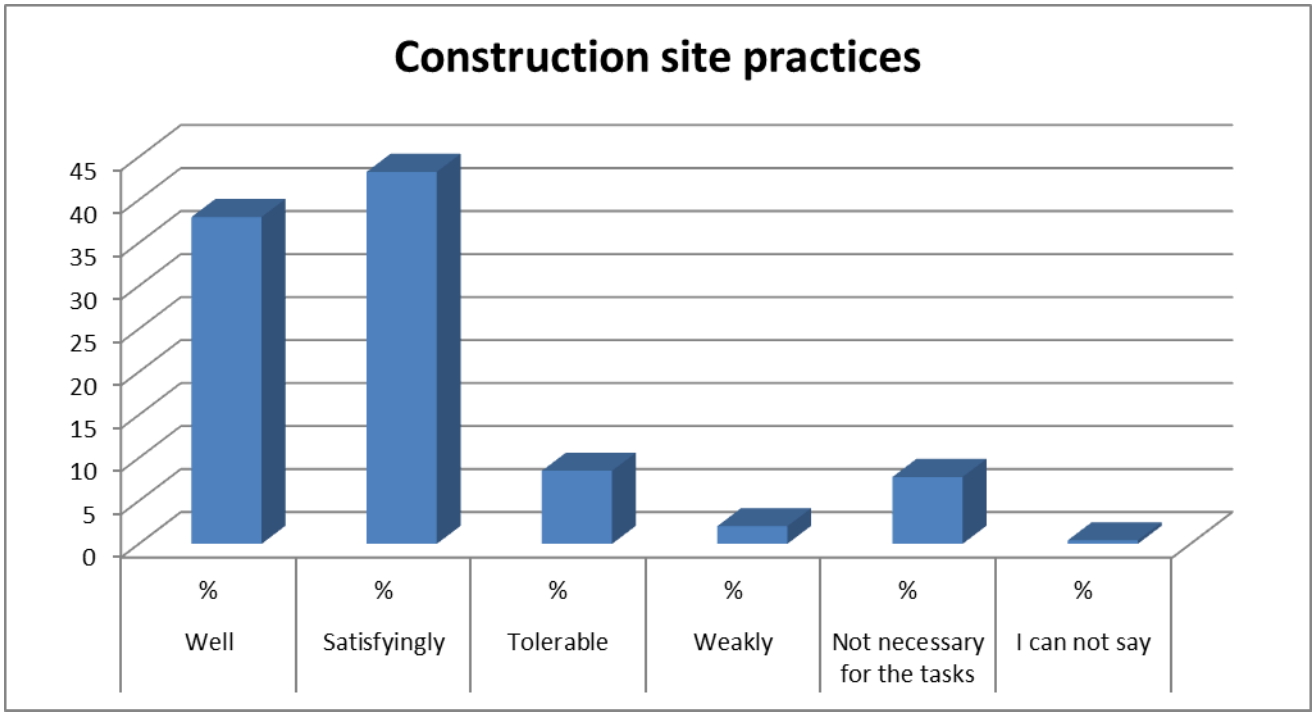


Table 22. Construction site practices, distribution of responses.

	well	satisfactorily	adequately	slightly	non-applicable to work task	no opinion
	%	%	%	%	%	%
Knows how to use tools and equipment/scaffolding correctly.	45	38	0	0	18	0
Is familiar with the protection of building materials, areas, and structures during the construction period.	39	39	7	2	12	0
Is familiar with energy-effective working methods and has a grasp of energy-	24	51	12	2	7	2

effective practices related to winter construction.						
Understands the importance of his or her work as part of the building's overall entity and the significance of high-quality work as it relates to energy consumption.	43	48	3	5	3	0
Is able to assess the quality of his or her work.	38	43	12	0	7	0
Is able to actively interact with other employees, also those in different trades, to ensure an energy-effective and workable overall entity.	39	41	17	2	0	0

7.2.1.6 Problems with energy-effective construction arising in the questionnaire

In the open comments section, many respondents bit into the problems concerning the construction sector's internal communications and grasp of the overall entity. In communications, deficiencies were observed between the different building parties; often the connection between designers and construction workers does not work, nor do the connections between the various on-site building trades. Implementing high-quality and energy-efficient construction is difficult when no one seems to be in charge of the total. An individual worker cannot grasp the importance of his or her work, nor will there be a need to implement energy efficiency with seemingly extraneous solutions, if he or she is missing the information about what affects what.

The foreign leased workforce brings its own problems, and according to the questionnaire's respondents requires careful supervision to ensure that work tasks are completed, but often, however, it is only a language problem, when for example, installation instructions are only provided in Finnish.

The respondents also complained that there is not enough time to think about energy efficiency matters on today's construction sites because money talks. According to the views of several respondents, important energy efficiency practices are on the other hand only now forming, which was also considered alarming. These matters were also handled in the Build Up Skills project's spring workshops.

7.2.1.7 Potential for error related to questionnaire's results

Ultimately the questionnaire covered only a fairly selective portion of Finland's construction sites. It can be assumed that those responding to the questionnaire are those organisations whose interest in energy efficiency issues, as well as the motivation to implement energy-effective construction, is otherwise higher than average. This assumption also affects respondents in supervisory positions as well as individual construction workers. That being the case, the results for energy-efficient construction skills would appear overly optimistic compared to the reality. The workshops arranged in connection with the project, as well as interviews with specialists, support this assumption.

Additional, the questionnaire received extremely few responses from Northern Finland; the percentage share of responses from Northern Finland and Lapland was only 4%. Admittedly, the volume of construction in Northern Finland is measurably lower than in the south. It would, however, have been instructive to compare the construction challenges created by snow and frost, as well as the practical implementation of winter construction, with the situation in Southern Finland. Finland is a long country in the north-south directions, and the difference in average temperatures and snow loads is substantial between the north and south. This naturally affects construction timetables and building practices.

Answering certain questions may have been difficult because the questions were not explained or further amplified. A certain kind of checklist might have been useful, for example when asking about winter construction practices. The questionnaire's compactness was, however, considered important at the preparation stage and for that reason, additional explanations were omitted.

When analysing the questionnaire, it was felt that many respondents may have answered more positively because they have wanted "put their best face forward" to give a better picture of themselves or their own employees than the actual situation might warrant. The questionnaire may have been considered a mapping of skills that should be answered to create the most positive impression. Efforts were made to reduce this potential for error during the questionnaire's preparation stage by stating that the questionnaire could be answered anonymously, and that the contact information was only needed if the respondent wished to obtain a summary of the questionnaire's responses for his or her subsequent personal use. In the questionnaire's cover text it was emphasised that the answers would be treated confidentially, and that the responses from individual company or construction site would be in no way identifiable, nor would any information be treated as a separate case. On average, the open-ended response provided more pessimistic overall picture of construction sites energy skills compared to the responses to the actual questions. The questionnaire's cover letter is Appendix 1.

7.2.2 Construction sector employees' further training need: skills and training needs by subject

In the construction site questionnaire, the views of the respondents regarding construction site workers' further education needs and energy efficiency skills. These have been assembled below by subject group, along with viewpoints that became apparent in other ways during the project period, for example in workshops or interviews with experts.

7.2.2.1 Control of the overall entity

Construction details, for example tightness, cold bridges, and insulation installations will become increasingly important in the future. The entity firmed by the details must, however, also be under control, or at least there must be an awareness of its significance. Employees must be able to grasp the importance of their own work as part of the overall entity. The same applies to the work supervision level that must also be included in all energy efficiency training; energy professionals must be trained at the work supervision and construction levels.

The development of training must take into account the contradiction between narrow specialisation and a diversified and often more relaxed control of the overall entity. Specialised expertise is however required for many new solutions. Controlling the total is not, however, a question of everybody knowing everything. Energy efficiency must also be viewed within the context of a broader overall entity of environmental impacts.

Trainers must be able to identify the major risk locations related to various job descriptions, for example construction labourer, carpenter, insulation, piping, ventilation, electrical, and automation installers, and be capable of eliminating them by providing precise guidance and sufficiently high-quality basic training. The trainers' own education and up-to-date skills are also of essential importance.

7.2.2.2 Heat insulation and airtightness

The new and increasingly stringent requirements set for heat insulation now require better structural performance from a building's outer skin. The thickness of insulation layers is increasing and buildings must be tighter than previously. Workmen must be able to identify the risk locations and grasp the need to insulate pass-throughs properly. This is a basic matter that should be known by all, but in practice even this is not always self-evident on construction sites. The measurement of airtightness, as well as the use of thermographic cameras and other technical devices, has come to the construction site, and their use must be learned.

7.2.2.3 Moisture control

Moisture and its consequential effects have been, and continue to be, a problem. One of Finland's special characteristics is its northern location. Having an overall grasp of moisture control skills on the construction site is becoming increasingly important as temperature fluctuations resulting from climate change increase the frequency of freezing and melting cycles. What is needed on the construction is an additional basic knowledge of structural physics that would motivate builders to use the most appropriate energy-effective solutions. A certain basic skills level would help in the understanding of the overall entity, which would be reflected as suitable solutions. Currently the awareness in these matters fluctuates widely.

Construction risks are increasing in connection with the trend towards passive and zero energy buildings, because their structures are unforgiving, for example if they become wet during the building period as a result of inadequate on-site protective measures. There are still construction sites where structures are left completely unprotected from rain, owing to haste or ignorance, and waterlogged structural layers are not allowed to dry adequately (Koiso-Kanttila 2012). Here there is a substantial need for further training. New research results and the models for passive construction must be quickly established on job sites and in training (Workshop 3, incl. Rakennuslehti 2012).

7.2.2.4 Building-technical installations

In building-technical installations – heating, ventilation, water, electricity, automation – greater precision is required, for example, to achieve the building's airtightness. In several sources, this was discerned as being one of the most critical factors in energy-effective construction. For example, faulty installations of waterproofing, can also seriously compromise a building's airtightness.

According to experts currently missing qualification requirements for HPAC installers are also needed; this would ensure investments in employees' skills. New products and systems are generating additional training needs. The entire HPACSA sector needs additional professionals, particularly well-schooled persons who have earned specialist vocational qualifications (Workshop 1).

7.2.2.5 RES installations and other new technology

New construction-related energy efficiency requirements, as well as the EU's and Finland's national targets, are generating new kinds of environmental-technical solutions, and existing solutions are being refined. The performance of the new energy-efficient structures and mutual compatibility of the various will be of central importance. The functioning of the new systems and hybrid systems will not, however, be problem-free. The risks related to the systems and their co-ordinated operations must be identified and avoided. New building regulations will substantially increase the use of renewable energy, resulting in additional training needs for HPAC equipment installers and designers. The sector's supplementary training needs are already acute owing to the tightness requirements for installations. Energy efficiency must be made an integral part of the entire HPACS sector's basic education.

In new solutions, for example related to solar energy, equipment manufacturers and employers typically provide their own training for various types of installation systems, new solar panel technology arriving on the market, and so forth. In this kind of training, the relevant energy efficiency skills applicable to the theme are built-in.

7.2.2.6 New basic skills

In education, the intent should be to provide a solid foundation for the sector's substance, or sector-specific "difficult basics", being studied. The knowledge and basic skills required in the sector are wide-ranging and change slowly. In the VOSE project it became clearly apparent that training system should guarantee primarily broad-based basic skills to students (Vieno et al 2012). The practical application skills are learned in working life. At the BUS workshops and interviews with specialists, it also became apparent that it is not self-evident that even the selection of a simple insulation thickness, or the insulation of a building's corner, will be done correctly. New regulations for buildings are arriving at an accelerating rate, and even basic skills must be relearned.

The questionnaire's responses indicated a clear need for practical no-nonsense teaching packages, for example concerning various kinds of pass-throughs. Energy-effective building skills can be viewed as part of an automatic consequence when construction is high-quality and complies with regulations.

7.2.2.7 Renovation construction

In Finland, the centre of gravity of building is shifting from new construction to the renovation construction side as the building stock ages. Only 1.5% of the building stock is renewed annually. Besides achieving significant energy efficiency benefits, renovation construction could also generate new employment opportunities. The increased quantity of piping renovations during the coming years will also increase the quantity of renovation construction. In the future, the management of existing properties will become more involved with renovation construction and energy-efficient solutions. The use of new energy-effective technology in renovation construction, as well as the interplay between old structures and new technology, requires new types of skills.

7.2.2.8 Co-operation among different operators in key position

Finding trainers, also for work supervisors, can be problematic. In the construction sector's training, the national co-ordination of trainers and education among different operators and educational institutions is needed to establish energy efficiency skills as quickly as possible in teaching and on construction sites. The co-ordination of various qualifications is also important.

7.2.2.9 Foreign workforce

The foreign workforce's often missing or difficultly verifiable qualifications have created the need to find ways to further educate them. The problem is to motivate employers to arrange training. Teaching materials in different languages, at least covering the basics, should be made available to immigrant students, as well as foreign workers obtaining supplementary training in Finland. In practice, however, training in the Finnish language is absolutely necessary because drawings, installation instructions, and other similar materials in different languages are rarely found on construction sites.

7.2.3 Training needs by occupation

When speaking of the development of energy-effective training, a focusing on individual occupational titles would not do justice to the scope and diversity of construction site workers' job tasks. For that reason, the necessary volumes of each individual occupational group requiring energy-efficient

construction skills have not been displayed numerically in this report; the focus is on skills needs. These needs and skill segments for the most part permeate the entire construction sector, and they need to be developed at all training levels.

The project's further activities can possible make use of a Finnish classification of occupations, issued in 2010, that is based on the ISCO-08 International Standard Classification of Occupations prepared by the International Labour Organisation (ILO) and ratified by the United Nations. Below is a listing of the occupations most relevant with respect to this project. Certain categories, such as Class 93, Labourers in mining, construction, manufacturing and transport, have been omitted because it is a question of a group of professionals not requiring actual vocational training (Statistics Finland/ Ammattiluokitus).

7 Construction, repair and fabrication employees

71 Construction workers and other similar. (incl. electrical installers)
711 Construction workers and other similar.
7111 House-builders
7112 Masons and other similar.
7113 Stonecutters and other similar.
7114 Concrete builders and steel fixers
7115 Carpenters and woodworkers
7119 Other construction workers
712 Building's finishing employees
7121 Roof installers and repairpersons
7122 Flooring employees
7123 Plasterers
7124 Insulation installers
7125 Glazing installers
7126 Pipe insulation installers
7127 Ventilation and cooling equipment installers
713 Painters and building cleaners
7131 Building painters and other similar.
7132 Spray painters and lacquerers
7133 Building cleaners and chimney sweeps

74 Electricity and electronics sector employees
741 Electrical equipment installers and repairpersons
7411 Building electrical installers
7412 Other electrical installers
7413 Line installers and repairpersons
742 Electronics and data communications installers and repairpersons
7421 Electronics and automation equipment installers and repairpersons
74211 Electronics installers and repairpersons
74212 Automation installers and repairpersons
7422 Information and communications technology installers and repairpersons

Of these occupational groups, those in key positions with respect to the achievement of energy-efficient construction, would appear to be, based on the analysis of the status quo, construction workers, house-builders, pipe insulation installers, insulation installers, ventilation and cooling equipment installers, electrical equipment installers and repairpersons, electronics and data communications installers and repairpersons as well as electronics and automation equipment installers and repairpersons.

In these fields, there is good reason to integrate energy-effective construction practices with all new training, and further educate the group of professionals operating in the entire sector. From the standpoint of controlling the overall entity, for example, energy skills must reach all trades on the construction site.

Table 23. Construction site's most important basic and supplementary training needs.

SKILLS NEEDS	**BASIC / SUPPLEMENTARY-TRAINING** (B=basic, S=supplementary)	**OCCUPATION MOST AFFECTED BY THEME** (according to International Standard Classification of Occupations 2010)
Control of overall entity	B+S	All occupations cross-cutting
Heat insulation and airtightness	B+S	Construction workers and other similar. House-builders Insulation installers Pipe insulation installers
Moisture control	B+S	Construction workers and other similar. House-builders Insulation installers Concrete builders and steel fixers Carpenters and woodworkers Other construction workers Roof installers and repairpersons
HPACS installations	B+S	Pipe insulation installers Ventilation and cooling equipment installers Electrical equipment installers and repairpersons Building electricity installers Other electrical installers Line installers and repairpersons Electronics and data communications installers and repairpersons Electronics and automation equipment installers and

		repairpersons Electronics installers and repairpersons Automation installers and repairpersons Information and communications technology installers and repairpersons
RES installations	B+S	Pipe insulation installers Ventilation and cooling equipment installers Electrical equipment installers and repairpersons Building electricity installers Other electrical installers Line installers and repairpersons
Basic skills	primarily B	All occupations cross-cutting
Renovation construction	B+S	Construction workers and other similar. House-builders Masons and other similar. Carpenters and woodworkers Other construction workers
Co-operation between the sector's different operators	primarily B	All occupations cross-cutting
Foreign workforce's training needs	primarily S	All occupations cross-cutting, primarily: construction workers

7.3. Changing needs in training content

7.3.1 New qualification requirements

A considerable number of certificates are already being used in the Finnish building sector, and the quantity is increasing. Certain certificates are voluntary, while others are mandatory. The main concerns relate to the certification system's co-ordination, or a loss of credibility for the certificates. If the qualification is not, from the standpoint of the employee's job opportunities or financial benefit, the certification system will not hold together, and the certificates will suffer inflation. In the workshops conducted during the project period, a proposal was made for an additional energy professional certificate; energy efficiency issues could be included as part of one's existing card training. Qualification requirements would be obtained to guarantee sufficient skills along the entire employee chain if the development of the certification system continues.

7.3.2 Basic education

From the standpoint of the development of training in the building sector, it is essential that basic vocational education be separated from the further and supplementary education aimed at persons who have already earned qualifications. From the standpoint of training implementation, the challenges and expedients, as well as the target groups and training methods, are highly diverse. The development areas in basic education related to theoretical knowledge, as well as the need for basic

skills in, for example, moisture control, pass-throughs, and insulation installations. Every effort must be made to minimise the deficiencies observed in this report regarding current skills, particularly for those being educated in new sectors.

Within the building sector, the vocational qualification, first degree system is seen as workable in terms of its structure. Energy skills training would be included in nearly every type of training instead of being treated as its own separate discipline.

The increase of on-the-job learning at the expense of more theory-based vocational training has proved to be somewhat problematic. Renewed regulations would, however, require an expansion of theoretical studies. The quality levels of on-the-job learning and educational possibilities vary. It would appear that educational institutions lack the resources to supervise the quality of on-the-job learning. Occasionally persons with extremely weak professional skills graduate from educational institutions.

In the development of education, co-operation among the various parties is essential because system is slow to change, and there is an element of urgency associated with the changes required for energy expertise. In qualification-oriented training, it is possible to obtain teaching of consistent quality regarding the knowledge and use of the qualification's principles. The skills examination system can also be used to achieve nationally co-ordinated skills in the construction sector.

7.3.3 Further education

Further education must take into account all activities that support energy-efficient construction. The skills segments observed in this report (section 7.2.2 and the preceding table) must be taken into account with respect to building technology and construction technology; these can develop their own further education packages that combine theory and practical skills.

Further training must reach more students, and educational institutions require additional competent trainers as the population ages and trainers retire. The further education of employees already working on construction sites is challenging. Training aimed at the enhancement to energy skills should be of high quality and short-term, but this is also the source of an unresolved conflict. The subject mater may be so difficult that short-term training is not enough to achieve a good learning result Employers often lack the resources, or are unwilling to let employees enrol in long-term courses because time in money in construction. Companies should be given incentives to enhance their employees' skills, as well as guarantees for their benefits (Ainasoja, BUS workshop 6 June 2012).

These problems will be solved in the final stage of the Build Up Skills project, the result of which will be used to generate the construction sector's educational roadmap for the achievement of the 2020 energy savings targets.

7.4. Monitoring needs

7.4.1 Development plan for education and research

The dimensioning of training supply and development of educational content requires the assessment or prediction of future training and workforce needs. The anticipation of training needs is an integral part of the educational policy's direction and decision-making.

Every fourth year, the Council of State approves a Development Plan for Education and Research based on the objectives stated in government programmes. In December 2011, the Council of State approved a development plan for the years 2011–2016. This development plan is functioning as the government programme's implementation plan, and will be used for decision-making related to the

main qualitative, quantitative and structural aspects of educational policies (Ministry of Education and Culture 2011a).

With respect to institutions of higher learning, the dimensioning of the training supply is agreed upon in three-year performance and target agreements. In the polytechnics' target agreements the starting places are agreed upon by training sector. In the universities' performance agreements, qualification targets are agreed upon by academic discipline, as well as the overall target number of new students. The enrolment figures for vocational education are decided as maximum student quantities for vocational education, whose limits are decided upon by the organisers of education depending on the training supply in their own fields.

The quantitative forecasting of training needs is particularly emphasised in the operations of the Ministry of Education and Culture. The Finnish National Board of Education and institutions of higher learning are responsible for the qualitative forecasting in their own operations. The specialist body carrying out the qualitative forecasting is an educational committee system consisting of a steering group, training committee, as well as fixed-term expert groups.

Forecasts glimpse far into the future because depending on the duration of qualification-oriented education, those earning qualifications will be entering working life only 5-8 years from the time decisions were made concerning the changes in training supply. Additionally, they will be in working life for decades. In particular, young people in comprehensive schools are assessed along a 10-15-year time span: the timeline for adults' further education and other training can be shorter.

7.4.2 Development of qualification system for vocational education

On 16 February 2012, the Ministry of Education and Culture established a steering group and working group (TUTKE2) to develop the qualification system for vocational education. The steering group will direct, support, and monitor the progress of the development work. The working group has been charged with the tasks of preparing a project plan and basic proposals for the development of the qualification system. The steering group's term will conclude at the end of 2014 (Ministry of Education and Culture 2011b).

7.4.3 European Social Fund's anticipation projects

Each year, the Ministry of Education and Culture also uses national and ESF funding to initialise projects that anticipate training needs. Support has also been allocated to projects involved with training, as well as subject entities and themes, considered necessary from the standpoint of social policy (Ministry of Education and Culture 2011b).

7.4.4 Construction sector's qualitative training development needs observed in the VOSE project

The National Project on Anticipation of Competences and Skill Needs (VOSE) implemented by the Finnish National Board of Education assembled qualitative forecasts of future skills needs in vocational education as well as real estate and building sector. A report generated during the project, "Skills needs in the real estate and building sector, a qualitative summary of forecasting projects". summarizes the qualitative development of training in the construction sector. The report supports the findings of the Build Up Skills project.

The publication notes that according to a qualitative clarification, the basis for the competitiveness of the real estate and building sector is viewed as its well-grounded and continuously developing expertise. For this task, the training should also provide sufficient preparedness for lifelong learning. Co-operation among educational institutions should be stepped up, as well as the co-operation between educational institutions and working life. Greater attention than previously should also be paid

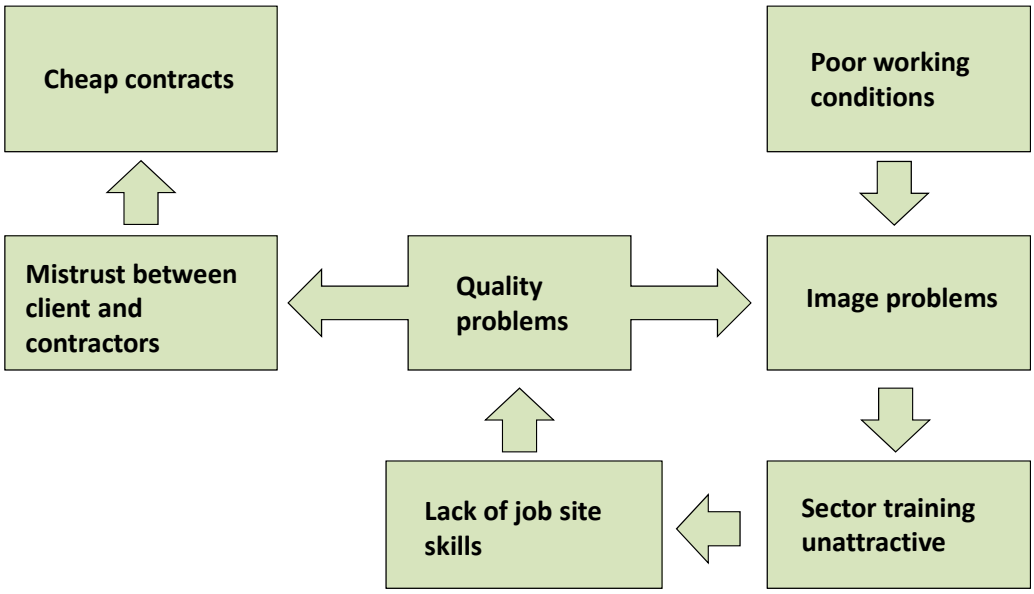
to the internationalisation of education. With the help of various teaching systems, diversity should be taken as a cross-cutting theme across the entire sector.

Ensuring the sufficiency of basic skills was considered one of the most important educational tasks. A newly educated workforce is sufficiently available, and their skills level has been assessed as good in the project's clarifications. Problems were encountered primarily in the broad sub-areas of construction site skills. On the other hand, there would appear to be a shortage of experienced professionals. The demand for formal skills has grown as the sector has developed, and for that reason the employer sector should ensure the availability of further training possibilities for those already working in the field (Vieno et al 2012).

7.4.5 ERA 17

The monitoring group for the ERA17 for an Energy-Smart Built Environment 2017 action plan has ascertained that the construction sector's professional skills level must be raised, particularly with respect to renovation construction, energy efficiency, and structural physics. Smart energy use and reduced emissions must be a cross-cutting target in all training content. The broad spectrum of teaching and education can be further expanded by emphasising interdisciplinary co-operation. Teaching must also be targeted more effectively and teaching materials developed systematically. The anticipation of training needs can also continue to develop. The monitoring group observations for the most part concur with the results obtained with the Build Up Skills project's analysis of the national status quo (ERA17).

8. Obstacles



Picture 15: The vicious cycle of construction site skills (Vieno et al 2012).

8.1 Construction sector's fragmentation and lack of co-ordination among different trades

In energy-effective construction control of the overall entity is a decisive factor. A building's quality is created as a part of the building process. For that reason, the quality of the process itself substantially affects the quality of the final product. Even an excellent design will become diluted unless each builder on the construction site implements his or her own task properly. This places a considerable responsibility on construction site supervisors and foremen. Breakdowns in communication also undermine efforts to achieve construction quality and energy efficiency.

New operators, ranging from the executive management to designers, supervisors, and builders, are often hastily assembled for building projects. Faced with the time schedule pressures typical of the sector, it is often challenging to generate common quality objectives, especially if operators do not even meet each other concretely face-to-face around the same table (BUS workshops 2012).

For its part, the construction sector in Finland is fairly concentrated because there are only a few large building companies on the Finnish market. The sector, however, also has thousands of small companies that operate in smaller-scale projects or as subcontractors for the large building companies. Characteristic of the business area are long subcontracting chains, subcontracts, and subsidiary contracts; deficiencies easily arise in their co-ordination. These, combined with the sector's characteristic lengthy and uncontrolled subcontracting chains, as well as the workforce's gig-based job practices, pose challenges for high-quality construction (Vapaavuori 2011).

That being the case, the supervision of building works is often fragmented, and it may even be unclear as to who should assume the foreman's role. For example, at a construction site for a detached house, the prefabricated house supplier assumes responsibility for his own contract, the HPAC contractor for his own, and the electrical contractor for his own. Overall responsibility, or a commitment to quality work, is not always recognized in the chain of contracts. On small-scale building locations, contractors

are not even on the construction site at the same time. A foreman is not necessarily on the site all day, and may even visit the site only once in a while. In this type of situation it is extremely difficult to obtain an overall picture of the situation, or even react to possible locations; no one takes responsibility for construction defects (BUS workshops 2012, Saastamoinen 2012, Koiso-Kanttila 2012).

8.2. Control of overall entity and attitudes

The results of the Build up Skills project's questionnaire "Energy Efficiency Management on the Construction Site" demonstrate that the control of the overall entity at the construction site is not always the best possible. An individual construction worker may find it difficult to grasp the significance of his or her own work as it relates to the entire building's energy efficiency, and this dampens the motivation to examine the quality of his or her own work. The importance of energy savings and the significance of eco-efficient building techniques are still not always understood on construction sites (BUS questionnaire 2012). Older and more recent studies demonstrate that ultimately attitude is the decisive factor in construction. Professional skills are useless if there is no interest in the end result (Jääskeläinen 2012). A lack of respect for the value of one's work easily leads to carelessness and a tendency to underestimate of defects. At its worst this leads directly to building damage and, for example, negligence in protective measures during the building period (Koiso-Kanttila 2012).

According to Jan Vapaavuori, Minister of Housing during the period 2007–2011, within the context of the construction sector's typically mobile and irregularly employed gig-oriented workforce, the pride in one's own trade and high ethical standards are, if not quite extinct, at least vanishing phenomena. The yearning for professional carpenters and right-on-time electricians is not a yearning for past decades, but a question arising from genuine needs (Vapaavuori 2011).

The transfer, introductory training and teaching of energy-effective construction skills is often difficult because they are occasionally opposed by entrenched construction site attitudes based on obsolete practices. A supervisor on a construction site may think that it know what it is doing because "This is way we've always done it," or when it is assumed that a certain working method is the only correct solution. A younger workforce receiving training in new information and energy efficiency skills may be looked down upon by older workers, as well as "old school" construction site supervisors and foremen. Conversely, young professionals may also underestimate the expertise of employees with long careers. Employees from different generations, or with different amounts of job site experience, do not therefore necessarily always respect each other's views and skills, which in turn hinders the setting and attainment of common objectives (BUS workshops 2012).

There is, however, no time to wait for the arrival of new types of vocational education to job sites. All new energy efficiency-related knowledge must be quickly established on construction sites because new regulations will quickly require additional skills (BUS workshops 2012, Saastamoinen 2012).

The attitudinal climate is changing more rapidly at the higher levels, primarily among the construction sector's decision-makers and specialists. In the questionnaire formulated by Sitra, Tekes, and the Ministry of the Environment, nearly four-fifths of the respondents in public administration, companies, and professional associations indicated that energy efficiency is part of their own organisation's operational strategy (Ministry of the Environment 2010).

8.3. Time pressures and problems with different contract forms

In a lump-sum contract, a single sum of money is agreed upon; the cost risk lies with the contractor alone. In that case contractors attempt to execute the contract as quickly as possible to maximise their profits; consequently haste is the usual reason for construction defects. Job tasks are limited only to what is strictly necessary; if energy efficiency factors, or other qualitative factors are not precisely

regulated, measured, or marked in the contract agreement, they easily remain unrealised. From the builder's standpoint, the achievement of good quality is more often than not disadvantageous with respect to the attempt to maximise profits.

On the other hand, builders may not always face the risk of financial accountability for defects or other negligence because these errors are often revealed only after many years, if at all. Additionally, aside from visible quality, proving the existence of these defects is almost without exception difficult. There are also virtually no opportunities to transfer existing knowledge through the master-apprentice system in lump-sum contracts.

In a target price contract, the lower the implemented costs, the higher the fee. This naturally creates pressures to perform the work as cheaply as possible, which may be visible in the finished result, or in the quality of workmanship.

Time is related to quality, also in supervision. Good foremen put the workers on overtime. Often everyone is used to going over where the fence is the lowest to keep the situation under control. Attempts are made to keep the quantity of new matters to assimilate to a minimum, and new building regulations are opposed (BUS workshops and questionnaire).

A complete lack of construction site supervision is also a timely problem. Work is carried out on the construction site as cheaply as possible with a disregard for quality, also often on weekends and evenings when a construction supervisor is not present on the construction site. The finished result is supervised, but not its execution stages. An increase of training does not necessarily alleviate this situation, nor does it motivate companies to invest in training because there is a danger that the works will be assigned to companies with unschooled workers that often use a unskilled foreign workforce, trusting in the lack of supervision (Ainasoja 2012).

8.4. Deficiencies in design monitoring

The construction sector's established operational culture has generally failed to emphasise the importance of design, documentation and project monitoring as a part of the building process. Their role, however, will become increasingly emphasised as Finland's buildings become increasingly technical, and the regulations affecting them proliferate, or at least become more complex, as they attempt to improve energy efficiency (Vapaavuori 2011). Buildings also suffer because their servicing is neglected. Residents and users who no longer automatically manage their own dwellings require information concerning the care and maintenance of the building and its property. Servicing often has a direct effect on a building's energy efficiency. Construction site installers could already provide guidance to future residents regarding, for example, the servicing of ventilation or heat recovery equipment (Saastamoinen 2012).

According to the Land Use and Building Act, a maintenance manual must be prepared for new construction locations, or demanding renovation locations requiring a building permit, that are used permanently for living or working. The preparation and adoption of a maintenance manual is also highly recommended for old buildings or buildings in use (Taloyhtio.net).

The management and supervision of the construction site and building production require production expertise as well as feasible architectural, structural, and building-technical systems' designs. A designer must be familiar with the possibilities and limitations of the construction site's production technologies. Production management must also have a grasp of production technology with respect to the construction site's organisation and equipment selections, and must be capable co-ordinating work schedules and the contractors' tasks. A lack of design and monitoring skills will substantially hinder energy-efficient construction (Building Information 2011). Areas of responsibility are also

spelled out in the designs. In building-technical installations, for example, the situation is often extremely disjointed when equipment suppliers deliver devices to the site but do not install them (Saastamoinen 2012).

8.5. Construction costs

The construction sector is sensitive to economic fluctuations, and competition is fierce among entrepreneurs. On the public side, regulations governing competition favour the selection of the cheapest contract, and small-scale entrepreneurs in particular may offer to work with an extremely low profit margin. Compromises with carefulness and money can be seen in today's buildings (Ahonen et al. 2008).

According to studies, however, Finns are ready to pay for energy-effectively constructed houses. The matter was clarified at the 2010 Kuopio Housing Fair with a questionnaire designed by Tekes and Motiva. Nearly 85% of those planning to build a house would be ready to pay an additional cost for improved energy efficiency. Most would be ready to pay no more than EUR 5,000, but a small number would even pay over EUR 15,000. 10% of the respondents would not pay for additional energy efficiency, but indicated a willingness to compromise on other issues such as such as floor areas and the quality of appliances. Regarding the selection of a home's heating system, affordable running costs became the most important criteria. For nearly half, ease of use was an essential criteria; 40% of the respondents considered renewable energy use important.

A commonly perceived obstacle to energy-effective construction was the difficulty of easily obtaining information from a single source. On the other hand, respondents also felt that designers and contractors are not providing enough information. Additionally, the information currently available was considered contradictory or unreliable; only 22% of the respondents selected cost as an obstacle to low energy construction (Tekes 2010).

8.6. One-off companies and the black economy

To achieve high building quality, and consequently energy efficiency, solving the problems of the black economy is essential.

The black economy, where employees are paid undeclared wages without the payment of any taxes, has been possible, particularly in connection with long subcontracting chains. The main contractor orders the work from a subcontractor who orders the work from cheaper subcontractor that for its part can still order the work from a new subcontractor. The last link in the chain, the party actually performing the work, can be a company that does not perform its tax obligations properly, and for that reason can offer the work cheaper than others. In Finland, efforts have been made to curtail the influence of the black economy by, for example, better controlling the identities of subcontractors, as well as other workers moving about on the construction site, and by setting auditing obligations on clients with respect to the performance of subcontractors' tax payments.

Of the construction sector's operators, 35% owe taxes. During the period 2004–2009 the quantity of unpaid taxes exceeded EUR 600 million. On construction sites, the black economy is the result of the use of unregistered and "hidden" workers who pay no taxes of any kind. This distorts competition and raises the construction sector's unemployment costs. In 2009, at the beginning of the last economic downswing, there were approximately 10,000 unemployed workers collecting benefits from the construction sector's unemployment fund. It can be estimated that at least half of these would be employed if the dark economy was less prevalent (Harjuniemi 2009).

Subcontracting chains are the black economy's most common operational model. One way to curb the black economy is the conscious reduction of subcontracting chains. In the private services sector, continuously proliferating subcontractor chains are for their part increasing the risk that companies will neglect their obligations to their employees as well as surrounding society (The Finnish Construction Trade Union 2012).

In the building sector, there have been visible results in the battle against the black economy that has taken years. An increasing number of operators are requiring their partners' affiliation with client responsibility services, as well as adherence to a set of criteria for construction (Harjuniemi 2012). Several courses of action are currently underway. To boost the efficiency of verifiable employment relationships and tax supervision, a tax number, among other things, appearing on mandatory photo ID cards will be adopted during the autumn of 2012 (Tax Administration 2012).

8.7. Deficiencies in training

The construction sector's training may be partially planned incorrectly, and the right persons are selected for the training. What is needed is expertise along the entire supply chain – from designers and construction site supervisors to builders and installers. The training of construction site supervisors and foremen is of primary importance in energy-effective construction.

Construction site workers seem fairly unwilling to pursue further training. Investments in training have been made in larger building firms, but in smaller companies there would currently appear to be very little interest in training. What is needed is carefully planned short-term training that clearly also benefits companies (Ainasoja 2012).

New kinds of skills are needed to cope with increasingly stringent building regulations and energy efficiency requirements. The implementation of high quality construction requires, besides technical expertise, wide-ranging professional skills, as well as a knowledge of the compatibilities among various solutions. Additional information treating, for example, structural performance, structural physics, and how the entire building lives is needed in training. Today's teaching does not meet the level that will be necessary in the future. Another problem is the persistent attitude that anyone can function on a job site without any knowledge. At the least, however, anyone working on a construction site should at least have a vocational qualification, first degree (Lampilahti 2010). Currently, there is clearly a shortage of practical professionals on construction sites, the result of skilled employees being transferred to office or supervision tasks (Vielma 2012).

The final learning of quality issues and professional pride is, however, achieved on the construction site. More co-operation between educational institutions and companies is needed. In Oulu, excellent results have been achieved at a "school construction site", where on-the-job learning and training have been successfully linked (BUS workshops and questionnaire 2012).

On the other hand, it has also been observed that on-the-job learning is not automatically beneficial education. The learning locations and tasks may be one-sided, and many important matters may remain unlearned. Increasing the quantity of on-the-job learning positions has correspondingly clearly decreased the quantity of theoretical studies. New regulations and energy efficiency requirements would, however, also require a sound theoretical understanding. In many sectors, for example, the training of electricians, a problem is the scarcity or complete lack of teaching materials treating energy efficiency. In installation works, general quality is also directly proportional to the structure's energy efficiency (Saastamoinen 2012).

Deficiencies related to training content are treated in greater detail in Chapter 7 of this report, Skills gaps between current situation and targets for 2020.

8.8. Ageing of skilled workforce and trainers

Owing to the ageing of the workforce and retirement of populous age brackets, the working-age population will begin to decrease, in which case field-specific, local, and skills-related questions related to the workforce's availability will pose an even greater threat to economic development. On average, the quantity of working-age people in Finland will decrease during the period 2010 - 2025 at the rate of 17,000 persons per year. Initially, the decrease of the working-age will be more rapid, but it will slow over time (Tossavainen 2007, Ministry of Employment and the Economy 2007).

The construction sector's workforce is fairly aged, resulting in a substantial number or retirees Retirement has removed, and will continue to remove, an average of approximately 3,500 persons, of whom approximately two-thirds are skilled workers, from the workforce annually during the period 2005 - 2025. (Ministry of Employment and the Economy 2007, RIL 2008) The transfer of quiet information to the construction sector's new employers, as well as the sufficiency of a skilled workforce is problematic, except perhaps for certain fashionable sectors such as data communications installers. A natural solution for the problem of an insufficiently skilled workforce is not in sight, at least within Finland's borders where the country's service ratio weakens day by day.

8.9. Foreign workforce

The foreign workforce has been growing in Finland, particularly in Uusimaa. According to a report carried out in the autumn of 2010 within the scope of Confederation of Finnish Construction Industries' house-building sector, approximately 26% of the workforce employed on the construction sites of the Confederation of Finnish Construction Industries' member companies in Uusimaa are foreigners. Another study shows that, in the entire country, foreigners working on the construction sites of Confederation of Finnish Construction Industries' member companies account for 14.5% of the workforce (Confederation of Finnish Construction Industries 2011).

Table 24. Workforce survey summary 2011.

	2011	**2010**	**2009**	**2008**	**2007**
Companies	**219**	221	226	208	216
Construction sites	**1812**	1933	1716	1822	1698
Employees total	**27898**	21726	18518	21425	22313
Own employees	**9303 (33%)**	8512 (39%)	7751 (42%)	10018 (47%)	8963 (40%)
Own foreigners	**409 (4.4%)**	177 (2.1%)	151 (1.9%)	194 (1.9%)	134 (1.5%)
Leased employees	**1788 (6.4%)**	1053 (4.9%)	664 (3.6%)	1150 (5.3%)	1455 (6.5%)
Foreign leased employees	**592 (33%)**	307 (29%)	150 (23%)	275 (24%)	225 (15%)

Subcontracting companies	**6886**	6117	4114	4849	5241
Subcontracting employees	**17605 (63%)**	12801 (59%)	10482 (57%)	11420	12431 (56%)
Subcontractors' foreign employees	**4559 (26%)**	2663 (21%)	1437 (14%)	1746 (15%)	1212 (10%)
Foreigners total	**5560 (20%)**	3147 (14.5%)	1738 (9.4%)	2215 (10%)	1571 (7%)

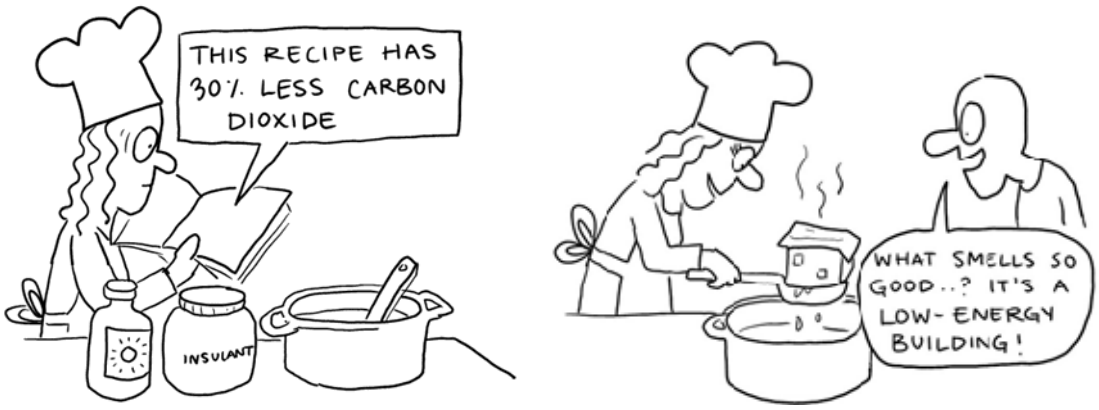
Confederation of Finnish Construction Industries2011.

The lack of a single language on construction sites hinders the co-ordination of work. The responsibility of site supervisors for the skills required on the entire construction is emphasised, even though each employer should have a sufficient understanding of his or her tasks, and through that a grasp of the overall total and the possibility to assess the quality of one's own work. This becomes complicated when there is no common language, and the texts on product packages are not necessarily understood by foreigners. Ascertaining the foreign workforce's competence has been difficult (BUS workshops).

It is difficult to find information regarding the role of the foreign workforce in the black economy, but according to estimates, it is substantial. At their worst, the wages paid to foreigners working in the building sector are 50% less than the minimum wages stipulated in collective labour agreements. Additionally, tax revenues do not accrue to Finland any better than they do for the employee's home country. Competitive bids are often inadequate sums, and there is no time available for employee orientation (Pohjola 2011).

The education of immigrants is hindered by the fact that training materials are not always conveniently available in different languages. The RATU Construction Productivity Information File (RATU File) has, however, already been translated into Russian, and translation work has already begun on the English and Estonian versions. A Finnish-Russian multimedia presentation of the RATU File is also being used as a teaching aid in several educational institutions (Ratu Net 2012).

9. Conclusions



Picture 11: Achieving energy efficiency objectives requires the co-operation of all organisations in training and commonly approved recipes. (pictures: ERA17/Leena Ahveninen)

9.1 Further education

During the Build Up Skills Finland project, it has been observed that in practice almost all employees in the building sector must be at some level brought within the sphere of further training**. Energy skills must be included in basic and further education as a cross-cutting objective in all content**. Motivating students to be trained as energy professionals at the scale now required is challenging if the energy efficiency training is implemented as a disconnected study. This is difficult particularly in further education, where the employer's interests and working life realities (time pressures, money) are decisive.

Teaching must be focused more efficiently and teaching materials must be developed. What is needed is carefully planned short-term training that clearly also benefits companies. Companies can be provided with incentives to raise skill levels, as well as a guarantee for the achieved benefits.

The supplementary education already existing in working life is of primary importance because professionals for energy-effective construction must be trained rapidly. Depending on the duration of qualification-oriented education, those earning qualifications will be entering working life only 5-8 years from the time decisions were made concerning the changes in training supply. The development of basic vocational education must certainly be heading with further education towards the same goal, the attainment of the 2020 energy efficiency targets.

The roadmap concerning increasingly stringent building regulations, drawn up by the Ministry of the Environment and included in the ERA17 programme, can also be used in development of training. The roadmap facilitates the anticipation of the increasingly stringent statutes and regulations affecting energy efficiency.

9.2 Quality construction

Energy-effective building is for the most part a question of the construction's general quality. The implementation of high quality construction requires, besides technical expertise, wide-ranging professional skills, as well as knowledge of the compatibilities among various solutions. The co-

operation between different operators must be intensified, also in training. The flexible combination of training and working life is essential.

All new public buildings will have to be nearly zero energy buildings beginning in 2019 and all new buildings nearly zero energy buildings beginning in 2021. Finland's northern location is challenging with respect to energy-effective construction. The successful construction of passive and nearly zero energy buildings in Finland requires thick insulation layers, excellent airtightness, comprehensive moisture control in the building and on the construction site, as well as consistently high-quality workmanship where no link in the building chain may fail. Combining these factors with the time schedule pressures prevalent in the building sector makes the attainment of targets challenging, in new and renovation construction. Besides construction workers, training in energy skills must also be provided for persons at the work supervision level, particularly when the greatest responsibility for the control of the overall entity rests with them.

The construction sector's new certificates must be considered case-specifically; their genuine benefit must be weighed to avoid the certificates' inflation. According to Finland's current government programme, the specifications for qualifications' skills principles will be ratified at all phases of education, and the renewal of the vocational education qualification system will continue in close co-operation with working life. According to currently available information, the European Credit system for Vocational Education and Training (ECVET) will be taken in all vocational qualifications in 2014.

9.3 Skills deficiencies

According to this report's findings, the construction sector's level of professional skills must be raised, particularly with respect to structural physics, heat insulation, buildings' airtightness, moisture control, piping installations, and renewable energy. In the questionnaire oriented to the constructions sites as well, problem areas were areas that are critical from the standpoint of energy efficiency. With respect to the control of the overall entity at the construction site, the main concerns that became apparent are deficiencies in basic skills and the challenges posed by renovation construction.

A lack of control of the overall entity and **co-ordination among the various operators** is generally considered the construction sector's biggest problem. This must be reviewed, and attempts must be made to solve this problem at different training levels. A grasp of the overall entity requires a knowledge and appreciation of one's own work. A construction site's splintered contracting chain and hurry must by some means be brought under control. In training, there should be an attempt to find a common ground among the different parties, students, or professionals in various trades. Besides the control of the overall entity at the construction site level, there are also often deficiencies higher up, at the designer level.

Even **in basic skills as well**, there would also appear to be deficiencies in special critical areas such as moisture control. Basic skills levels will be improved by training when all parties are able to obtain basic or further education. Increasing the amount of one-the-job learning has clearly reduced the amount of theoretical instruction in vocational studies. Increasingly stringent building codes and energy efficiency requirements would however require a strong theoretical basis, although they are also good targets in on-the-job learning.

The development of training must take into account the contradiction between narrow specialisation and a diversified and often more relaxed control of the overall entity. Specialised expertise is however required for many new solutions. Controlling the total is not, however, a question of everybody knowing everything. Energy efficiency must also be viewed within the context of a broader overall entity of environmental impacts.

It can also be ascertained that training needs can be divided into **two separate operational policies:** a return to basic skills and a search for the new kind of energy skills required by new solutions and challenges.

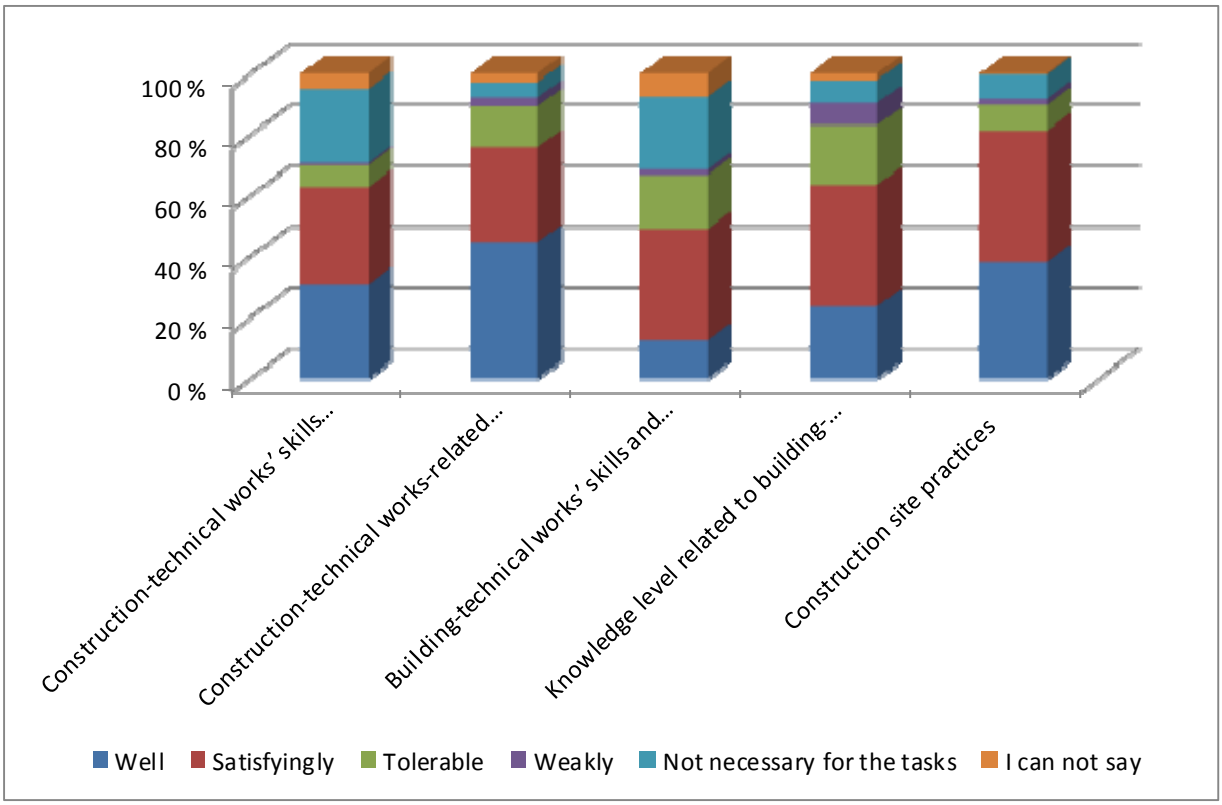
9.4 Additional challenges

New technical systems, such as hybrid heating systems and their operations, are posing new challenges; any risks related to the systems should be identified and avoided. New regulations will significantly increase the use of renewable energy, and this must be taken into account in the planning of further training.

The **foreign workforce** brings challenges, such as language problems, particularly in the southern Finnish province of Uusimaa, where over 25% of persons working on construction sites are foreigners. In recent years, investments have already been made regarding the authentication of skills and foreign workforce's further training, and teaching materials are already available in certain foreign languages. It is unlikely that the size of the foreign workforce will decrease, considering that many Finns reaching retirement age will be leaving the workforce, also the building sector, during the next few years.

Renovation construction will be a pivotal area in the advancement of energy efficiency. Although Finland's building stock is, at the European scale, fairly young, the centre of gravity of construction will shift from new construction to the renovation construction side as the building stock ages. Renovation construction will generate significant energy efficiency benefits and new employment opportunities. Even in old detached houses, reasonably simple measures will reduce energy consumption by as much as 60-70%.

Picture 17: Summary of construction site questionnaire. From left to right: construction-technical works' skills and quality level, knowledge level related to construction-technical works, building-technical works' skills and quality level, knowledge level related to building-technical works, construction site practices. On average, construction-technical works' skills were assessed in the questionnaire better than building technology. The were fluctuations with respect to skills in construction site practices, and for example difficiencies were seen in the skills related to energy-efficient winter construction.


100 %
80 %
60 %
40 %
20 %
0 %
Construction-technical works' skills...
Construction-technical works-related...
Building-technical works' skills and...
Knowledge level related to building-...
Construction site practices
Well
Satisfyingly
Tolerable
Weakly
Not necessary for the tasks
I can not say

BUILD UP SKILLS FINLAND

ANALYSIS OF THE STATUS QUO

Characteristics of Finnish building construction

- The northern location of Finland and its challenges for energy efficiency.
- The building stock in Finland is amongst the newest in Europe - most of the buildings have been built in 1970s and 1980s.
- The renovation of suburb areas has become a big issue that needs to be solved in 2000 – that always means also an energy renovation.
- Every fifth construction worker on Finnish construction sites is a migrant worker.
- Over 80% of all buildings in Finland are built of wood.
- The new, rapidly tightening building regulations will call for new solutions to improve the energy efficiency.

The northern location of Finland is challenging for energy efficiency.

Barriers for achieving the energy efficiency

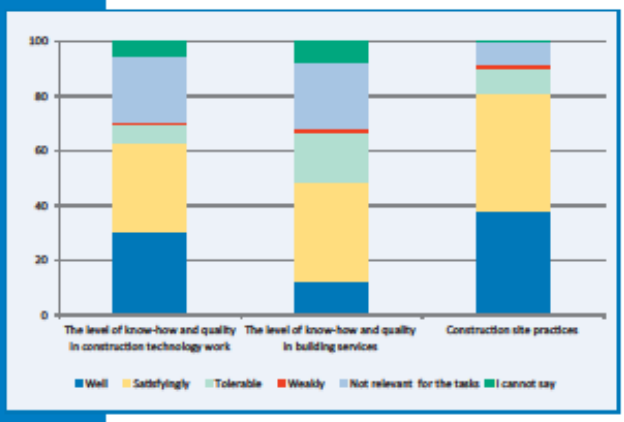
- Fragmentation of the building sector: long subcontractor chains.
- Lack of coordination among crafts and professions.
- Control over the big picture is weak.
- Negative attitudes when dealing with reform or changes.
- Inadequate planning and monitoring.
- Black economy.
- Inadequate training.
- Aging of skilled workforce and trainers.
- Language barrier with migrant workers.

Development needs in training

- Sufficient basic knowledge on construction physics for all.
- Control of the construction site entity and cooperation of the different parties within the projects.
- Tightness of the outer wall mantle: holes for the cables and pipes, insulation.
- Controlling the damp during the construction work.
- The functionality of new energy efficient structures and the compatibility of different solutions.
- Training of the installers according to the new regulations.

The level of know-how on Finnish building sites

- In spring 2012 a Build Up Skills questionnaire "Managing energy efficiency on building sites" was carried out to investigate the level of know-how on building sites.
- Some results of the survey:



Observing the critical points for the energy efficiency with the infrared camera for leaks in the mantle of the building. Build Up Skills Finland workshop in May 2012.

Build Up Skills partners in Finland: Motiva, TTS, Amiedu, RATEKO. Execution of the Status Quo Analysis: TTS.

BUILD UP SKILLS

ENERGY TRAINING FOR BUILDERS

Picture 18: EU exchange meeting, Slovenia 11.-13.6.2012. Poster presenting the Finnish analysis of the national status quo.

10. Authors/contributors

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This analysis report has been assembled and written by Minna Kuusela, Anne Korhonen, Sari Liski-Markkanen, and Maritta Paakkinen.

At various stages, the Build Up Skills Finland project's partners Motiva, Amiedu, and RATEKO have provided comments and assisted with information searches. Comments were also solicited from the consortium's organisations committed to the project, as well as from stakeholder groups' selected experts.

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Chapter 3. Characterisation of the building sector

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12. Glossary

Adult education centre: Adult education centres offer voluntary basic and further vocational training, as well as training in workforce policy. The training is intended for adult students 18 years of age or older. Applications for training in workforce policy are made through the Employment and Economic Development Office. Applications for voluntary training are submitted directly to the educational institutes. The schools also offer courses tailored for companies, as well as courses aimed at the upgrading of vocational skills. Training is organised in daytime, evenings, or as multiform study. In adult education, the school year is the calendar year (Wikipedia 2012a).

Vocation-oriented training: Vocational training consists of vocational qualifications, first degree as well as further vocational qualification and special vocation qualifications undertaken as supplementary education. Young people well as adults can study for the same vocational qualifications, first degree. The training is qualification-oriented. Further and supplementary vocational education is possible at different career stages. The studies take place in educational institutions as well as, to an increasing degree, at the workplace and in online learning environments (Finnish National Board of Education 2012).

Polytechnic and university education: Finland's system of higher education consists of polytechnics and universities. Characteristic of universities is higher education based on their scientific research. Polytechnics are oriented towards working life and the demands of high-level professional skills.

Arava: The word is an acronym from the Finnish ***A****sunto****RA****kennustuotannon* ***Va****ltuuskunta*; Arava was an organisation for state-subsidised housing production, founded in 1949, that arranged low-interest loans for housing production. Subsequently, the government's loan system for housing production has traditionally been called *arava financing,* the loans *arava loans,* and the buildings *arava buildings*. Nowadays the Housing Finance and Development Centre of Finland (ARA) manages the state-subsidized housing system.

E-number: A point of departure for a building's energy efficiency classifications, the E-number is based on an overall energy assessment that takes into account all energy consumption taking place in the building. The E-number is made up of a building's annual calculated consumption of purchased energy weighted with various types of energy coefficients.

EEAP (Energy Efficiency Action Plan): An energy efficiency action plan published by the EU that assembles the main courses of action promoting energy efficiency.

ECVET (European Credit System for Vocational Education and Training): ECVET is a system that facilitates the consistent utilisation of studies or other expertise acquired in different countries throughout the European area.

EQF (European Qualifications Framework): The EQF is based on the specification of learning results. It describes information, skills and competency regardless of where in the system the qualification has been earned or the competency acquired.

ERA17 action plan: "An Energy-smart Built Environment in 2017" was launched in 2010 jointly among the Ministry of Housing, Sitra, and Tekes. The objective was to map the best ways to promote energy-smart construction (ERA 17 2012).

FINECVET: The FINECVET project, supported by the Finnish National Board of Education, aims at piloting the application of ECVET in the Finnish vocational education and training system for transnational mobility.

Black economy: Otherwise legal business or corporate operations where statutory payments or taxes, for example income tax deducted at source, or social security and pension payments, are not made.

One-off companies: Companies dealing in forged receipts and acting as connectors in the black economy. A one-off company sells forged receipts of a contract to another company that uses the forged receipts to avoid paying taxes. A one-off company assumes responsibility for the unpaid taxes. The company buying the forged receipt keeps the money obtained in the contract and can use it to pay, for example, untaxed wages.

Nearly zero energy building (nZEB). An nZEB building is extremely energy-efficient, and it also has its own energy production systems utilising, for example, solar or wind power. A zero energy building generates at least as much renewable energy as the non-renewable energy it consumes. A plus energy building generates more energy at the annual level than it consumes.

Suburb: A predominantly residential area, usually built in a single stage outside a city's central area, that has, or at least has had, its own commercial centre with the most essential public services. The suburban building stock often primarily consists of apartment buildings. Suburbs built in different periods may substantially differ, for example in terms of their construction methods and town planning principles. Most of the suburbs in Finland were built during the 1960s and 1970s by large construction companies.

Low energy building: Since early 2010, a low energy building is defined as a building whose heating consumes 85% of the energy needs of an equivalent structure meeting minimum norms. A low energy building consumes less than 60 kWh/m² of heating energy annually in Southern Finland and less than 90 kWh/m² of heating energy annually in Northern Finland.

NEEAP (National Energy Efficiency Action Plan): Finland's second national energy efficiency action plan (NEEAP-2) presents a computational estimate of the energy savings for energy implemented in 2010, as well as savings estimates for the years 2016 and 2012. The energy savings effects of a total of 36 energy efficiency measures have been calculated in Finland's NEEAP-2. Besides these, the plan has compiled approximately 50 other measures promoting energy efficiency.

NREAP (National Renewable Energy Action Plan): The national renewable energy action plan approved at the EU level in 2010 contains detailed time schedules and operational instructions explaining how each Member State will be able to achieve its year 2020 targets regarding the end use of renewable energy.

Finnish National Board of Education: A development agency for teaching, the Finnish National Board of Education is responsible for pre-school education and basic education, morning and afternoon activities, upper secondary school education, basic vocational education, as well as the development of liberal adult education. (Finnish National Board of Education 2012)

Apprenticeship training: Apprenticeship training can be used to study for nearly all vocational qualifications. It suits young people and adults. An apprenticeship contract is based on a fixed-term employment agreement, including on-the-job vocational training, drawn up between a student at least 15 years of age and the employer. Apprenticeship training can be used as basic vocational training to earn a vocational qualification, first degree. Additionally it can be preparatory training for the skills examinations required for vocational qualifications, vocational qualifications, and specialist qualifications (Finnish National Board of Education 2012).

Passive building: The heating energy need for a passive building is approximately one-fifth of an ordinary house built in the early 2010s. The building is for the most part heated by the home's lighting, as well as the "waste heat" released by people, and only during cold weather is there a need for additional heating. A passive building requires approximately 20 kWh/m² of heating energy in Southern Finland per year and in Northern Finland approximately 30 kWh/m² of heating energy per year.

Long Term Climate and Energy Strategy: A strategy, approved Finland's Council of State, that treats courses of action related to climate and energy policies in detail until the year 2020 and indicatively until 2050.

Primary energy: Unrefined natural energy measured in its form before any conversion processes. This includes, for example, oil in oilfields, wind, and solar radiation. Primary energy is divided into renewable and non-renewable energy.

Permanent snow cover: Permanent snow cover means the longest winter period when the ground is covered by a layer of snow at least 1 cm in thickness.

Energy Performance of Buildings Directive (EPBD): In May of 2010, the European Parliament approved a renewed directive aimed at the improvement of buildings' energy efficiency. The directive went into effect in the early spring of 2010 and the national regulation became ready in the summer of 2012. According to the directive, energy efficiency must be advanced in new construction as well as the existing building stock. By the end of 2020, new buildings shall be nearly zero energy buildings. The directive also sets minimum national requirements for energy efficiency in renovation construction.

Building's energy certificate: Consumers can use energy certificates to compare a building's energy efficiency. The energy quantity required for the building's intended use is stated in the energy certificate. Depending on the energy efficiency, an energy classification using the scale A-G is specified for the property.

RES Directive: The Renewable Energy Sources Directive is an EU directive specifying the individual energy targets for each Member State; the countries themselves then deciding on the courses of action necessary to attain the objectives set for the year 2020; these include increasing the share of renewable energy to 20% of energy end consumption. Renewable energy sources include solar energy, hydroelectric power, wind power, wood energy, biomass, biopower, and heat pumps.

War veteran's house: A one and a half storey detached house, wood-framed and with a ridge roof, created as a solution to the post-Second Word War housing shortage. At the end of the war, the number of emigrant families, displaced from ceded areas and without homes, exceeded 11% of the entire Finnish population. The model was reasonably easy to build without special tools or traditional carpentry skills. There were several type models for the war veterans' houses, but the models resemble each other fairly closely. There continue to be approximately 150,000 war veterans' houses in Finland. Because they form an important portion of the existing building stock, their energy consumption is significant with respect to the entire country.

Feed-in Tariff: A governmental policy mechanism for electricity markets intended to stabilise the price of electricity. With feed-in tariffs, a specified price is guaranteed for the electricity producer; if the market price is lower than this guaranteed price, electricity consumers pay the difference. The most common feed-in tariffs are used to promote the competitiveness and adoption of renewable electricity generated by renewable forms of energy, but tariffs are also applied to other electricity production methods.

Supplementary education: Vocational supplementary and further education is possible at different career stages. Basic vocational education and further training is qualification-oriented training. Study takes place in educational institutions as well as at the workplace and in online learning environments (Finnish National Board of Education 2012).

Contract forms: When using a lump sum contract, a builder concludes an agreement for the entire work with a single contractor. The main contractor then contracts out the necessary special works, such as building-technical contracts, as subcontracts with specialised firms. In a sub-divided contract, the builder concludes separate contract agreements for contracts divided into separate parts. In a turnkey contract, the contractor assumes the entire responsibility for the implementation of the entire building project, including architectural design and the project's overall co-ordination.

Tax number: All persons working on construction sites in Finland must have a photo ID visible at all times. Beginning 1 September 2012, the photo IDs of those working on construction sites must also include a tax number that can be obtained from the Tax Administration.

Green employment: As stated in the United Nations Environment Programme (UNEP), green employment relates to all jobs that improve the quality of the environment. This includes the protection of ecosystems and biodiversity, boosted energy efficiency, the more effective use of materials to, for example, inhibit climate change, as well as the reduction of emissions and waste quantities. Green employment does not only relate to works whose connection with nature would enable them to be classified as green, but all work that is carried out to solve environmental problems.

VTT: The VTT Technical Research Centre of Finland is a domestically and globally networked multi-technological applied research organization. VTT is a part of the Finnish innovation system under the domain of the Ministry of Employment and the Economy. VTT is a not-for-profit organisation (VTT 2012).

Environmental certificates: Assessment systems, measuring buldings' environmental impacts, whose grading or classification principles vary. Examples of such certificates are the American LEED, Finnish PromisE, and English BREEAM.

APPENDIX 1: Construction site questionnaire cover letter

Construction site questionnaire:

Energy Efficiency Management on the Construction Site

This questionnaire is part of the Build Up Skills project whose purpose is to clarify the current skills levels of those working on construction sites, as well as further training needs, as they relate to energy-efficient construction. The questionnaire has been implemented jointly with **The Confederation of Finnish Construction Industries** and **The Finnish Construction Trade Union**, and has been assembled by TTS, RATEKO, Amiedu, and Motiva.

The responses will be handled confidentially. The responses of individual companies or construction sites will not be identifiable, nor will any information will be treated as an individual case.

The questionnaire can be answered either with respect to personal skills, or on behalf of a group of employees, in which case the responses will be provided by a foreman or supervisor. If the group's skills levels vary, please respond according to the average skills levels. If the group contains representatives of different trades (for example carpenters, HPAC installers), we hope that you will fill out the questionnaire separately for each trade.

Filling out the questionnaire will take about 10 minutes. Please submit your response before Wednesday 4 April 2012.

Your response is extremely important because you will be participating in the development of training in the construction industry. The questionnaire can be sent to others. Thank you in advance for your response!

CLICK HERE TO GO TO THE QUESTIONNAIRE:
http://www.webropolsurveys.com/S/2565CE32EA5D983D.par

Additional information about the questionnaire:

TTS is responsible for the implementation of the questionnaire.
Contact person: Minna Kuusela, minna.kuusela@tts.fi, GSM 044-7143695.

Several workshops will be organised for the project's participants. Further information:
http://www.motiva.fi/ajankohtaista/tapahtumat/

Build Up Skills, a project belonging to the EU's Intelligent Energy Europe (IEE) programme, is being implemented in 21 countries. Motiva is the co-ordinator; other participating organisations are TTS, Amiedu, and RATEKO. The objective of the Build Up Skills project is to enhance the energy efficiency and renewable energy skills of professionals working on construction sites.

APPENDIX 2 : Construction site questionnaire's questions

Construction site questionnaire: Energy Efficiency Management on the Construction Site

Questions 1-8 background questions
Questions 9- response alternatives: well/ satisfactorily/ adequately /slightly /non-applicable to work tasks/ no opinion

CONSTRUCTION-TECHNICAL WORKS
Construction-technical works' skills and quality level

(Go directly to Question 12 if you are only assessing building-technical works skills).

- Can make door and window joints.
- Can insulate and seal other pass-throughs.
- Can install a vapour barrier.
- Can perform cleaning of base related to heat insulation.
- Can perform cutting of wool/ selection of correct material size related to heat insulation.
- Can install various types of insulation materials at foundations.
- Can install various types of insulation materials for the structural frame and supplementary building components.
- Can install various types of insulation materials on roofs.

Knowledge level related to construction-technical works

- Understands how the U-value describes a structure's heat insulation capacity
- Understands a material's heat transfer coefficient, the significance of careful installation on the heat insulation capacity, and the U-value
- Understands the importance of air leaks and structural tightness, as well as the significance of cold bridges as they affect a structure's heat insulation capacity.
- Understands the principles of moisture transfer in structures and knows the meaning of "dew point".

Comments related to construction-technical works' skills and knowledge levels

BUILDING-TECHNICAL WORKS

Building-technical works' skills and quality level

(Go directly to question 15, if you do not estimate technical work skills)

- Can take into account energy efficiency in piping installations (routing, pipe fittings, valves, pressure drops, special rooms).
- Can take into account energy efficiency in piping installations (pump installations, shunt circuits, sub-distribution board equipment).
- Can take into account energy efficiency in piping installations (piping and tank insulation).
- Can take into account energy efficiency in ventilation installations (duct installations).
- Can take into account energy efficiency in ventilation installations (Mechanical equipment installations, roof fans).
- Can take into account energy efficiency in ventilation installations (duct insulation).
- Can take into account energy efficiency in installation of water cooling units.

- Can take into account energy efficiency in the installation of room cooling equipment (chilled beams, fan coils).
- Can take into account energy efficiency in the installation of heat pumps.
- Can take into account energy efficiency in electrical and automation works.

Knowledge level related to building-technical works

- Knows the importance of the heating and cooling system's operations in the determination of the building's energy efficiency (E-number).
- Knows the importance of the ventilation system's operations in the determination of the building's energy efficiency (E-number).
- Knows the proper operational prerequisites for the ventilation system's heat recovery.
- Knows the issues related to the balancing and adjustability of ventilation ducts.
- Knows the significance of energy-effective ventilation and the SFP license from the standpoint of installation work.
- Knows the main issues related to the balancing and adjustability of fluid flow systems from the standpoint of installation work.
- Knows what is meant by building-technical basic improvements.
- Knows how renewable forms of energy can be utilised in buildings.

Comments related to building-technical works' skills and knowledge levels

CONSTRUCTION SITE
Construction site practices

- Knows how to use tools and equipment/scaffolding correctly.
- Is familiar with the protection of building materials, areas, and structures during the construction period.
- Is familiar with energy-effective working methods and has a grasp of energy-effective practices related to winter construction.
- Understands the importance of his or her work as part of the building's overall entity, and the significance of high-quality work as it relates to energy consumption
- Is able to assess the quality of his or her work.
- Is able to actively interact with other employees, also those in different trades, to ensure an energy-effective and workable overall entity.

Comments related to construction site practices' skills and knowledge levels

OTHER

17. Other comments

18. In your opinion, what kinds of supplementary training needs related to energy-efficient construction are required to improve construction workers' skills?

BUILD UP Skills

The EU Sustainable Building Workforce Initiative in the field of energy efficiency and renewable energy

BUILD UP Skills is a strategic initiative under the Intelligent Energy Europe (IEE) programme to boost the continuing or further education and training of craftsmen and other on-site construction workers and systems installers in the building sector. The final aim is to increase the number of qualified workers across Europe capable of delivering renovations offering high energy performance, as well as new, nearly zero energy buildings. The initiative addresses skills in relation to energy efficiency and renewable energy in all types of buildings.

BUILD UP Skills has two phases:

I. First, the objective is to set up national qualification platforms and roadmaps to successfully train the building workforce to meet the targets for 2020 and beyond.

II. Based on these roadmaps, the second step facilitates the introduction of new and/or upgraded qualification and training schemes.

Throughout the entire duration of the initiative, regular exchange activities are being organised at the EU level to underline the European dimension of this important initiative and foster educational interaction among countries.

The BUILD UP Skills Initiative contributes to the objectives of two flagship initiatives of the Commission's 'Europe 2020' strategy: "Resource-efficient Europe" and "An Agenda for new skills and jobs". It is part of the Commission's Energy Efficiency Action Plan 2011. It will also enhance interaction with existing structures and funding instruments such as the European Social Fund (ESF) and the Lifelong Learning Programme, and will be based on the European Qualification Framework (EQF) and its learning outcome approach.