BUILD UP SKILLS

ENERGY TRAINING FOR BUILDERS

BUILD UP Skills – Sweden –

Analysis of the national status quo

August 2012

Further information

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

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

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0. Executive summary

The energy and climate objectives for 2020 demand major initiatives from the building sector, including the raising of skill levels. The EU programme Intelligent Energy Europe has initiated BUILD UP Skills projects in 30 countries across Europe. Each country runs its own project. The aim of the Swedish project is the production of a roadmap and platforms for vocational development and skills improvement for all those who work on building sites, i.e., tradesmen, construction workers and system installers. Further education primarily concerns the production of energy-efficient buildings, as well as learning how to install systems for renewable energy and carry out low-energy building renovations. In Sweden, this also includes a review of basic training.

This report presents an analysis of the current status of the building sector, a review of current and planned strategies for training within the field of energy, in addition to an analysis of the skills that are required on the building site and a preliminary analysis of the obstacles which exist. Subsequent stages involve the production of a roadmap and platforms, the implementation of which will then be guaranteed.

The workforce of the building sector is relatively well-educated, as far as its consultants and constructors are concerned. However, the building sector is, to a certain extent, fragmented into different branches and organisations. Internationalisation can be seen in the growing number of foreign building trade companies and an increase in foreign workers on Swedish building sites, although the exact extent of this is unknown. Internationalisation can also be seen through the fact that it has become easier in recent years to import building material and that an ever increasing number of low-price building material distributors have established themselves in the Swedish market.

Many people are employed within the construction industry; in 2010 the figure was 305,000 which corresponds to approximately 7% of all those in gainful employment. The majority of those employed within the construction industry are trade union-affiliated. The number of building site workers who can have an effect on the energy-efficiency of buildings when they are completed or renovated is approximately 100,000. Some of these can also have an effect on the systems for renewable energy. Many building companies are very small, basically one-man firms. The number of such companies is estimated at 11,000. The annual turnover of the construction industry, i.e. investments made within the construction industry, amounted to SEK 255 billion in 2000, which corresponds to 8 per cent of the GNP. Within the construction industry, there are workers who do not pay income tax, but payments to them are however estimated to amount to less than 4 % of the total investments made in the construction industry.

The proportion of low-energy buildings in new production is still low, on average under 2 %, or 350 apartments per year and, on average, under 0.25 % or 8 commercial premises per year, over the last ten years. This percentage is expected to rise in the coming years - in 2010, 7 % of new homes were low-energy buildings. Up to now, the number of annually renovated apartments is 24,000, but in only a very small number of these has the energy performance been considerably improved. Many operators within the building sector believe however that there will be an increasing demand for energy-efficiency, both from authorities and private purchasers. There are few grants available for energy-efficient building. Those that do exist are for the installation of solar cells and panels. The results up to now show that the total energy use for heat and hot water in buildings has not changed to any great degree, despite the increase in terms of square metres floor area. On the other hand, electrical use, primarily in commercial premises, has been on the increase since the 1970s.

According to the proposals of the Swedish Energy Agency, the introduction of nearly zero energy buildings (nZEB) would mean that the current minimum energy requirements for new buildings, in accordance with the building regulations of the Swedish National Board of Housing, Building and Planning, would be halved. As a first step in this process, it is proposed that 25 % of all new buildings should be nearly zero energy buildings in 2015. The target for major renovations is proposed to be set at 80 % of the current requirements of the Board's regulations and the first interim objective, for 2015, is that 40 % of major renovations reach this target. Since a great deal of time will pass before all buildings are replaced with new buildings, existing building must be made more energy-efficient so that the overall climate goals can be achieved.

The Government has drawn up a communication based on, inter alia, information provided by the Swedish Energy Agency, in which it is principally current nearly zero energy buildings that are defined as those that satisfy the energy requirements found in the regulations of the Swedish National Board of Housing, Building and Planning. Closer adherence to these regulations is to be progressively implemented, with checks to be carried out in 2015. A number of promotional measures to facilitate the implementation of the requirement for near zero-energy buildings are proposed, i.e. more demonstration projects and initiatives that improve the skills of certain key groups.

In 2009, when the proportion of renewable energy already amounted to 47 %, a decision was taken that, in 2020, renewable energy should account for at least 50 % of total energy use.

There are still no regional energy policies or strategies stating how the 2020 goal is to be achieved. On the other hand, there are examples of plans and environmental programmes at local, municipal and county level which make strict demands of energy use in buildings. This makes it more difficult however for the building industry to produce uniform concepts for low-energy buildings.

The most important educators for skilled workers within the building industry are the upper secondary schools, independent trainers and vocational colleges. None of the education currently offered addresses explicitly energy-efficient building. However, there are formulations which allow education concerning energy-efficient building in the curriculum of the upper secondary school. There are a few examples of vocational training with special emphasis on energy efficient construction being established.

Some vocational development or training is given by companies, by the Swedish Construction Federation's Entrepreneurs' School, within the educational activities of the industrial organisations and under the auspices of the installers and material suppliers, but this is limited in terms of elements related to energy-efficiency and renewable energy for buildings. Passive house centrum holds a two-day course in passive house construction for building workers, which attracts 20-25 participants per year. There is also a recently started and on-going project which is aimed at producing relevant vocational development for skilled workers within the construction industry.

Several accredited organisations certify skilled working within the building sector. A number of certifications are related to energy-efficient building and renewable energy.

The majority of skilled workers need further training with respect to new low-energy buildings, the renovation of low-energy buildings and the use of renewable energy. In the long term, all such workers will have to undergo vocational development for these subjects. If all new build is to satisfy the requirements for low-energy use, and all renovations are to be improved so that they meet the minimum requirements with regard to energy performance in 2020, this means that approximately 100,000 craftsmen will have to undergo vocational development within the next 8 years. According to a first analysis an acceptable period for education is thought to be 1-3 whole days. At least 500 specially trained instructors will be required for this. The basic training for skilled workers needs to be supplemented with training related to low-energy buildings. At least 1,500 instructors will be required for this. Building site management will also need to undergo similar vocational development. This group consists of approximately 15,000 technicians/engineers. However, a building will not be energy-efficient if not requirements are made and if not planned and designed to be energy-efficient.

Potential obstacles to the implementation of the training are financial, institutional, cultural and social factors, as well as a lack of time, in addition to the fact that too few low-energy buildings are being built or are carrying out low-energy renovations. However, a slight increase is noticeable. Many of these obstacles could be overcome if the demand for energy efficient buildings increased strongly.

Facts

- In 2010, 305,000 workers were employed within the construction industry, of whom approximately 250,000 worked specifically with buildings. Of these, approximately 160,000 were craftsmen.
- In 2010, the total energy use was 411 TWh, of which buildings were responsible for 166 TWh, with 58 % deriving from renewable energy.
- The goal for 2020 is to reduce the total energy use by 20 % and by 25 % within the building

sector.

- Approximately 100,000 skilled workers within the construction industry need to receive vocational development in order to achieve the 2020 goal: 8,000 bricklayers, 4,200 concrete workers, 32,200 construction woodworkers etc., 2,000 roof fitters, 1,500 insulation fitters, 1,500 glaziers, 13,500 plumbing and HVAC contractors, 8,500 ventilation installers, 4,700 cooling technicians, 23,650 installation electricians and electrical fitters, 1,200 other construction tradesmen, 300 steel construction fitters and sheet iron fitters. Building site management will also need to undergo further training and this amounts to 15,000 technicians/engineers.
- The basic training offered by the upper secondary schools will be supplemented and vocational development at vocational colleges and training companies will be implemented in order to provide a broad general grounding and overall view of the construction of energy-efficient building and low-energy renovations, as well as renewable energy sources and systems. In addition to this, more detailed skills connected to their own field of operation is required for bricklayers, concrete workers, construction woodworkers, roof and insulation fitters, glaziers, plumbing and HVAC contractors, ventilation installers, cooling technicians, installation electricians and fitters, steel construction fitters and sheet iron fitters. At least 1,500 instructors will be required for the basic training. At least 500 instructors will be involved in the vocational development. Monitoring of the education should be possible using existing vocational boards.

1. Introduction

The energy and climate objectives for 2020 demand major initiatives from the building sector. An important investment in this work is the improvement of skills within this sector of the labour market. The EU programme Intelligent Energy Europe has therefore initiated a project area known as BUILD UP Skills. It will run for 18 months from November 2011 and involves 20 countries across Europe, where each country runs their own project based on their country-specific conditions. 10 more countries joined during 2012.

The aim is to establish a roadmap and platforms for vocational development and skills improvement for all those who work on building sites, i.e., tradesmen, construction workers and system installers. Further education primarily concerns the construction of energy-efficient buildings, as well as learning how to install systems for renewable energy and carry out low-energy building renovations. In Sweden the project will also include a review of basic training, since it is believed that this supports the improvement of skills within all of these areas.

One of the fundamental goals of the project and this report is to conduct an analysis of the current status of the building sector, to review current and planned strategies for education within the field of energy, the skills which are required on the building site and how the obstacles that exist can be overcome. Subsequent stages involve the making of decisions regarding the production of a roadmap and platforms, the implementation of which will then be guaranteed.

The report is financed to the tune of 75 % by the EU's Intelligent Energy Europe (IEE) programme.

2. Objectives and methodology

1.1 Aim

The aim of this report is to establish the current level of knowledge and the type and scope of vocational development required by skilled workers within the construction industry in order to achieve the energy targets for buildings in 2020. The most important vocational categories of workplace-based roles are included in the area of application.

The main operators that provide further training and education/qualification systems/certification for the building of energy-efficient building and plants for renewable energy will be identified. The current status of the building sector and its workforce will also be analysed, as will the national strategies for energy and vocational development.

The skills gap between the current situation and the needs for 2020 as far as skills development is concerned will be estimated (data primarily from WP3).

An identification and preliminary analysis shall be conducted of obstacles which may be due to the lack of qualifications of the construction workers (data primarily from WP3) and obstacles to the implementation of an improvement in skills which could prevent the nation from achieving the 2020 targets for the building sector (for example: language issues for guest workers, the fragmentation of the building sector, the lack of coordination between trades and professions, work insecurities, the specific difficulties that small and medium-sized businesses have in gaining access to training, etc.)

1.2 Method

Information will be gathered through desk research and interviews/questionnaires with relevant market operators. The project group (8 organisations) and the reference group (33 organisations) will assist with the collation of the information and give feedback on the results. The results will be accounted for, described, analysed and summarised in the report.

The work has been divided up into a number of subassignments:
Assignment 1. The current situation regarding the national system for vocational development within the building sector.
Assignment 2. The current existing education, qualification and certification system.
Assignment 3. The current (and planned) status of the building sector.
Assignment 4. The current (and planned) energy policy and strategy.
Assignment 5. The current (and planned) vocational development and training policy and strategy.

Sections 7 and 8 are partially based on WP3 Identification of skills requirements, obstacles and solutions.

1.3 Target group

The target groups for this report are the building industry (property developers, building contractors, installation engineers, manufacturers, trade unions) and educators (public and private).

3. Characterisation of the building sector

3.1 General

Professional building in Sweden is carried out by a workforce that is relatively well-educated, as far as its consultants and operatives are concerned. However, according to Sweden's Building Commission, the level of education within the building sector is lower than elsewhere in the labour market (Swedish Agency for Public Management, 2009). The difference in the level of education primarily concerns the number within the building sector that has continued to study after leaving school. The percentage is

low, at only 8 per cent, whilst the corresponding figure for the labour market as a whole is 28 per cent. However, in the long term, skills levels in the sector are increasing, due to retirements, as the majority of new skilled workers have a three-year upper secondary school education and engineers who previously had an upper secondary school education are being replaced by engineers who have been educated at a vocational college or at a university college/university.

The building sector can be described as fragmented, in terms of its various branches and organisations (Swedish Agency for Public Management, 2009). Within certain branches of the industry there is a lack of competition. The demand within certain parts of the building sector, for example the construction of new homes, is strongly dependent on the economic climate. A certain market concentration can be found in the market for building contractors. Material manufacturers are powerful and are often a part of international groups of companies. Internationalisation can also be seen in the increased number of foreign building trade companies operating in the Swedish market. On the other hand, competition from foreign companies has not increased in any significant manner in the installation engineers market (Swedish Agency for Public Management, 2009).

An analysis of the prevalent market conditions states that foreign companies still face considerable entrance barriers, primarily in the form of informal contact between already established companies.

The building process is often described as fragmented, with a number of stages where each new stage is taken over by a new operator. The building process is usually divided up into six different stages:

- The planning stage
- The ideas and programme stage
- The design stage
- The purchasing stage
- The construction stage
- The administration stage

The planning stage
At the planning stage, the municipality establishes a structure plan and a local plan.

The ideas and programme stage
At the ideas and planning stage, all the known preconditions and requirements applicable to the construction are described in a building programme and, through configuration, it is determined how the building is to be designed. The work is usually led by the property developer's project managers.

The design stage
At the design stage, the construction documents are drawn up; these describe in detail the building and its method of construction. This stage of the work is also usually led by the developer's project managers.

The purchasing stage
In the purchasing stage, tender documentation is formulated and tenders are received from the various contractors. Those who are to be involved in the construction are selected. There are different types of contract form which the developer can draw up and use for procurement, including design, bid & build contracts and design & build contracts.

Implementation contracts imply that the developer, with the help of consultants, produces the construction documents and the tender documentation and that they therefore dictate the implementation of the project.

Instead of design, bid & build contracts, the developer can choose a design & build contract – something which is becoming increasingly common. This implies that the contractor is already engaged prior to the design stage, and that they take responsibility for the whole design and the entire construction stage. Accordingly, the design & build contractor may also handle the procurement from any other contractors/subcontractors that may be deemed necessary.

Other new contract forms have also been developed of late. The design & build contractor often becomes involved at an earlier stage. There are also examples of design & build contractors who

handle both the construction and property management stages. The latter has, for example, been carried out by Skanska for a number of properties, and by NCC for roads.

"Partnering" is often talked about in this context, which is a close collaboration between developer and contractor where they often work with common cost targets and share profits or additional costs through an "incentive contract". Partnering implies that the property developer, the consultants, the contractors and other key operators collaborate to complete a construction task. This whole concept is based on a collaboration of trust, where the intentions of each party are clearly visible and where the vocational skills of each party complement each other's at all stages of the construction process. In this way, the traditional "relay race", where the various operators are involved in the process for a limited period of time, can be avoided. With partnering, the skills of all parties are utilised and everyone works together in the project from start to finish.

The construction stage
In the construction stage, groundwork and foundation-laying work is carried out, followed by concrete frameworks, supplementary concrete frameworks, installation work and interior fittings work.

The administration stage
In the administration stage, the service and maintenance are taken care of, and if required, at a later stage, even rebuilds, additions to buildings or demolition work.

In 2010, the construction industry employed 305,000 workers and investments in construction, i.e., investments in new and renovated properties and investments in plant establishments, amounted to SEK 266 billion, which corresponded to 8 per cent of the GNP (see also section 5.1. The Building Sector). The vocational categories within the construction industry which are encompassed by the analysis of its current state can be split into construction workers, plumbing and HVAC engineers, electrical installation engineers and others (see table 3.1).

Table 3.1 Vocational categories within the construction industry encompassed by the analysis of its current state.

Construction workers (BYN - The Swedish Construction Industry Training Board)
Steel fixers
Concrete workers
Floor-layers
Hole punchers
Machine operators, crane drivers
Bricklayers
Tilers
Scaffolding constructors
Pavers
Roof fitters, Suspended ceiling fitters
Woodworkers/Carpenters
Plumbing & HVAC engineers (The vocational board of the plumbing and HVAC industry)
Insulation fitters
Ventilation fitters/technicians
Ventilation platers
Plumbing and HVAC fitters including installers of systems for renewable energy
Plumbing and HVAC technicians, automation and control technicians, adjusters
Electrical installation engineers (Central Committee of the Electrical Trade for Vocational Training)
Electrical installation engineers
Others

Site engineers
Surveyors
Construction workers involved with the prefabrication of buildings
Sheet metal workers
Glass fitters
Authorised Supervisor
Blacksmith
Control and surveillance engineers

3.2 The most important parties

The most important parties in the construction process are the developer/administrator, consultants/architects, contractors, manufacturers. These parties are represented within the various industry organisations (see table 3.2).

Table 3.2 The major industry organisations within the building sector.

Organisation	Industry
The Swedish Construction Clients Forum	This is a trade association for developers which has approximately 130 members
The Swedish Construction Federation	The construction industry and employers' association which has approximately 3,200 member companies
The Swedish Association of Plumbing and HVAC Contractors	The industry and employers' association for companies operating within plumbing and HVAC. It is also an employers' organisation for companies operating with refrigeration, industrial pipes, ventilation and technical insulation and has approximately 1,450 member companies.
EIO	The Electrical Installation Engineers' Organisation is the industry and employers' organisation for Sweden's electrical and telecommunications companies which has approximately 2,600 member companies.
Byggmaterialindustrierna (The Building Material Industries)	An industry association for building materials companies with approximately 1,000 member companies
Glasbranschföreningen (The Glass Industry Association)	An industry and employers' organisation with just over 550 companies as full members and approximately 40 companies as associate members. The number of employees within the member companies is approximately 2,500.
The Contractors' Association	The Contractors' Association (EPF) is a joint venture by the PLR (Plåtslageriernas Riksförbund - National Association of Sheet Metal Workers) and the MVR (Mekaniska Verkstädernas Riksförbund - National Association of Mechanical Workshops). The EPF is the service company.
Svensk Betong (Swedish Concrete)	The industry organisation for ready-mixed concrete and concrete panel manufacturers.
Svensk Ventilation (Swedish Ventilation)	Swedish Ventilation represents approximately 100 ventilation companies, including manufacturers as well as installation companies.
VVS-fabrikanternas Råd (The Plumbing and	The industry organisation for the plumbing and

HVAC Manufacturers' Council)	HVAC industry with 67 member companies
TMF	The industry and employers' organisation for the wood processing and furniture industry in Sweden, with approximately 750 member companies.
The Swedish Property Federation	This is a trade and industry association for property owners with approximately 17,000 members.
Fastigo	The property industry and employers' association with approximately 1,300 members employing over 20,000 workers.
SABO (Swedish Association of Public Housing Companies)	Industry and trade organisation for approximately 300 public housing companies. In total the member companies own and manage almost 730,000 homes, i.e., approximately 30 % of all apartments.
The Swedish Federation of Consulting Engineers and Architects.	This is an industry and employers' organisation for Sweden's architects and consulting engineering companies within the building and industry sector, with approximately 700 member companies.
Swedish Association of Architects	Trade association and trade union organisation for all of Sweden's architects, interior architects, landscape architects and spatial planners with over 11,500 members.

The property developer is more often than not the property owner (The Swedish Construction Clients Forum 2012). In total there are 99,115 property owners, of which 20,000 are tenant-owners' associations, 2,374 are public operations, 49,905 are limited companies, etc. (Boreda 2012). There are approximately 40 property owners valued in excess of SEK 10 billion. The ten largest are presented here (see table 3.3).

Table 3.3 The ten largest property owners in 2011 (Fastighetsvärlden 2011).

Company	Value, SEK billion	City
Vasakronan	76.1	Stockholm
Akademiska hus	48.8	Göteborg
Svenska Bostäder	35.6	Stockholm
Castellum	30.3	Göteborg
Diligentia	29.8	Stockholm
Stockholmshem	27.5	Stockholm
Fabege	26.6	Stockholm
Humlegården	24.0	Stockholm
AMF Fastigheter	23.5	Stockholm
Wallenstam	22.6	Göteborg

Many public housing companies are members of SABO, the Swedish Association of Public Housing Companies, which is the trade association and industry organisation for approximately 300 public housing companies. SABO affiliated companies can be found throughout Sweden and are of many different sizes - with everything from 115 up to 23,600 apartments. SABO affiliated companies are important players in the Swedish housing market, both locally and nationally. Together, the member companies own and manage almost 730,000 homes. The total area of the premises of the SABO affiliated companies amounts to 7.8 million square metres.

The Swedish Property Federation is a trade association and industry organisation with just over 17,000 members. The majority of the members are property owners with rights of tenancy for homes, premises and industrial properties. The others are tenant-owners' associations. The private property owners own in total around 80,000 properties comprising 700,000 apartments. They also own approximately 80 per cent of all commercial premises.

There is quite a number of consulting firms, such as large companies like ÅF, WSP, Ramböll, Sweco, Grontmij and Tyréns (not stated in order of size) in addition to a number of smaller companies. The Swedish Federation of Consulting Engineers and Architects is an industry and employers' organisation for Sweden's architects and technical consulting firms within the building and industry sector. It has almost 740 member companies, which together employ approximately 30,500 and as such, the affiliated companies represent almost two thirds of those operating in the industry.

There are a number of larger contractors and many smaller ones. The seven largest construction and plant contractors with more than 500 employees are Peab, which was the largest in 2010 (Swedish Construction Federation 2012), followed by Skanska, NCC, Svevia, JM, Infranord and Veidekke Sverige (Veidekke Sweden). Building contractors represent the largest category of operators within the various branches of the building sector with a combined turnover in 2007 of approximately SEK 227 billion, which is an increase of approximately 55 per cent from 2002 (Swedish Agency for Public Management 2009).

As far as installers are concerned, there are a number of major companies such as YIT and IMTEC (NVS, NEA and Sydtotal) each with more than 1,000 employees. In addition to this, there are a number of medium-sized electrical firms and several thousand smaller firms.

Manufacturers of construction and installation products: The Building Material Industries is an industry association for Sweden's building materials companies, whose 1,000 member companies have a combined annual turnover of more than SEK 130 billion. The Plumbing and HVAC Manufacturers' Council's 67 member companies manufacture, import and export. The combined annual turnover is SEK 16 billion, which constitutes approximately 85 per cent of the turnover of construction and installation products. Exports amount to SEK 7 billion. Within the installation sector there are a number of world-leading Swedish industrial companies such as Camfil, Swegon and IVP, etc.

A high degree of prefabrication is common, primarily in the production of one-family houses. In 2010, small, prefabricated houses to a value of SEK 9.8 billion were produced and for the previous year, the figure was SEK 8.5 billion (TMF 2010).

The property manager and the property owner are more often than not the same. As mentioned previously, there are a number of larger operators, several of which are involved in the energy-efficiency work through their participation in the BELOK or BEBO purchaser group. BELOK, the purchasing group for commercial premises, is a network and a collaboration between the Swedish Energy Agency and sixteen of Sweden's major property owners who are involved with commercial premises. The sixteen property owners are responsible for approximately 25 % of all commercial premises. BELOK's task is to be an objective party and to run development projects where energy-efficiency and environmental issues are common denominators amongst its members in their

properties. BeBo, the purchasing group for homes, is a collaboration between the Swedish Energy Agency and Sweden's major property owners (approximately 18) involved with housing, who are responsible for approximately 70 % of all apartment blocks. The group runs development projects specialising in energy-efficiency and environmental issues.

3.3 Trade union organisations

A large proportion of the workforce within the building sector is members of a trade union organisation.

There are two major trade union organisations for skilled workers within the construction industry - Byggnads (The Swedish Association of Construction Workers) and Svenska Elektrikerförbundet (The Swedish Association of Electricians). In addition to these there is also Svenska Målareförbundet (The Swedish Association of Painters and Decorators) and SEKO (Service and Communication). Byggnads is involved with employees within the construction and plant sector. Byggnads is the LO's (Swedish Trade Union Confederation) fifth largest trade union and it currently has 115,000 members within over thirty different vocational groups, including different kinds of construction workers and plumbing and HVAC engineers (see section 5.3 also). Furthermore, there are also members from upper secondary schools. Pupils studying building or energy programmes at upper secondary schools can be members for free. Svenska Elektrikerförbundet (The Swedish Association of Electricians) is a trade union-affiliated vocational association that is involved within the fields of electrical installation, private power stations, radio and TV and other service sectors. Elektrikerna, or Svenska Elektrikerförbundet, SEF, which is the official name of the association, has, on average, 25,000 paying members each year. Of these, 21,000 are professionally active. A further 2,500 are student members.

In supervisory roles that are closely related to production, membership in one of the trade union organisations Ledarna or Unionen is common.

For university-educated engineers and civil engineers there is the trade union organisation, the Swedish Association of Graduate Engineers, which has approximately 132,000 members.

There are also a number of trade associations based on individual membership that do not conduct any trade union-affiliated activities. Swedvac, the Swedish Society of HVAC Engineers, SBR Byggingenjörena (Building Engineers) and SVR, the Swedish Society of Civil and Structural Engineers are examples of such. These associations are primarily involved with different types of engineers and are in engaged in development issues, for example, within the field of energy. These organisations are therefore important information channels.

3.4 Market developments - general

The ongoing downturn in the Swedish economy is dragging the construction industry down to a low level (The Swedish Construction Federation 2012c). Investments in housing are sinking this year as the amount of new builds is reduced. However, as early as next year, housing is expected to once again act as a catalyst for investments in construction, when plant construction weakens. The positive development of investment in commercial premises prevents an even greater downturn from occurring this year and contributes to the upturn that will be seen in 2013.

In Sweden, the downturn in the economy which started in the last quarter of 2011 is continuing. Weak global growth is slowing down foreign trade and households are keeping a tight rein on their spending. The effect of the slowing development of the GNP, which has arisen as a result of the debt crisis within the Euro-region, is expected to subside during the autumn and the Swedish economy should fair somewhat better (The Swedish Construction Federation 2012c)in 2013.

The impaired pace of growth in the economy and the still pessimistic view of development held by householders means that the number of new homes under construction will be lower in 2012-2013 than last year. This year, the demand for services where a tax reduction for construction services in household properties has also declined, which has led to a fall in the level of investment for renovation. Next year, the repairs of the property owners to their rental stock should start to take

effect, which will lead to the volume of rebuilds increasing, at the same time as investment in new builds should start to increase again.

There is still a major need for both new builds and the improvement of older housing stock.

Investments in commercial premises are expected to increase during the forecast period. For the private construction of commercial premises, 2012 will however be an off year, as several projects will be postponed. Investment growth will not start until next year, when the state of the market is expected to improve. Public investment in commercial premises follows previously advised plans and continues to show positive growth throughout the whole forecast period.

R&D and innovations

SBUF, the Development Fund of the Swedish Construction Industry, which was founded in 1983, is the construction industry's own research and development organisation. SBUF works for the development of the building process so that better commercial conditions are created for contractors and so that electrical contractors can benefit from research and conduct developmental work. SBUF is backed by the Swedish Construction Federation, the Swedish Association of Plumbing and HVAC Contractors, Ledarna, Byggnads and SEKO.

An SBUF funded survey shows that the majority of Sweden's fifty largest construction and plant contractor companies are involved in R&D and innovation (Bröchner 2006). A major part of new development involves processes and systems which are supported by the opportunities presented by today's information and communications technology. This can affect both productivity and quality. The construction companies will, typically, be involved in research, development and innovations in close collaboration with other companies, within and outside of their own industry.

Their collaborative partners in their research, development and innovation work are primarily their customers, i.e., those who would normally be called property developers, but they may also collaborate with a combination of suppliers of materials, components, IT, architectural services and technical consulting services. The collaboration pattern shifts however and involves various different activities with which the company is involved. The major construction companies also collaborate cross-border within EU supported projects.

The survey indicates differences between the larger and smaller companies. Even the smaller companies can often have a wide area of operation. On the other hand, they almost always lack their own research educated employees, and it is even less likely that these companies collaborate with colleges and research institutions.

New contract and collaboration forms

Both purchasers and builders within the construction and plant industry want to see an increased usage of design, build & operate contracts within public procurement (Swedish Competition Authority 2012). This would increase the interest of contractors in investing in research and development and encourage them to highlight other competitive means than just the price in procurement procedures.

A design, build & operate contract constitutes functional requirements being established during the procurement procedure. This allows the contractor to implement the contract in the most suitable manner, as long as the construction/plant fulfils the set functions.

Partnering

One of the trends within the building sector is the application of partnering (Swedish Competition Authority 2012, see also section 3.1 General), which is a way of working where, for example, purchasers, suppliers, architects, financiers, developers or consultants look for a mutual and effective form of collaboration where the parties, inter alia, contribute with their experience, skills and financing, in order to achieve a common goal.

This form of collaboration is primarily intended to be used in major, complex contracts and the aim is to create a more efficient construction process and to minimise the project time, share the risks, reduce costs and improve quality.

Increased import of building materials

In many other markets, within for example the motor vehicle, grocery and furniture industries, prices fall whilst the price of building materials remains high (Swedish Competition Authority 2012). Within Scandinavia, there can be a difference of up to 65 per cent between the lowest and the highest prices of, for example, plywood and gypsum wallboards. The highest prices can be found within the electrical and plumbing and HVAC industries.

In recent years it has become easier to import building material and more and more low-price building material distributors have established themselves in the market. Many larger companies purchase or plan to purchase building material from, for example, China and Poland. In the long term, this could lead to lower prices in Sweden. Even wholesalers within the plumbing and HVAC and electrical industries have started importing to a greater degree than before.

3.5 Market developments – low-energy buildings

There is still no national register in Sweden of low-energy and passive buildings, and there is only limited information on the actual (measured) energy use of the existing low-energy buildings.

A study from 2010 (Andresen 2010) estimated that in Sweden less than 1 % of all building categories can be described as low-energy. This figure is however expected to rise sharply over the coming years. There are already a number of property developers/managers who are constructing low-energy buildings, i.e., ByggVesta (apartment blocks), Eksta Bostads AB (apartment blocks) and Svenska Hus, and others carry out low-energy renovations, i.e., Alingsåshem (apartment blocks), Vasakronan (offices) and Göteborgs lokalförvaltning (schools). The same study provides figures for the number of buildings/apartments based on the various categories of buildings that were built in Sweden as passive buildings, plus energy buildings or green buildings during the period 2005-2010. Homes were the most prevalent type of building that were built in accordance with the voluntary passive house criteria (Nollhus 2012). Out of the total number of homes built, only 0.6% of detached or semi-detached houses / terraced houses and 0.8 % of apartment blocks were built as passive buildings (a total of 1,070 completed units out of a total of 145,000 homes produced). Two detached houses were built as plus energy buildings. During the same period, four schools were built with the help of passive house technology, whilst over thirty offices were built as Green Buildings, which is an insignificant figure compared with the approx. 20,000 standard office buildings which were built.

Improving the energy-efficiency in existing building is also on the agenda for many property owners, research institutes and contractors. The figure for renovated apartments with considerably improved energy performance up until 2010 is, however, very low.

The introduction of real low-energy buildings into the Swedish market has been slow, but over the last two years, the market share has increased, according to a study from 2011 (Wahlström 2011). Of the homes built, the percentage of low-energy buildings was approximately 0.7% in 2008, 2.2% in 2009 and 7.2% in 2010, according to the study. The majority of the new built low-energy buildings were apartment blocks.

The interest in real low-energy buildings is rather substantial at the moment and several projects are in the planning stage. Many operators within the building sector expect to encounter tougher demands with regards to energy-efficiency, both from authorities and private purchasers.

At the start of 2011, there were very few government subsidies encouraging the construction of energy-efficient buildings. Exceptions are subsidies for the installation of solar cells (max 60 %; from 2012, 45 % of the cost of the investment, or SEK 2 million) and solar panels (max SEK 7,500 per apartment or SEK 3 million per project). Furthermore, there are subsidies provided for the replacement of old oil-heated boilers or electric boilers with more energy-efficient heating systems. The Swedish Energy Agency has, since 2006, through various programmes, supported demonstration projects that

can be used as examples of the construction of energy-efficient buildings and that have a great potential. The latest programme, LÅGAN www.laganbygg.se for buildings with very low energy use was started in 2010 in order to

- stimulate energy-efficient new and rebuilds,
- to make visible a national market for buildings with low-energy use,
- to help establish a wide national range of suppliers of products and services and to secure purchasers of such.

LÅGAN gives funding to demonstration projects and regional / local collaboration initiatives. The programme also focuses on providing support to the development of ideas through evaluating and disseminating information from demonstration projects.

An interesting initiative for public housing companies is Skåneinitiativ, an initiative launched by SABO-affiliated companies in 2007. 80 companies have proposed an objective that means that the companies involved shall reduce their energy use by 20 % between now and 2016. Participation in the initiative is voluntary and all housing companies in Sweden are welcome to become involved. At the start of 2012, 107 member companies with 393,568 homes had endorsed the initiative, i.e., more than half of all the homes under the auspices of SABO.

Examples of a regional stimulation of low-energy buildings can be found in e.g., Skåne, Stockholm, Östersund.

Miljöbyggprogram syd (Environmental Construction Programme- South in Skåne), is a collaboration between the City of Malmö, Lund Municipality and Lund University (see section 4.4 Regional Energy Policy…).

Stockholm's environmental programme for 2012-2015, has been produced by the City of Stockholm (see section 4.4 Regional Energy Policy…).

In Östersund, it has been decided to support low-energy buildings with a financial incentive. If a building within the municipality is built in accordance with the Swedish passive house definition, charges are repaid in respect of building permits, maps, city plans and, where applicable, private water and sewage disposal.

Other incentives are the various environmental and energy systems/classification systems used for buildings. In Sweden, a number of different energy and environmental classification systems are used for buildings. The most common are Miljöbyggnad, BREEAM and LEED. During 2011, the market for and interest in environmental classification systems for buildings and city districts have increased sharply. The different systems vary in their scope and the aspects that can be considered important for the safeguarding of sound environmental performance. The energy performance of the building is stated in all systems, but ambitions vary.

3.6 Guest workers and foreign contractors

There has been increased internationalisation within the construction market, both in the production and administration phases. The use of foreign labour and subcontractors (often subcontractors to Swedish companies) has increased sharply during the economic boom of recent years. This trend may now reverse, as a result of the weaker construction market and a lower utilisation of capacity. There are currently 45 foreign companies registered with the Swedish Construction Federation (BI) that do not have Swedish corporate identification numbers, and 21 companies that are registered for Swedish tax clearance (Lager 2011) This is a total of 65 companies. There are currently 3,160 members of the Swedish Construction Federation.

An increase in wage levels in the new EU countries and the conscious strategy of, inter alia, Poland's government, to get construction workers to return home, so that there is an adequate skills base in their own country, are other reasons that could temporarily reverse this development over the coming two years.

Companies within the building sector are hiring foreign personnel more regularly. The workforce comes from low-pay countries both within and outside of Europe. According to Byggnads, there is a sharp increase (Sydsvenska Dagbladet 03-02-2012) in terms of workers who come from a third country, i.e. from outside the EU. Four years ago, Swedish construction firms applied for permits to

hire 25 workers who were not EU citizens. Last year, the figure had risen to 1,137 work permits, according to Byggnads. This sharp increase is probably due to the fact that the national regulations for workforce migration have been changed during this four year period.

It is even more common that companies hire in labour from other EU countries. In these cases, no permit is required at all and there is therefore no information regarding the extent of this mobility.

There are no statistics regarding how common it is to hire foreign labour. When LO (the Swedish Trade Union Confederation) investigated the construction of the City Tunnel in Malmö, Citybanan and Norra länken in Stockholm, the organisation's report showed that approximately 45 per cent of the personnel had been hired in from other countries. In these cases, the percentage of foreign skilled workers and companies is due partly to the conscious strategy of the Swedish Transport Administration to make the Swedish construction market more competitive, and partly that there is lack of suitably educated personnel in Sweden with the necessary construction-oriented qualifications.

The problem, as LO sees it, is that foreign personnel risk receiving worse pay and working conditions, which consequently distorts the competition (Jonsson 2010).

Foreign labour is hired for major and minor projects; it could be a City Tunnel or a tenant-owners' association renovating its stairwell. The problem is that the employers get good working conditions on paper, the equivalent to those found in a Swedish collective agreement, but in practise the pay is often quite different. Companies that break these rules can cut their costs substantially, according to lawyer Claes-Mikael Jonsson, co-author of the LO report.

A common procedure, according to Claes-Mikael Jonsson, is for Swedish or foreign construction companies to hire in a certain percentage of their workforce through foreign recruitment agencies. This development has increased over the past two years, since the financial crisis. This is primarily due to the major differences in wage levels that exist between the various EU countries. The EU expanded as long ago as 2004, but it is only now that this company structure has established itself.

Byggnads (the trade union for all construction workers in Sweden) is inquiring after a better control system. The industry organisation The Swedish Construction Federation is also positive to more controls, but recognises free competition of equal terms.

Companies may hire foreign personnel for reasons other than their level of pay. The employer may need skills which are available overseas; this is also the case in several of the major plant construction projects. Foreign workers are often more flexible and work when they are required - important prerequisites for competitiveness. This may involve working intensively for four working days or changing working hours, so that machines can be utilised and production kept running. It is completely natural for workers to want to work longer shifts and in concentrated periods when their place of work is a long way from home. This also applies to Swedish skilled workers who operate abroad, for example, in Norway.

Byggnads is currently (April 2012) conducting an investigation into, inter alia, the extent to which foreign contractors are operating in Swedish building sites around the country, what the situation looks like in various construction companies, etc.

3.7 The informal economy

Within the construction industry, there are illegal workers. According to the assessment of the Swedish Tax Agency, the tax shortfall in 2007 was approximately SEK 130 billion per year, i.e., 5 % of the GNP, of which SEK 65 billion was estimated to be the result of non-payment of income tax (Swedish Tax Agency 2008). A rough estimation suggests that the construction industry is responsible for SEK 10 billion, i.e., approximately 4 % of the total sum invested in construction. Four industrial conditions are particularly conducive to the non-payment of taxes within the construction industry: the project format, informal networks, industrial culture and the antagonism which exists between large and small companies within the industry (Brå - The Swedish National Council for Crime Prevention 2007). The

industrial conditions present opportunities for breaking the law and create space for neutralisations, i.e., excuses that people use in defence of their criminal actions.

The project format
The construction industry is almost entirely based around projects, that have a clear beginning and end. Each construction project is to some extent unique and requires individual planning. The nature of the activity makes it difficult to calculate exactly how much time is expended, how much labour is needed or how great costs will be. The activity also implies long-term insecurity; one cannot employ more people than one can afford to pay on an ongoing basis; at the same time, one may need to employ more workers if one procures a major assignment.

Informal network
The informal networks that exist within the construction industry are due, to a large part, to the project format where the insecurity that project work entails creates the need for informal solutions. New projects also mean new contacts. The informal networks imply that many within the construction industry know who they should turn to if they need "a favour", whether that be legal or otherwise. Great loyalty may exist within these networks.

Industrial culture
There are a number of predominant perceptions concerning attitudes and actions that are acceptable, for example, pride, loyalty and professional skill. There are also notions regarding a man's responsibility to provide for his family and codes of silence. An example of neutralisation could be that someone does not pay income tax on the pay he receives - but that he does a good job. This is one notable conclusion drawn from the Brå study, and is worthy of discussion.

Antagonisms between small and large companies.
Small and medium-sized companies can sometimes feel that they are being used by the bigger companies. This (real or perceived) utilisation can sometimes create situations where non-tax-paying labour is hired in order to resolve a situation which someone might not consider to be their responsibility.

What crime looks like on the building site
Organised trade with illegal workers is characterised by "black money", i.e., income, from otherwise legal work, which is used for "black wages" on which no tax is paid. The customer in a law-abiding society pays with "white money" for a service that is being carried out "black". This often requires adaptations being made by the "black" side, in order to hide the fact that the construction work has been carried out with illegal workers. An example of this adaptation is the division of a building site up into several parts; a legitimate company is hired to carry out the work which is seen from the street and in this way they ensure that the controls that should be carried out by employer organisations, union inspectors and other authorities are carried out by the legitimate building contractor. In this manner, the "black" activities going on further inside the building site can continue undisturbed.

Since 2005, employer organisations and trade unions have together been running the group "Byggbranschen i samverkan" (BBIS) (trans. The construction industry in collaboration) which, inter alia, incorporates the programme "Krafttag mot svartarbete" (trans. Crackdown on illegal workers) (Byggbranschen 2012).

Following the initiative of Byggbranschen i samverkan, a policy group working to counteract "black" labour was started in 2007.

The aim of the policy group was to combat the occurrence of "black" labour, to induce sound market conditions and change attitudes to "black" services and work for the introduction of rules that encourage "white" labour. The policy group comprises:

- BBIS (Byggcheferna/Ledarna, Byggnads, Elektrikerförbundet, Elektriska installatörsorganisationen EIO, Glasbranschföreningen, Maskinentreprenörerna, Plåtslageriernas Riksförbund, SEKO, The Swedish Construction Federation, Målareförbundet, Målarmästarna and the Swedish Association of Plumbing and HVAC Contractors)
- The Swedish Economic Crime Authority
- The Swedish Tax Agency

In 2009, it was noted that, out of the measures taken in recent years to counteract the use of illegal workers, the ID-06 system (Compulsory ID and attendance reporting for building sites) is now beginning to have a greater impact and is an established system within the market.

In December 2011, "BBIS" wrote "that it has now been three years since the government decided to introduce household tax deductions for property repairs (Byggbranschen 2012). The reform is popular; during 2010, work subject to such deductions was commissioned by 870,000 people, at a cost of approximately SEK 35 billion. This tax deduction has led to the adoption of different attitudes with regards to the purchasing of "black" labour.

The tax deduction has created almost 25,000 new "white" jobs and at the same time has changed people's attitudes regarding the purchasing of "black" services. This is described in a new report from BBIS and the Swedish Federation of Business Owners. The investigation shows that 90 per cent of companies consider that the household tax deductions for property repairs contribute to a reduction of "black labour" in the construction industry. This is an increase from the already high level of 78 per cent in 2009, when companies were asked the same question.

The rules for "ROT deductions" imply the possibility of tax deductions for repairs, maintenance and rebuilding and extensions to one-family houses, tenant-owner's apartments and owner-occupied apartments. The aim is to make "black" labour "white" and to increase the supply of work within the construction industry.

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

A number of EU decisions form the basis for the national policy and strategy:

- The EU's climate and energy policy targets for 2020: The "20-20-20" target. These are
    - A reduction of the EU's emissions of greenhouse gases by at least 20% compared to the levels of 1990.
    - 20% of the EU's energy use shall come from renewable sources
    - A 20% reduction of primary energy use compared with expected levels, to be achieved through improved energy-efficiency.
- The EU directive on energy end-use efficiency and energy services [2006/32/EC] and the cogeneration of useful heat directive (2004):
    - Annual renovation target of 3 % of publicly owned buildings
    - Energy companies shall save energy for their customers corresponding to 1.5 % of their sales
    - Promote combined power and heating
    - Financing of measures
- The directive on the energy performance of buildings [2010/31/EU], EPBD2, entails, inter alia, that the member states shall:
    - Establish requirements for energy performance in buildings (new and existing)
    - Ensure near zero-energy for all new buildings from 2021 (public buildings from 2019)
    - Develop a national strategy for nearly zero energy buildings
    - Develop a national definition of nearly zero energy buildings
    - Improve energy declarations
- Ecodesign (minimum environmental and energy requirements for products) [2005/32/EC]

4.1 Basis for the national strategy for low-energy buildings

Sweden has had an active energy policy for some considerable time with informative, financial and normative means of control (Swedish Energy Agency 2010). A number of means of control and promotional measures affect the consumption of energy and the emission of greenhouse gases from homes and commercial premises. The Swedish National Board of Housing, Building and Planning's building regulations (The Planning and Building Ordinance, BBR – the Board's building regulations and BÄR - the Board's regulations for alterations) are a central means of control for the energy use of buildings. One means of control closely connected to the Board's building regulations is the energy declarations. Other important means of control are the energy and carbon dioxide taxes. Buildings are fully covered by these taxes that provide financial incentives to implement energy-efficient measures and phase out the use of fossil fuels. The introduction of the municipal property charge for homes since 2008 leads to fewer property owners than before receiving increased charges when they carry out energy investments that lead to one-family houses and apartment blocks having an higher taxation value.

The Swedish Riksdag (parliament) has adopted the EU's climate and energy policy targets that shall be achieved by 2020, known as the "20-20-20-" targets. The EU's 20-20-20 target implies that we shall reduce our climatic impact by 20 per cent, achieve another 20 per cent through the use of renewable energy and streamline our energy use by 20 per cent, all by 2020. In this context, buildings play a key role, something that was underlined in the Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings. The directive states that national plans for nearly zero energy buildings should be established. In accordance with article 9 of the directive, regarding the energy performance of buildings, the member states shall ensure that all new buildings are nearly zero energy buildings, no later than 31 December 2020. In addition to this, the member states shall, in accordance with article 7, take the necessary measures to ensure that, when buildings undergo major renovation, the energy performance of the building, or the renovated part of the building, is improved so that it fulfils the minimum requirements to the extent that is technically, functionally and economically feasible. The requirements shall be applied to the renovated building or the renovated part of the building in its entirety.

In accordance with the Swedish Energy Agency (Assignment 13: National strategy for low-energy buildings ER 2010:39), the national strategy for nearly zero energy buildings shall significantly contribute to the achievement or exceeding of society's energy and environmental targets. The requirements for the specific energy use of the buildings should be made considerably more stringent, in relation to present requirements. In addition to energy requirements, other requirements regarding the technical qualities of the building shall also be satisfied. The general energy requirements for nearly zero energy buildings should, in accordance with EPBD2 be, in order of priority:

1. Very energy-efficient outer shell
2. Very energy-efficient installations
3. A large proportion of the energy required shall be renewable

Based on assessments of the current market situation and estimated technological developments, the Swedish Energy Agency proposes a halving of the minimum requirements for energy compared with BBR18 from 2011. BBR 19 from 2012 implies a reduction of 20 kWh/m²year for non-electrically heated buildings compared with BBR 18. The proposed but as yet undecided target levels for new buildings can be found in Table 4.1. The requirement in terms of the average heat transfer coefficient according to BBR18 is 0.4 W/m²K for homes and 0.6 W/m²K for commercial premises.

Table 4.1 The proposed but as yet undecided target levels for the promotion of near zero-energy for new buildings in accordance with the proposals of the Swedish Energy Agency. The levels refer to the highest permitted energy use (the energy which, with normal usage, over a normal year, needs to be supplied to a building (often known as purchased energy) for heating, comfort cooling, warm water and the energy required for the operation of the property).

	Non-electrically heated [kWh/m², year]			Electrically heated [kWh/m2, year]		
Building category/ Geographical zone	I	II	III	I	II	III
Homes BBR19	(75) 130	(65) 110	(55) 90	(50) 95	(40) 75	(30) 55
Commercial premises -basic value BBR19	(70) 120	(60) 100	(50) 80	(50) 95	(40) 75	(30) 55
- highest addition for air flow BBR19	(35) 72	(30) 59	(25) 46	(25) 42	(20) 36	(15) 29

As a first step in the national strategy for near zero-energy buildings, the Swedish Energy Agency proposes that 25 % of all new buildings should successfully pass the above mentioned levels in 2015.

The directive requires the member states to report the measures that they are implementing, i.e., targets, to stimulate the conversion of buildings that are being renovated into near zero-energy buildings. The renovation of buildings is of great importance to a conversion to a sustainable energy system. It is therefore proposed that target levels also be introduced for renovations. For major renovations, it is decreed that the target level shall be approximately 80 per cent of the requirements in BBR19 from 2012 (see table 4.2).

Table 4.2 The proposed but as yet undecided target levels for the promotion of near zero-energy for major renovations, in accordance with the proposals of the Swedish Energy Agency. The levels refer to the highest permitted energy use (the energy which, with normal usage, over a normal year, needs to be supplied to a building (often known as purchased energy) for heating, comfort cooling, warm water and the energy required for the operation of the property).

	Non-electrically heated [kWh/m², year]			Electrically heated [kWh/m², year]		
Building category/ Geographical zone	I	II	III	I	II	II
Homes BBR19	(105) 130	(90) 110	(75) 90	(70) 95	(55) 75	(40) 55
Commercial premises - Basic value BBR19	(100) 120	(85) 100	(70) 80	(70) 95	(55) 75	(40) 55
- highest addition for air flow	(50) 72	(40) 59	(30) 46	(30) 42	(25) 36	(20) 29

Furthermore, an interim step is proposed whereby 40 per cent of the renovated buildings shall fulfil the proposed target level in 2015.

4.2 The government's proposals and assessments regarding nZEB

The government has, in a written communication to the Riksdag (parliament), described the route to (nZEB) nearly zero energy buildings (The Government 2012), which is based, inter alia, on information provided by the Swedish Energy Agency (see section 4.1).

The government's assessment with regards to a Swedish application of the nearly zero energy buildings concept: ”A Swedish application of the concept of near zero-energy building, where the near zero-energy level from 2021 will generally be a legally binding level for the requirements regarding the rational use of energy imposed on all new buildings, should mean stricter requirements for the rational use of energy compared with the requirements that apply according to current building regulations – in any case, for most categories of buildings and climate zones. There is currently insufficient information to allow us to give a quantified guideline for how far-reaching reductions might be, but this will be assessed on the basis of solid data based on, inter alia, the evaluation of existing low-energy buildings, certain demonstration projects of new energy-efficient buildings and economic analyses, etc. Only reductions that are environmentally justified or are reasonable in terms of property economics and socio-economics shall be implemented. In Sweden, a review of the rational use of energy requirement is being conducted, in the light of the requirements set in the EU directive regarding the energy performance of buildings. The review has, consequently, brought about reductions. Consequently, as an example, the requirements for non-electrically heated homes in climate zone III have been tightened. The highest permitted energy use level in 2006 was 110 kWh/m²; in January 2013 it will be 90 kWh/m². In the light of, inter alia, the reductions that were imposed between 2006 and 2012, technical and economic developments and global factors that affect the construction market, our assessment is that future reviews will also lead to gradual reductions which are environmentally justified or are reasonable in terms of property economics and socio-economics. The first checks will be made in 2015 with regard to this. These recurring revisions are an important part of Sweden's strategy to approach near zero-energy requirements and gradually increase the rational use of energy requirements and work with nearly zero energy buildings.”

The government's assessment in respect of the promotional measures for knowledge and effective implementation: ”Promotional measures should be instigated to facilitate the implementation of the requirements of nearly zero energy buildings. The combined purpose of the promotional measures is twofold: to contribute, through reduced educational costs, to possibly minimising the additional costs associated with energy-efficient building, and to contribute, through improved knowledge, to the final and legally binding definition of near zero-energy building being based on sound information. The promotional measures should, inter alia, encompass demonstration projects with a greater geographical dispersion than that which has applied up until now for the construction of low-energy buildings in Sweden. The measures should also encompass initiatives that are designed to improve the skills of key groups, continual monitoring and evaluation of all technical quality requirements as well as cost aspects connected with energy-efficient buildings. Target levels for demonstration projects to be implemented should be that the energy requirement of the building should, by and large, not exceed a maximum of 105.9 kWh/m², if the building is erected in northern Sweden, or be lower than a minimum of 20 kWh/m². It should also be possible to implement demonstration projects with target levels that lie between these limit values.

The government's assessment with regards to renewable energy in nearly zero energy buildings: ”The definition of nearly zero energy buildings that is given in the directive also contains wording to the effect that the low amount of energy required should, to a very high degree, come from renewable energy sources. Sweden utilises a high percentage of renewable energy sources in its energy use, including that consumed by buildings. Sweden applies general means of control in order to support the supply and usage of energy from renewable energy sources; it sets requirements, through regulations, for energy declarations in respect of analyses of alternative energy provision systems and provides relatively advantageous conditions, in the building regulations of the National Board of Housing, Building and Planning, for heating and refrigeration systems that run on energy from renewable sources. Sweden has implemented the EU directive regarding the promotion of the use of energy from renewable sources, including the regulations which refer to renewable energy in buildings. In the light of this, it is considered that Sweden satisfies the demands set in terms of renewable energy in nearly zero energy buildings.”

4.3 National action plan for the promotion of renewable energy

The Riksdag (parliament), following the Government's proposals, has decided that the percentage of renewable energy in 2020 shall be at least 50 per cent of the total energy use (Sweden's National Renewable Energy Action Plans under Directive 2009/28/EC of the European Parliament and of the Council made 30.6.2009. Government Offices of Sweden, 2010). At the same time, the percentage of renewable energy in the transport sector shall be at least 10 per cent. The Riksdag also decided on a target whereby the use of energy is to become 20 per cent more efficient by 2020. In 2009 we had reached 47 % renewable energy (see also section 5.7).

The target is expressed as an objective for all sectors, whereby energy intensity is to be reduced by 20 % between 2008-2020. In order to reach the target of at least 50 per cent renewable energy by 2020, the Government has, inter alia, proposed the development of an electrical certification system for the renewable production of electricity. The target for new, renewable electricity, which has been decided by the Riksdag, is that it shall increase by 25 TWh by 2020.

The Riksdag, following the Government's proposals, has also decided on a national planning framework for wind power that equates to 30 TWh by 2020, of which 20 TWh refers to energy produced is on land and 10 TWh to energy produced at sea. A number of simplifications have been implemented into the trial process for wind power.

Fundamental to the long-term energy policy are general economic means of control, such as carbon dioxide tax, international emissions trading and certification for renewable electricity.

From 2009, the Swedish Energy Agency has had recourse to over SEK 1 billion for energy research. In the field of energy, the annual funding allocated to universities and colleges also increased by SEK 50 million in 2010, with a further SEK 50 million to follow in 2011 and a further SEK 60 million allocated for 2012. The financing is directed at the following areas: Large-scale production of renewable energy and its integration into the electricity supply system, electric transmission systems and hybrid vehicles, energy combines (conversion equipment where several energy carriers are

obtained as a result of the conversion), biofuel and renewable material, in addition to fundamental energy research within the areas of, inter alia, new nuclear technology and carbon dioxide separation and sequestration.

In the 2009 budget proposition, a total of SEK 389 million was set aside for investments in solar cells and biogas for the period 2009-2011. A new government support for solar cells was introduced on 1 July 2009 and, on 1 November 2009, a new government support was introduced for measures relating to the production, distribution and utilisation of biogas and other renewable gases, with the intention that 60 per cent should support technology that is not yet commercially viable. The Riksdag has approved the allocation of SEK 122 million during 2010. For 2011, the allocation is estimated to be SEK 117 million. A further SEK 50 million was provided during 2009 for the national support of solar cell installation. In October 2011, the Government decided to provide a further SEK 60 million to a 45 per cent support of the installation of solar cells (SFS 2011:1027).

4.4 Regional energy policy and strategy for achieving the 2020 targets

There are still no regional energy policies or strategies stating how the 2020 goal is to be achieved. On the other hand, there are climate and energy strategies that have been drawn up by county administrative boards, municipal energy plans and local environmental programmes with requirements for low-energy buildings.

Laws regarding municipal energy plans have been in existence since 1977. According to the laws, the municipality shall, in its planning, promote the rational use of energy and work towards the secure and sufficient provision of energy. In each municipality, there should be a current plan for the provision, distribution and usage of energy within the municipality. These plans should contain an analysis of the effect that the activities in the plan would have on the environment, public health and the rational use of land, water and other resources.

A total of 73 per cent of Sweden's municipalities had an energy plan in 2006 (Municipal energy planning - A survey of Sweden's municipalities ER 2006:40, Swedish Energy Agency). Of those municipalities that had an energy plan, just over half of them planned to revise it (and a further half of these municipalities planned to do this during 2007). Of the municipalities that still did not have an energy plan, 69 per cent planned to draw one up!

Examples of targets set in energy plans:

Alingsås' energy plan 2005-2008: Following a review of the current situation and a survey of energy provision and usage in Sweden and in Alingsås, the following opportunities for Alingsås are primarily considered:

- Energy-efficiency, i.e. consume less energy per resident.
- Continue the conversion to renewable energy sources, primarily biofuels.
- Invest in alternative fuels for transportation.
- Use electricity only for specific purposes.

Lerum's energy plan 2008: Increased investments in energy-efficiency and rational energy use. Energy use in the municipality's premises has been reduced by 10 % from 1997 to 2000 and shall be reduced by a further 5 % by 2010.

The energy and climate plan for Mariestad, Töreboda and Gullspång:
Heating

- Emission of fossil carbon dioxide-equivalents from homes, industry and the service sector shall reduce by 20 % between 2004 and 2020.
- When municipal land is assigned for home building, the use of low-energy buildings shall be encouraged.

Reduced electricity consumption

- The consumption of electricity in the home shall reduce by 10 % per resident, between 2004 and 2020.

- The consumption of electricity in municipal premises shall reduce by 10 % per resident, between 2004 and 2020.

In addition to this, there are local environmental programmes which have energy requirements. Here are some examples:

Stockholm's environmental programme for 2012-2015, has been produced by the City of Stockholm (Stockholm 2012). The environmental programme contains six directional targets and 29 detailed subtargets. With new builds, energy use corresponding to passive house standards is introduced as a target. This target applies for properties allocated land by the City. Where major reconstructions of the City's buildings involves a renovation cost constituting 25 - 40 per cent of the building's value, the target is that energy use in the building shall be reduced to the highest level allowable in accordance with the new construction norms found in the BBR (The National Board of Housing, Building and Planning's building regulations). This aspirational measure shall, in the long-term, prepare the way for the introduction of energy use levels which correspond to energy plus house standards. Stockholm's environmental programme indicates the city's ambitions as far as the environment is concerned. The purpose of the environmental programme is to guide and coordinate the city's own operational areas in an environment-friendly direction. The programme will also form the basis for collaborations with industry, local residents, organisations and authorities.

Miljöbyggprogram syd (Environmental Construction Programme- South), which is a collaboration between the City of Malmö, Lund Municipality and Lund University (Malmö 2012). The programme is primarily aimed at property developers who wish to build on municipal land and is applied to the new construction of homes and commercial premises within the City of Malmö and Lund Municipality. The programme introduces the decisions and agreements undertaken between the parties in conjunction with land allocations or other types of agreements (not exploitation agreements, however). Miljöbyggprogram syd (Environmental Construction Programme- South) initially focuses on four core areas for ecologically sustainable construction: energy, indoor health and comfort, moisture protection and urban biological diversity. These core areas are in turn divided into three different classifications: A (best alternative, principally "passive house"), B (good choice), C (basic level). The developer can himself choose class A and B; alternatively, the municipality can demand class A or B, in order to demonstrate excellence in the exploitation of specific areas. To build on municipal land, at least class C must be satisfied within all core areas. All classifications within the programme entail stricter requirements than the BBR, with regard to energy, for example.

Furthermore, each county administrative board has, in regional collaboration, drawn up a climate and energy strategy, in order to clarify the initiatives/measures which are required and how they can be implemented.

The disadvantage with the differing local energy requirements for buildings is that they make it difficult for the construction industry to produce uniform concepts for low-energy buildings. General energy requirements facilitate this.

4.5 Building code

According to Swedish building code, buildings shall be designed in such a manner that energy use is restricted through low heat loss, low cooling requirements, efficient use of heat and cooling and efficient use of electricity. Fundamental regulations and general advice are provided in the building regulations for ventilation, thermal comfort and moisture control (BBR 2012). The various regulations and general advice usually result in well-insulated buildings with controlled ventilation and heat regeneration.

Homes shall be designed so that the specific energy use in the building does not exceed 90 kWh per m² (heated usable) floor area and year in the southern climate zone, 110 kWh per m² floor area and year in the central climate zone and 130 kWh per m² floor area and year in the northern climate zone. For homes with electric heating as the main source of warmth, the specific energy use in the building

shall be 35 kWh per m² floor area and year lower than the above requirements. Energy use includes the energy supplied to a building (often known as purchased energy) for heating, comfort cooling, hot water, fans and pumps. Household electricity is not included. The specific energy use in buildings can be reduced with energy from thermal solar panels and solar cells that are installed in the building. The average heat transfer coefficient shall be lower than 0.4 w/m²K.

Commercial premises shall be designed so that the specific energy use in the building does not exceed 80 kWh per m² (heated usable) floor area and year in the southern climate zone, 100 kWh per m² floor area and year in the central climate zone and 120 kWh per m² floor area and year in the northern climate zone. For homes with electric heating as the main source of warmth, the specific energy use in the building shall be 25 kWh per m² floor area and year lower than the above requirements. Energy use includes the energy supplied to a building (often known as purchased energy) for heating, comfort cooling, hot water, fans and pumps. Operational electricity e.g. for office equipment is not included. The average heat transfer coefficient shall be lower than 0.6 w/m²K.

In principle, the same requirements apply to alterations to a building as apply to the construction of a new building. When making alterations to a building, one should always consider the scope of the alterations and the conditions in the building upon application of the requirements. The requirements for new buildings are never directly applicable upon alteration of a building. If a major part of a building is obviously renewed, then the requirements applicable to a new building may apply, if this is not unreasonable. Preservation of architecture and historical value must be taken into consideration. Reasonable U-factor requirements are given for major renovations in the building standards.

The current building standards have recently been updated - in January 2012. It is currently unknown when the next updating will be carried out. As advice in the current buildings standards, a definition is provided where a low-energy building is a building with an energy use of no more than 75% of the requirements of the building standards and, for a building with very low energy use, the maximum energy use shall be no higher than 50% of the requirements of the building standards.

4.6 The contributions of the building sector to the 2020 targets

For Sweden, the objective is that approximately half of the "20-20-20" target shall be achieved within buildings, i.e. homes and commercial premises (Government 2011). The target for 2020 will thus be a reduction in energy use in buildings of approximately 25 %, compared with 1995 levels. The dependence on fossil fuels for energy usage in the building sector shall have been broken by the year 2020, at the same time as the percentage of renewable energy shall continually increase (Swedish Energy Agency 2010).

4.7 Vocational training

There are as yet no declared policies or strategies for vocational training, in respect of the 2020 energy targets for buildings. There are no specifically declared training targets for the production of energy-efficient buildings included in the training of skilled workers within the construction industry. On the other hand, guidance documents contain general formulations concerning sustainable development and a certain degree of concretising can be found in subject and course plans. It can therefore be claimed that there is a case for these issues being included in the vocational training but the scope to which they should be included is not specified.

Within the three construction-orientated upper secondary school programmes: Building and construction; Plumbing, HVAC and property; and the Electricity and energy programme, there is an optional course available as part of the closer study programme. The course can therefore hardly be thought to reach enough pupils. The course "Environment and energy", on energy-efficiency connected corporate identification numbers, buildings and renewable energy has been in existence since 2011 (Swedish National Agency for Education 2012) (see also section 6.6. Energy-efficiency.....).

4.8 Green skills and green job opportunities

The WWF (World Wildlife Fund), BirdLife, European Environmental Bureau, Conservation international, CEE Bankwatch Network, Friends of the Earth and Transport & Environment recently produced the report ”Investing for the future – more jobs out of a green EU budget”. The report shows that the EU should invest more money in the environment and sustainable energy, as these jobs are

cost-effective and benefit the environment, in comparison with investments in traditional industries. A summary of the study is that:

- Sustainability and economic welfare go hand in hand.
- Investing in a green EU budget creates more jobs than the current EU budget. A sustainable economy produces long-term employments with gradually increasing profits.
- Both land-based green activities such as the Natura 2000 areas and sustainable infrastructures such as renewable energy have a greater influence on the labour market than the current common agricultural policy and cohesion policy do (Världsnaturfonden, o.a., 2012).

Housing and service sectors are responsible for 40 % of the total energy use in Sweden (see 5.6 Energy use.....) and. as was previously mentioned, a large part of the housing market has an energy-saving potential of 20-50 %. These renovations lead to both the direct and indirect creation of new jobs. The sector consists, to a large degree, of small or medium-sized companies and therefore jobs are often created locally. Indirect jobs are created primarily within the manufacturing sector. In addition to this, jobs are also created in administration and counselling (United Nations Enviroment Programme, 2008). Within the construction industry, it is probably the case that the majority of green skills will need to be integrated into the existing workforce and new workers. Green jobs in this context involve the implementation of a more environmentally aware method and the development of working methods which are required for more energy-efficient building.

According to a report from Förnybart.nu, investments in renewable energy should be able to create more than 60,000 new jobs in Sweden, of which 20,000 - 25,000 would be involved with energy-efficiency, primarily within commercial premises (Petterson 2009).

4.9 National and regional implementation of The European Qualifications Framework (EQF) and the EU's other training policies within the building sector

The common European Qualifications Framework, EQF, is currently in the process of being implemented in to the Swedish education system. Basically, the system means that eight different levels of qualifications have been formulated, from very basic skills at level 1 to research-levels skills at level 8. To date, the implementation means that the formal education system will be connected to a national framework, NQF, which, in its turn, relates to EQF. This happens at system level, however, and it can be expected that it will take a long time before the system has any major impact.

There is also a proposal to make it possible for operators within the non-formal education system, i.e. industry training organisations, to connect to NQF, via a national quality assurance council. This would mean that industry-based training of foremen, for example, could be comparable with a foreman educated at a vocational training college. Another example is that the "on-the-job training" which commonly occurs within industry could be accepted as an enhanced skill level, compared with the three-year vocational training offered by upper secondary schools.

At a later stage, the common European work could lead to qualification requirements for different professions, or for professional roles being drawn up and connected to the common framework.

5. Statistics on building and energy sectors

5.1 The building sector

In 2010, the construction industry employed 305,000 and investments in construction amounted to SEK 266 billion, i.e., investments in the new or reconstruction of properties and investments in plants, which corresponded to 8 per cent of the GNP (Swedish Construction Federation 2011). However, over the past 60 years, the percentage of the GNP was considerably higher in the 1960s - approximately 15 %. Investments in construction increased sharply during the 1950s and 1960s (see figure 5.1). During the 1970s and into the 1980s, the Swedish economy experienced significant growth problems and the construction market stagnated. During the latter part of the 1980s, construction picked up again. The increase was followed, however, by a sharp downturn in the 1990s. Between 1990 and 1997, investments in construction reduced by 35 per cent. The industry recovered up until 2007 and the volume of investment at that time exceeded that recorded in the first half of the 1970s. After the financial crisis of autumn 2008, investments started to fall again. When the economy as a whole improved in 2010, investments in construction started to increase again.

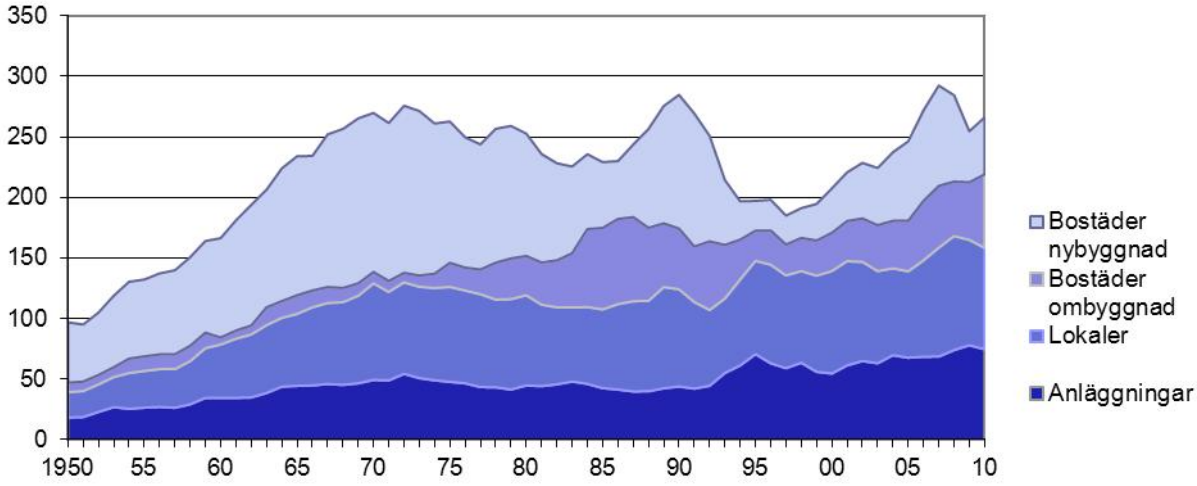

Figure 5.1 Total investments in construction (Swedish Construction Federation 2011). (Bostäder nybyggnad = dwellings new construction, bostäder ombyggnad = dwellings reconstruction, lokaler = commercial premises, anläggningar = construction works)

Up until the start of the 1990s, house new builds and rebuilds was the clearly dominant submarket. Its share of the total invested in construction was 57 per cent in 1991-1992 but this then fell dramatically to just 25 per cent in 1995. The increase that took place during the 2000s was not however of the same level as in 1991-1992; in 2009-2010 it only accounted for 40 per cent of the total invested in construction. The investments in houses amounted to SEK 108 billion in 20120, of which SEK 47 billion was for new builds and SEK 61 billion was for rebuilds. Investments in new constructions, which grew steadily between 1997 and 2007, started to decline in 2008 and an upturn was not to be seen until 2010. On the other hand, investments in reconstructions increased during the whole 1997-2010 period. Of the investments made in new constructions over the past 10 years, approximately 45 % have been in apartment blocks and the rest in one-family houses.

The housing shortage in the middle of the 1960s resulted in a political initiative, the "million homes program". The programme led to a million homes being built in ten years, from 1965 to 1975. Many of these homes are currently in major need of renovation and are one of the reasons why investments in rebuilds have increased in recent years. According to Industrifakta (which conducts market analyses of the building and property sectors), approximately 100,000 of the environment programme's buildings' apartments need to be renovated (renewal of technical building functions, technical installations and energy use) within the next five years (Johansson 2012). A total of 320,000 environment programme apartments require more or less extensive renovation. This represents an excellent opportunity to make these homes more energy-efficient. The introduction of tax reduction for construction services in

household properties (ROT deductions) in December 2008 has also been of major importance to the continued upturn in investments in rebuilds. Unfortunately, this reduction does not comprise any incentive for energy-efficiency.

Commercial premises consist to a large degree of offices and shops, together with public premises such as schools and hospitals. Buildings used by manufacturing industries are also included in this submarket. Commercial premises increased their percentage gradually, from 22 per cent of the total investments in construction made in 1950 to over 40 per cent in 2000, after which the percentage sank and in 2010 it amounted to 31 per cent. Investments in commercial premises amounted to SEK 84 billion in 2010, of which SEK billion was for private premises and SEK 35 billion was for public premises. Over the past 40 years, public investments have varied between SEK 20-30 billion per year, whilst private investments have fluctuated between SEK 30-60 billion per year. Private investments follow the state of the economy, to a large extent, whilst public investments are more stable.

Plant establishments such as roads, streets, water and sewage treatment works, and electricity and heating works constitute the remaining 30 per cent of investments in construction.

In 2010, employment in the construction industry increased by around 10,000 people in Sweden. The Swedish Construction Federation estimates that a further 20,000-25,000 people will be needed in 2011-2012 (Swedish Construction Federation 2012a).

5.2 Construction companies

In 2010 there were a total of 981,000 companies in Sweden, of which 83,000 were operational within the construction industry, i.e., 8 per cent of all businesses (see figure 5.2) (Swedish Construction Federation 2011). Of the construction companies, 88 per cent had no more than 4 employees and these companies comprised 17 per cent of all employees in the construction industry. The ten largest construction companies have between 200 and 12,000 employees and an annual turnover of between SEK 1,153 - 32,620 million (see table 5.1)

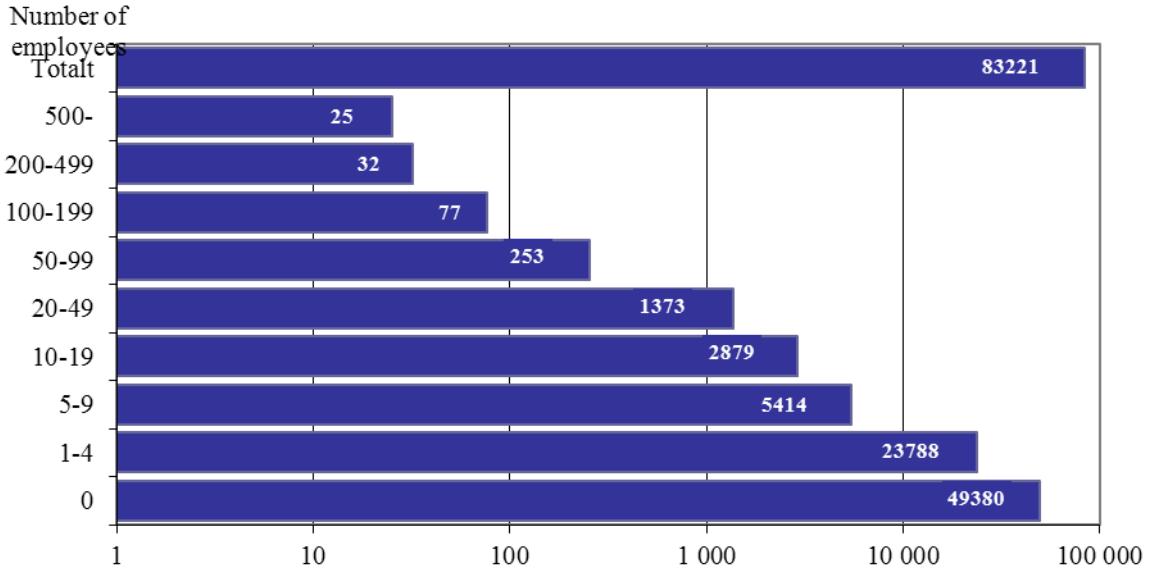

Figure 5.2 Number of companies in the construction industry in 2010 (source Swedish Construction Federation, 2011)

Table 5.1 The ten largest construction companies in Sweden, 2010 (Construction industries, 50 largest construction companies by turnover in Sweden)

Companies	Turnover contract operation in Sweden SEK million	Employees in Sweden
Peab	32,620	11,778
Skanska	28,252	9,982
NCC	26,530	9,407
Svevia	8,093	2,818
JM	7,704	1,797
Infranord	4,507	3,058
Veidekke Sverige	3,716	1,096
Oden Anläggningsentreprenad AB	1,225	475
Strukton Rail AB	1211	183
Balfour Beatty Rail AB	1153	360

The construction industry's companies can be divided up into the following operational areas: 30,000 building and plant contractors, 11,000 demolition firms and firms involved in foundation and ground works, 18,000 building installations firms (electricity, plumbing &HVAC, etc.) and 24,000 firms involved in building completions (building carpentry, flooring, painting, glass, etc.) (see table 5.2) .

Table 5.2 Number of companies per operational area within the construction industry (Byggindustrier, Fakta om byggandet 2011, 2011).

Operational area	Number of companies
Building and plant contractors	30,000
Demolition firms and firms involved in foundation and groundworks	11,000
Building installations	18,000
Firms involved in building completions	24,000

There are many small companies within the construction industry; consequently, a large number of the employees are self-employed. In 2010, the number of self-employed amounted to 21 per cent. White-collar workers constituted 20 per cent whilst blue-collar workers amounted to 59 per cent. It is no surprise that the number of blue-collar workers is as high as the construction industry is still an industry dominated by tradesmen.

Furthermore, the building sector is, to a large degree, local and national, even if international competition has increased in recent years. This applies to the whole building chain, from property ownership and consultant services via the building materials industry to building contractors. The number of companies within the construction industry (SNI 41-43), where more than half of the number of votes per share are owned by one or more foreign owners, was 376 in 2010, i.e., less than 0.01 per cent. The equivalent figure within industry as a whole amounted to 1 per cent.

However, amongst the members of the Swedish Construction Federation, 52 of the 3,211 are foreign, i.e., 1.6 per cent. The most common nationalities for foreign members are Poland and Germany.

There are, in other words, a great number of building and plant contractors. In total there are approximately 72,000 employees of building and plant contractors, divided by 18,200 companies (see table 5.3), which differs from the figure of 30,000 companies mentioned above. One explanation for this is that the lower figure is based on a new division of industry branches. Only 13 companies have more than 13 employees, whilst approximately 11,000 have no employees, i.e., they are one-man firms. Over the past three years, the number employed by major building and plant contractors, i.e., more than 500 employees, has fallen. The total number of those employed by building and plant contractors has also fallen.

Table 5.3 Building and plant contractors (SNI 41 and 42) size structure in 2010, source Statistics Sweden.

				Change compared with year 2008	
Company size (average employees)	Company Number		Employees Number, %	Company Number, %	Employees Number, %

Företagsstorlek (medeltal anställda)	**Företag** Antal	%	%*	**Anställda** Antal	%	**Förändring jämfört med år 2008** **Företag** Antal	%	**Anställda** Antal	%
0	10 759	59				195	2		
1 - 4	5 246	29	70	9 807	13	89	2	107	1
5 - 19	1 760	10	24	15 680	21	-82	-4	-814	-5
20 - 49	338	2	5	9 740	13	-52	-13	-1 779	-15
0 - 49	*18 103*	*99*	*98*	*35 227*	*48*	*150*	*1*	*-2486*	*-7*
50 - 99	74	*<1*	1	5 089	7	-6	-8	-212	-4
100 - 199	27	*<1*	*<1*	3 718	5	-15	-36	-2 117	-36
200 - 499	6	*<1*	*<1*	1 584	2	-9	-60	-2 952	-65
500 -	7	*<1*	*<1*	27 343	37	-5	-42	-10 969	-29
50 -	*114*	*1*	*2*	*37 734*	*52*	*-35*	*-23*	*-16 250*	*-30*
Summa	**18 217**	**100**	**100**	**72 961**	**100**	**115**	**1**	**-18 736**	**-20**

* Procent av företag med anställda.

Since 1999, the number employed by major building and plant contractors, i.e., more than 500 employees, has fallen from 50,000 to 27,000 (source Statistics Sweden). The total number of those employed by building and plant contractors has also fallen. The largest number employed was in 2007.

5.3 The workforce in the building sector

The number gainfully employed within the construction industry has varied to a large degree over the past 20 years, from 320,000 in 1990 to approximately 220,00 during the period 1995 to 2000 (see figure 5.3 Swedish Construction Federation 2011). During the 2000s, the number gainfully employed within the construction industry has gradually increased; in 2010 it was 305,000 which corresponds to 6.7 per cent of all those in gainful employment. The percentage of those employed on site is 20 % and the rest work indoors. The largest single category of tradesmen is woodworkers, which comprise approximately 25 % (see table 5.4). After this comes installation electricians at approximately 15 % and plumbing and HVAC fitters at approximately 10 %. Within the wider concept of the building sector, including, inter alia, project operations, the manufacture of building material and property management, the number of people gainfully employed amounts to over 500,000. More than one in ten of the Swedish labour market are operating within the building sector. The most crucial decisions regarding the energy performance of a building are made at the design stage and by people who fall outside of the target group for Build up Skills, namely purchasers, architects and technical consultants. It is naturally of great importance that the operatives implement the production in such a manner that the intentions are achieved. Insulation and sealing work should be conducted correctly and installation carried out in the right way, etc. The majority of skilled low-energy workers (see table 5.4), approximately 100,000 skilled workers/tradesmen can be assumed to have an effect on how energy-efficient buildings will be when they are completed. Some of them can even affect how well the systems for renewable energy will work. Furthermore, approximately 25,000 engineers and technicians, the vast majority of which operate at building sites, as foremen, site managers, etc. will also have an effect on how well energy-efficiency measures and the systems for renewable energy come to work in practise.

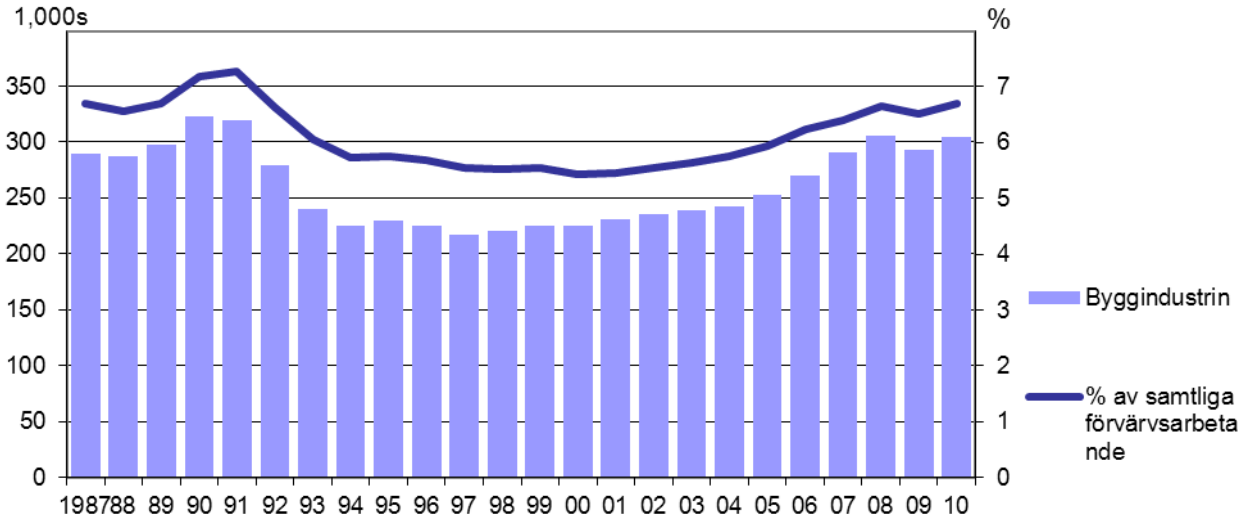

Figure 5.3 Gainful employment in the construction industry (Swedish Construction Federation, source: Statistics Sweden (AKU). From 2007, the information refers to those in gainful employment aged 15-74 (previously 16-64). (Byggindustrin = construction industry, % av samtliga förvärvsarbetande = % of all gainfully employed)

Table 5.4 Gainful employment in the construction industry - Housing (SNI 41100-41200,43210-43999) 2010. (Source: Statistics Sweden, Swedish Construction Federation). The compilation is supplemented with ventilation fitters and refrigeration technicians, with information provided by the Swedish Association of Plumbing and HVAC Contractors.

	Number	%	Skilled low-energy workers	Skilled low-energy engineers
MD, Operations Manager, Manager of smaller businesses, etc.	**13,190**			
Work which requires specialist skills	**3,914**			3,914
of which Civil Engineers, etc., building and plant	1,521			
Work which requires some college education or equiv. skills	**21,756**			21,756
of which Engineers and technicians	15,722			
Office/sales/service work, etc.	**15,782**			
Craftwork within building and manufacturing operations	**161,930**	**100**		
Miners and extraction workers, stonemasons	397	0		
Bricklayers, etc.	9,452	6	8,034	
Concrete workers	4,896	3	4,162	
Construction woodworkers, interior carpenters etc.	37,910	23	32,224	
Construction workers	3,872	2		
Other building and construction workers	8,980	6		
Roof fitters	2,331	2	1,981	
Floor-layers	3,512	2		
Insulation fitters	1,707	1	1,451	
Glaziers	1,785	1	1,517	
HVAC technicians etc.	15,693	10	13,339	
Ventilation fitters (separate information for HVP companies)	10,000	6	8,500	
Refrigeration technicians (separate information for HVP	5,500	3	4,675	

companies)				
Installation electricians and fitters etc.	27,812	17	23,640	
Caretakers	1,627	1		
Other building tradesmen	1,308	1		
Painters and varnishers	13,077	8		
Chimney-sweeps and decontamination workers	380	0		
Thin sheet iron fitters	6,522	4		
Steel construction fitters' and sheet iron fitters	345	0	293	
Divers	93	0		
Others within main group 72 (metal tradesmen, repairers, etc.)	3,376	2		
Precision tool and graphic tradesmen, etc. and other tradesmen	1,355	1		
Process and machine operator work, transport work, etc.	**9,118**			
Process operator work and machine operating and assembly work	4,069			
Vehicle drivers	1,771			
Plant machine drivers, etc.	2,355			
Crane drivers, etc.	621			
Others within 83xx (transport and machine driving work)	302			
Work not requiring a specific education	**5,248**			
Cleaners, etc.	983			
Miners within building and construction	2,051			
Others within vocational area 9	2,214			
Profession unknown	**26,774**			
Sum	**257,712**		**99816.35**	**25670**

The majority of the target group for the BUSS project operates within the construction industry but an important percentage can also be found in the manufacturing of panels for the building material industry.

The age distribution of those gainfully employed within the construction industry has changed between 1999 and 2009. The 55+ age group has grown by 27 per cent, from 16.8 to 21.4 per cents, or, put another way, by 25,000 people.

The age distribution of those gainfully employed shows a potentially large new recruitment requirement due to retirements. In 1999, 36,400 of those gainfully employed in the construction industry were 55 or older and would reach retirement age (65) during the period 2000-2009. The equivalent figure ten years later was 61,800. A contributory factor to the difference could be the number that retired early during the 1990s. The need to recruitment new staff to replace those retiring will therefore probably be considerably greater in the coming decade than in the previous one.

5.4 The building stock

In 1965, Sweden's Riksdag made the decision to build a million homes, the "million homes programme", in order to relieve the acute housing shortage that was prevalent in the country at that time. This was carried out between 1965-1975 and in Figure 5.4, a clear peak in the building of new homes can be seen at the end of the 1960s. After this, the building of homes in Sweden has reduced, apart from a peak in the 1990s.

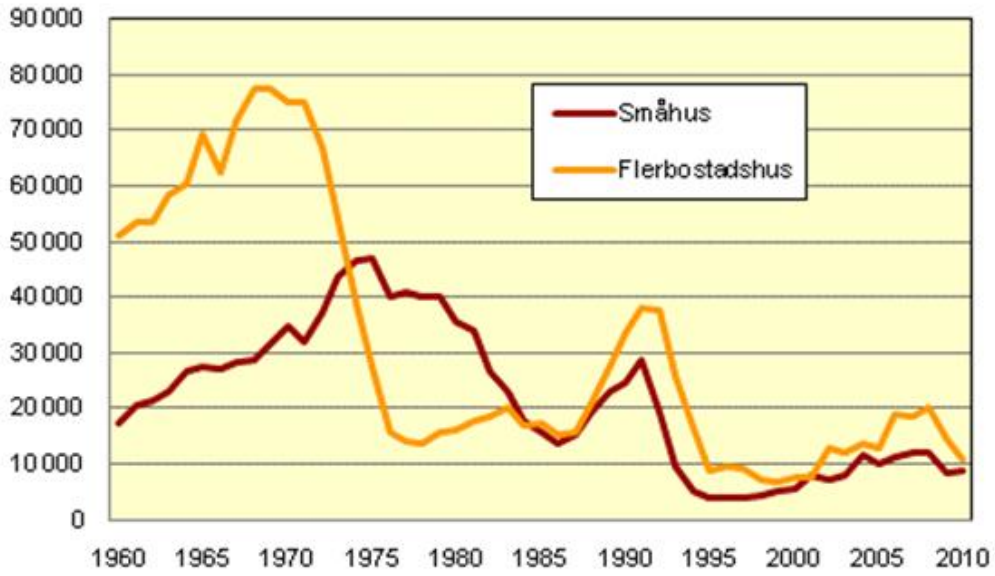

Figure 5.4 Completed apartments in Sweden 1960-2010 (source: (SCB, Nybyggnad av bostäder, 2011). (Småhus = one-family houses, Flerbostadshus = apartment buildings)

Between 1990 and 2007, the number of homes increased from 4 million apartments to 4.5 million, of which 2.5 million were in apartment blocks. During the same period, the population increased by 7 % (Boverket, 2011). For the distribution of the various forms of housing in Sweden in 2010, see figure 5.5.

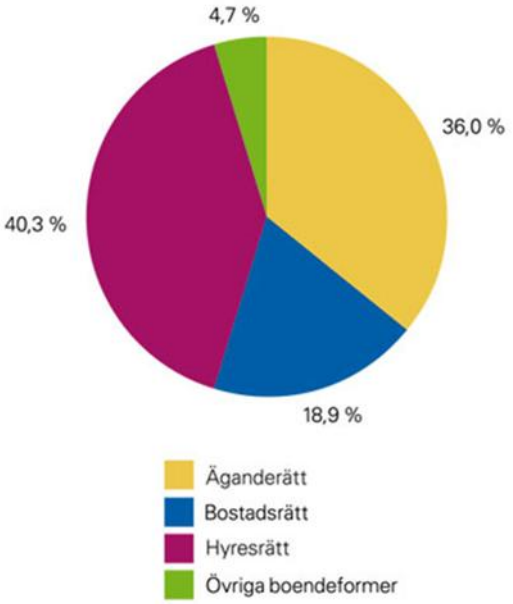

Figure 5.5 The distribution of forms of housing in Sweden, in 2010 (Boverket, 2011). (Äganderätt = ownership, bostadsrätt = condominium, hyresrätt = tenancy right, övriga boendeformer = other housing types)

The million homes programme's homes are today in need of renovation and, according to Statistics Sweden, a total of 308,000 apartments within blocks have been rebuilt between 1995-2008 with support provided by the Government. There is no information regarding the renovations that took places in 2009-2010. On average this is 24,000 apartments per year and the majority of these apartments were rebuilt in buildings which were completed between 1941-1960. According to SABO, the Swedish Association of Public Housing Companies, 11,000 environment programme apartments are currently being renovated per year (SABO, 2009). The most common rebuild measures are the

replacement of water pipes, drainage pipes, electrical wiring and hygiene equipment (SCB, Var femte ny lägenhet i flerbostadshus tillkom genom ombyggnad, 2008) . These measures ought to have a limited effect of energy use, but more extensive measures would represent an excellent opportunity to introduce better energy-efficiency. As mentioned in section 5.5, these buildings constitute a large proportion of the total number of buildings and as such a large proportion of the energy use. The renovations of environment programme apartment blocks have therefore a good energy saving potential of 25-50 % (this presupposes that no comprehensive energy-efficiency measures have been previously undertaken) (Blomsterberg & Edström, 2008). A total of 320,000 environment programme apartments require more or less extensive renovation (Johansson 2012).

5.5 Energy use in buildings

According to Sweden's energy policy targets, energy use should reduce by 20 % by 2020, compared with 1995 levels. Today (2010), Sweden's total energy use is 411 TWh (exc. losses and the consumption of non-energy objects including raw ingredients for the chemical industry, lubricants and oils to building and construction activities). The distribution of definitive energy use, divided in to sectors, can be seen in
Table 5.5. For housing and the service sector, energy use was 166 TWh in 2010; this is 40 % of the total energy use in Sweden (Energimyndigheten, Energiläget 2011, 2011a).

Table 5.5 Energy use in Sweden, divided by sector.

Sectors	Energy use (TWh)
Housing and service	166
Industry	149
Transportation	96

Source: (Energimyndigheten, Energiläget 2011, 2011a)

The general average energy use of heating and hot water in apartment blocks amounted to 158 kWh/m² in 2010. Figure 5.5 shows the energy use (kWh/m², not normal year-corrected energy use) for apartment blocks, divided by when the building was built; a clear decline in consumption can be seen around 1980. This stems from the introduction of a new building standard in 1980, SBN 1980, which, inter alia, made stricter demands on insulation. The straight line represents average energy use in 2010. As can be seen, energy use is above average in buildings that were built before 1980 and lower than average in those built after 1980 (Energimyndigheten, Energistatistik för flerbostadshus 2010, 2011).

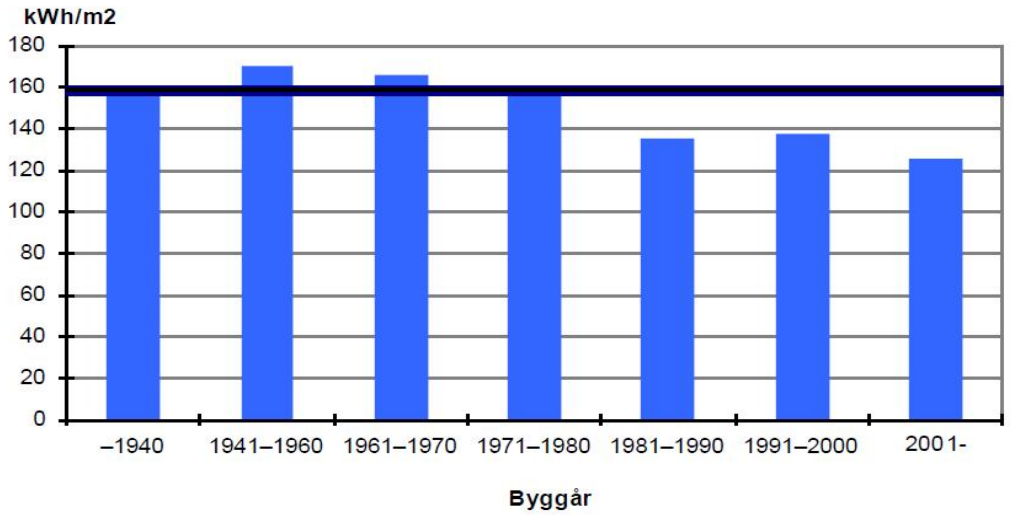

Figure 5.5 Average energy use for heating and hot water in apartment blocks in 2010, divided by year of construction (kWh/m²) source (Energimyndigheten, Energistatistik för flerbostadshus 2010, 2011)

Figure 5.7 shows energy use (kWh/m2) for one-family houses, divided by year of construction and figure 5.8 shows energy use (kWh/m2) for commercial premises, divided by year of construction.

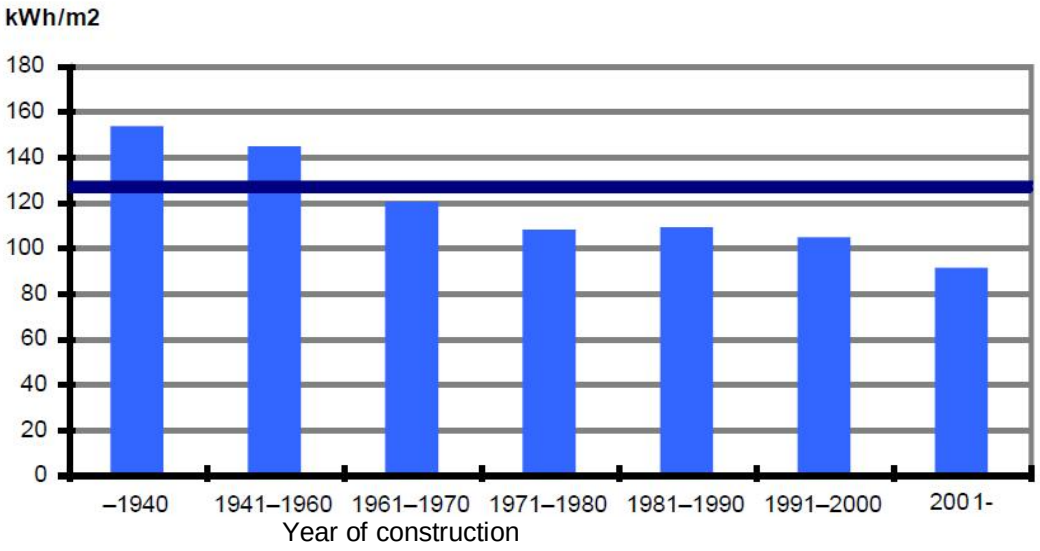

Figure 5.7 Average energy use for heating and hot water in one-family houses in 2010, divided by year of construction (kWh/m2) (Energimyndigheten, Energistatistik småhus 2010, 2011)

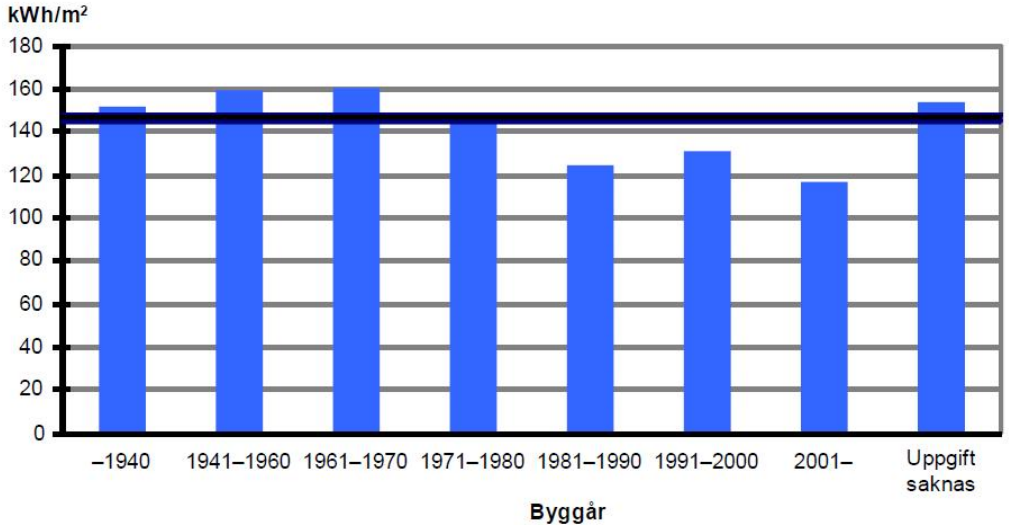

Figure 5.8 Average energy use for heating and hot water in commercial premises in 2010, divided by year of construction (kWh/m2) (Energimyndigheten, Energianvändning för lokaler 2010, 2011).

Above is shown the average energy use for various types of buildings. In order to see more clearly what recent years have looked like for apartment blocks, one-family houses and commercial premises, see table 5.6.

Table 5.6 Average energy use for various types of buildings for 2005-2010 (kWh/m2)

Average energy use	2005	2006	2007	2008	2009	2010
Apartment blocks (kWh/m²)	157	156	151	145	148.1	158.5
One-familyl houses (kWh/m²)		128.4	121.7	120.9	125.8	126.5
Commercial premises (kWh/m²) district heating	130	128	124	121	134	148

Source: (Energimyndigheten, Energianvändning för lokaler 2010, 2011) (Energimyndigheten, Energistatistik för flerbostadshus 2010, 2011) (Energimyndigheten, Energistatistik småhus 2010, 2011)

Areas for heated premises in apartment blocks in 2010, divided up by construction year are shown in figure 5.9. It is interesting to note that those apartment blocks that constitute the largest area are those buildings constructed 1940-1970. Many of theses buildings are a part of the environment programme and, as can be seen in Figure 5.7, these buildings also have greater energy use than buildings constructed in later years. A large part of the area in one-family houses is from the period 1971-1980 (see figure 5.10), but energy use is greatest in one-family houses built before 1960 (see figure 5.7).

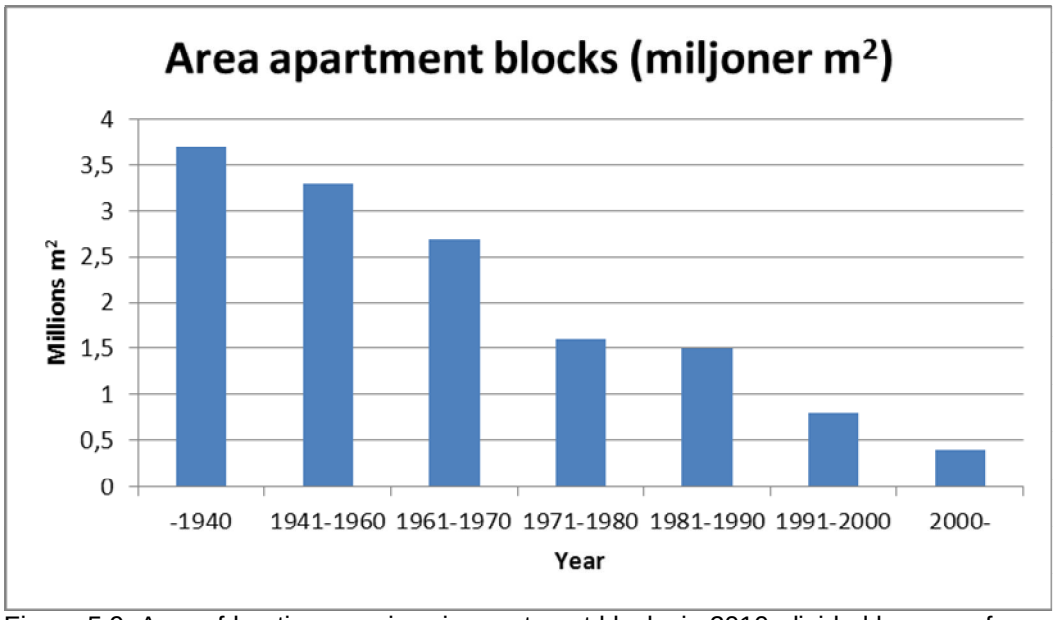

Figure 5.9 Area of heating premises in apartment blocks in 2010, divided by year of construction (Energimyndigheten, Energistatistik för flerbostadshus 2010, 2011)

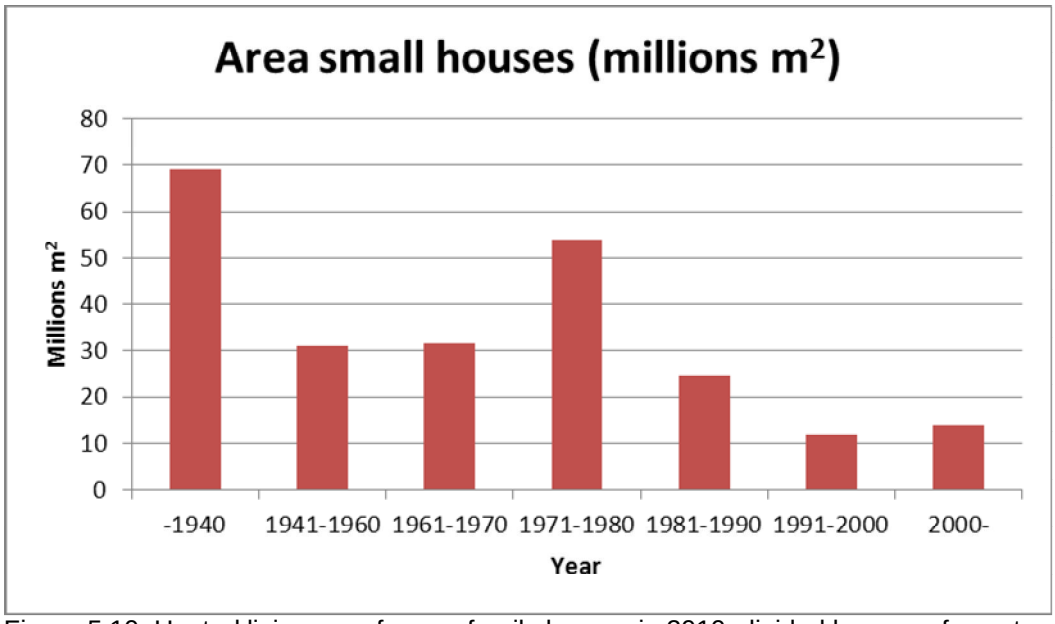

Figure 5.10 Heated living area for one-family houses in 2010, divided by year of construction (Energimyndigheten, Energistatistik småhus 2010, 2011)

Figure 5.11 describes the area in commercial premises during different time periods.

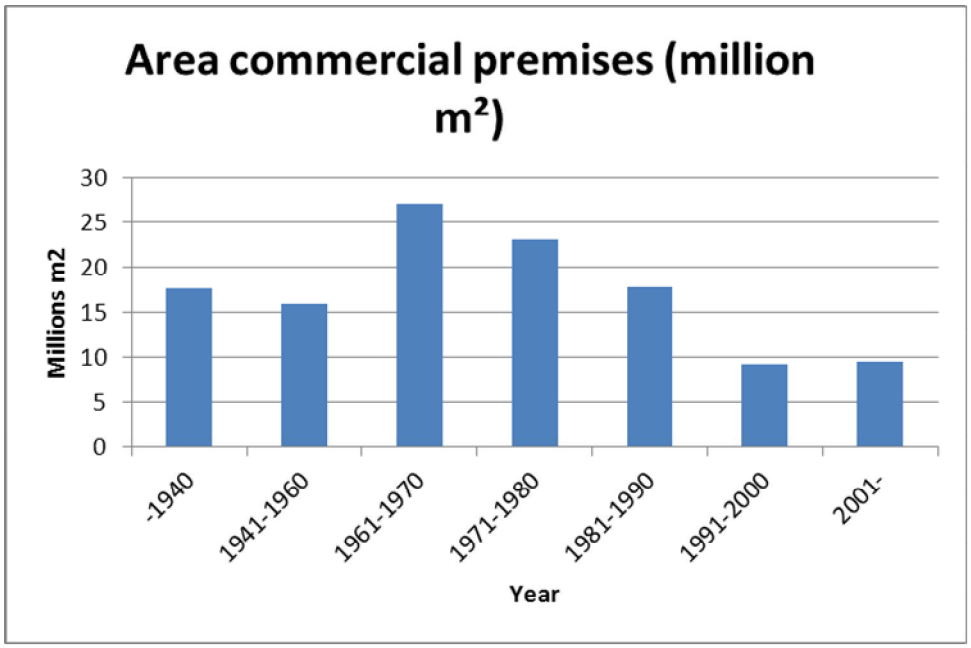

Figure 5.11 Heated area for commercial premises in 2010, divided by year of construction (Energimyndigheten, Energianvändning för lokaler 2010, 2011)

Figure 5.12 shows the total energy use in Sweden from 1970 to 2010 and the energy use of the housing and service sectors during the same period. Despite energy use per square metre falling in recent years, see Figure 5.14, the total energy use for homes and service has remained relatively constant in Sweden. This stems from the increase in floor area in buildings in recent years.

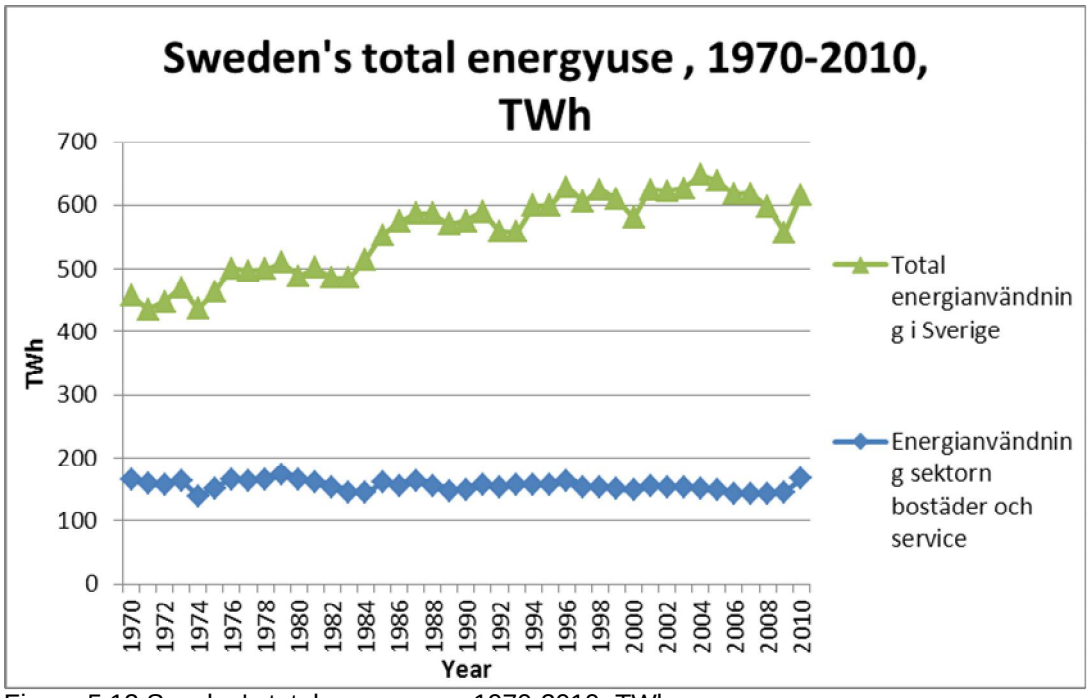

Figure 5.12 Sweden's total energy use, 1970-2010, TWh

In order to present a clearer picture of what energy use has been like for the various types of buildings in recent years, Figure 5.13 shows the total energy use for apartment blocks, one-family houses and commercial premises. In the figure it can be seen that there is a downward trend at first, but that energy use starts to rise again in 2009 and 2010. This is due to 2009 and 2010 having colder winters. In

Table 5.7, the figures from Figure 5.13 are accounted for.

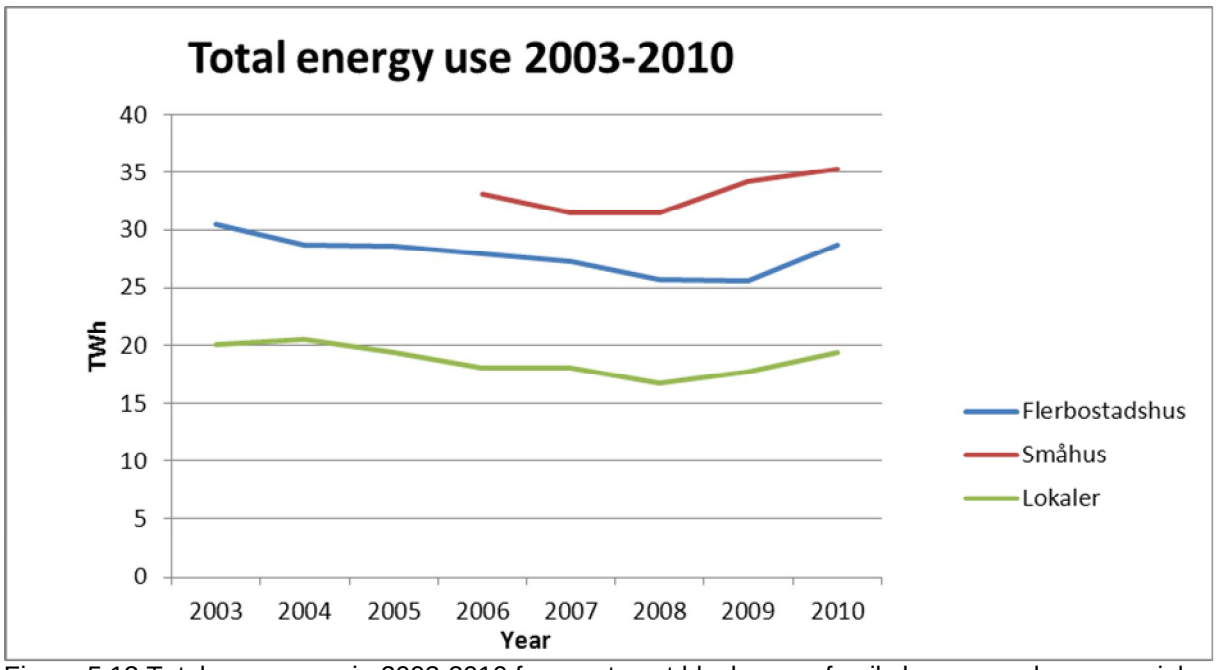

Figure 5.13 Total energy use in 2003-2010 for apartment blocks, one-family houses and commercial premises (Energimyndigheten, Energianvändning för lokaler 2010, 2011) (Energimyndigheten, Energistatistik för flerbostadshus 2010, 2011) (Energimyndigheten, Energistatistik småhus 2010, 2011).

Table 5.7 The total energy use for various types of buildings for 2003-2010 (kWh/m2)

Total energy use (TWh)	2003	2004	2005	2006	2007	2008	2009	2010
Apartment blocks	30.5	28.7	28.6	27.9	27.2	25.7	25.63	28.73
One-family houses				33.1	31.4	31.5	34.2	35.3
Commercial premises	20	20.5	19.4	18.02	18.03	16.74	17.73	19.36

Source: (Energimyndigheten, Energistatistik för flerbostadshus 2010, 2011) (Energimyndigheten, Energistatistik småhus 2010, 2011) (Energimyndigheten, Energianvändning för lokaler 2010, 2011)

Within the housing and service sectors, heating and hot water represents 60 % of the energy use. Heating is dependent on the outside temperature and therefore, temperature-corrected energy use is employed, so that comparisons between various years can be made, regardless of the actual outside temperature. Energy use for the housing sector, in terms of temperature-corrected heating and hot water per area unit, has declined since 1995, see Figure 5.14 (Energimyndigheten, Energiindikatorn 2011, 2011b).

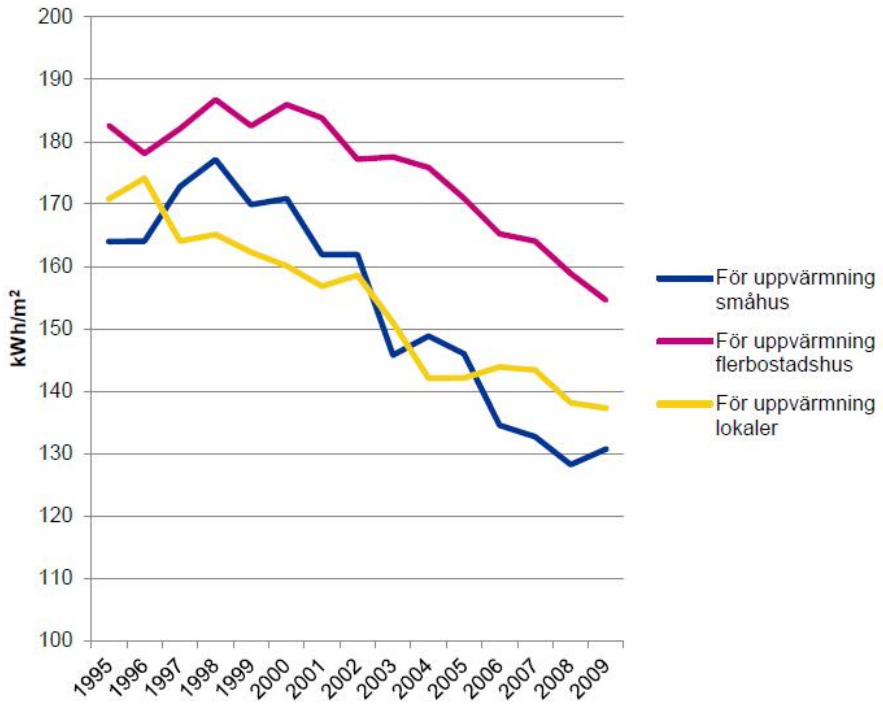

Figure 5.14 Temperature-corrected energy use for heating and hot water for homes and commercial premises, 1995-2009, kWh/m2 (Energimyndigheten, Energiindikatorn 2011, 2011b). (För uppvärmning småhus = for heating one-family houses, För uppvärmning flerbostadshus = for heating apartment blocks, För uppvärmning lokaler = for heating commercial premises)

There are three main reasons for why energy use has declined in the housing sector:

1. The use of heat pumps has increased.
2. Energy losses have been transferred upon replacement of heating systems.
3. Existing buildings have been made more energy-efficient.

(Energimyndigheten, Energiindikatorn 2011, 2011b)

If the consumption of electricity (household, operational and property electricity) during the same period is examined, it can be seen that this has been relatively constant for apartment blocks and one-family houses, at the same time as it has increased for commercial premises, see figure 5.15.

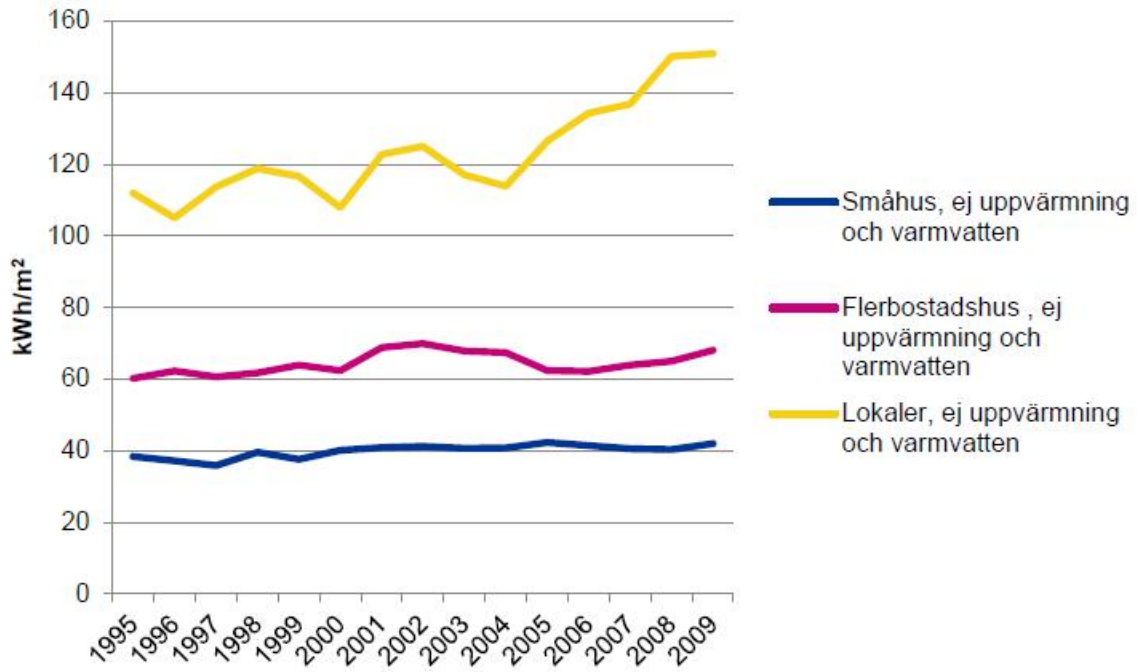

Figure 5.15 Energy use for all buildings (household, property and operational electricity), kWh/m2, 1995-2009 (Swedish Energy Agency, Energindikatorn (trans. Energy Indicator) 2011, 2011b) (Småhus, ej uppvärmning och varmvatten = one-family houses, not heating and hot water; flerbostadshus, ej uppvärmning och varmvatten = apartment blocks, not heating and hot water; lokaler, ej uppvärmning och varmvatten = commercial premises, not heating and hot water)

However, if the total consumption of electricity since the 1970s is examined, a distinct increase can be seen, see figure 5.16, which may even suggest a contrary trend, in terms of the energy consumed for heating purposes. In Sweden there is an ecodesign directive that regulates the scale of energy use for various product groups. However, despite the directive, the consumption of electricity is increasing and the main reason for this is that the number of household appliances is increasing, primarily computers and TV appliances (Swedish Energy Agency, energiindikatorn 2011, ER 2011:12). (Energimyndigheten, Energiindikatorn 2011, 2011b).

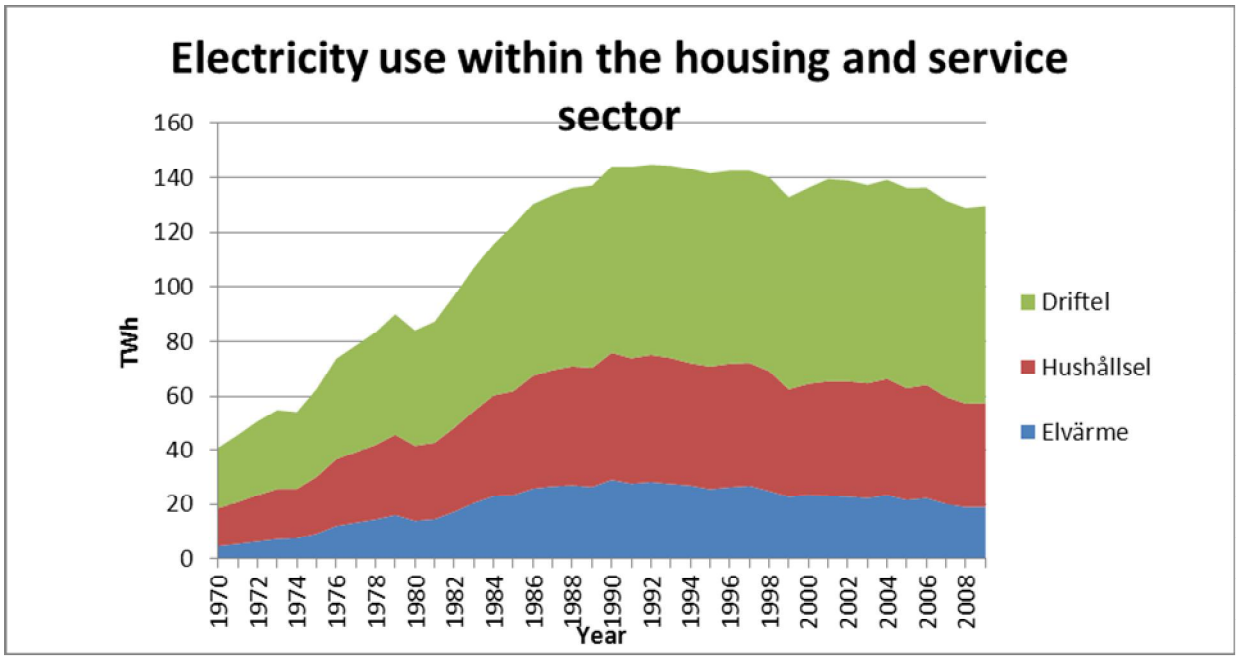

Figure 5.16 Electrical consumption within the housing and service sector, 1970-2009, TWh and normal year-corrected (Energimyndigheten, Energiläget 2011, 2011a). Driftel = operating electricity, Hushållsel = household electricity, Elvärme = electric heating) Low-energy buildings

5.6 Low energy buildings

In January 2011, a report was produced by Chalmers University of Technology regarding the amount of low-energy buildings in Sweden. During the 2000s, the building of low-energy buildings (buildings with an energy use at least 25 % lower than the BBR requirements) has been slow, but in the last two years the market has picked up. Of the low-energy buildings that exist today, 60 % have been built during the last two years. As far as private houses are concerned, it is still only a small percentage of new constructions that are carried out in accordance with low-energy standards - approximately 1 %. On the other hand, the figure for apartment blocks was approximately 11 % in 2010, and approximately 10 % for commercial premises. Figure 5.17 shows the number of apartments that have been converted into low-energy buildings (the orange line in the figure). The figure for these amounts to 811, compared with 3,229 newly built low-energy apartments during the period 2000-2010, see the clarification in table 5.8 (Wahlström 2011).

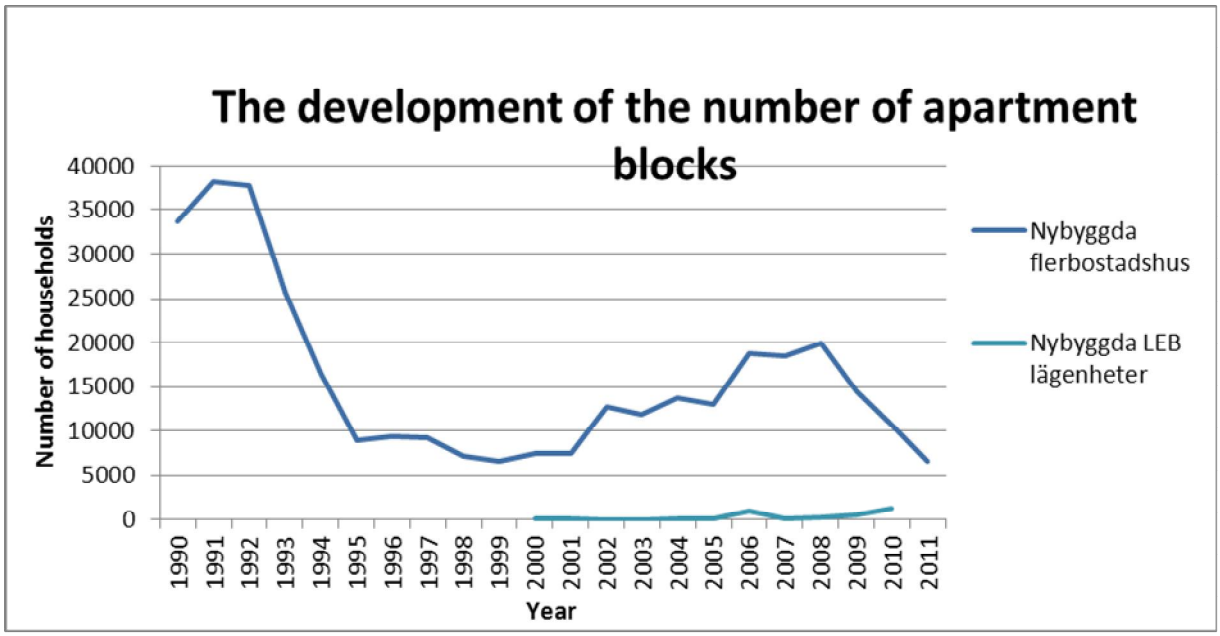

Figure 5.17 The development of the number of apartment blocks (Wahlström 2011). (Nybyggda flerbostadshus = New construction apartment blocks; Nybyggda LEB = New construction low energy buildings apartments)

Table 5.8 Year of construction for new-built LEB apartments and apartments converted to LEB (Wahlström 2011).

Year of construction	Number of LEB apartments built	Number of apartments converted to LEB
2000	34	
2001	31	
2002	0	
2003	0	
2004	111	
2005	68	101
2006	924	
2007	154	
2008	193	
2009	490	709
2010	1224	
2011		

Figures 5.18 and 5.19 show the development of the number of one-family houses and commercial premises; the figures are clarified in tables 5.9 and 5.10. As far as one-family houses are concerned, there is a peak during the 1960s and 1970s which stems from the political decision taken in 1965 to construct a million new homes.

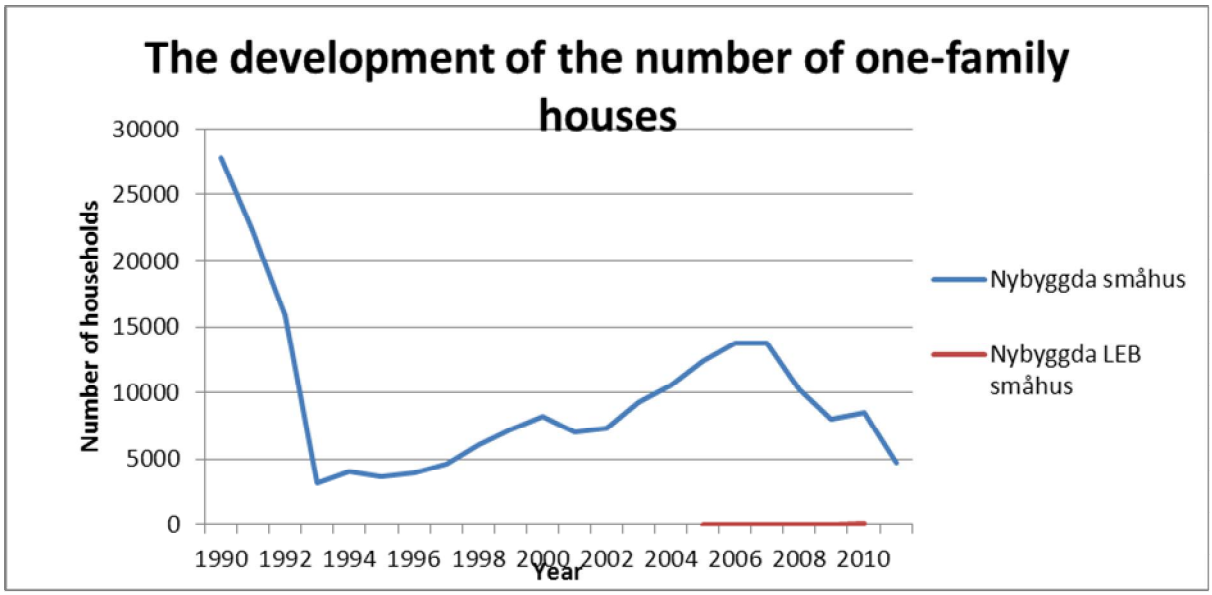

Figure 5.18 The development of the number of one-family houses (Wahlström 2011). (Nybyggda småhus = New construction one-family houses; Nybyggda LEB = New construction low energy buildings one-familiy houses)

Table 5.9 Year of construction for new-built LEB one-family houses and those converted to LEB (Wahlström 2011).

Year of construction	Number of LEB buildings built	Number of buildings converted to LEB
2005	1	
2006-2007	7	
2008-2009	27	1
2010-2011	63	

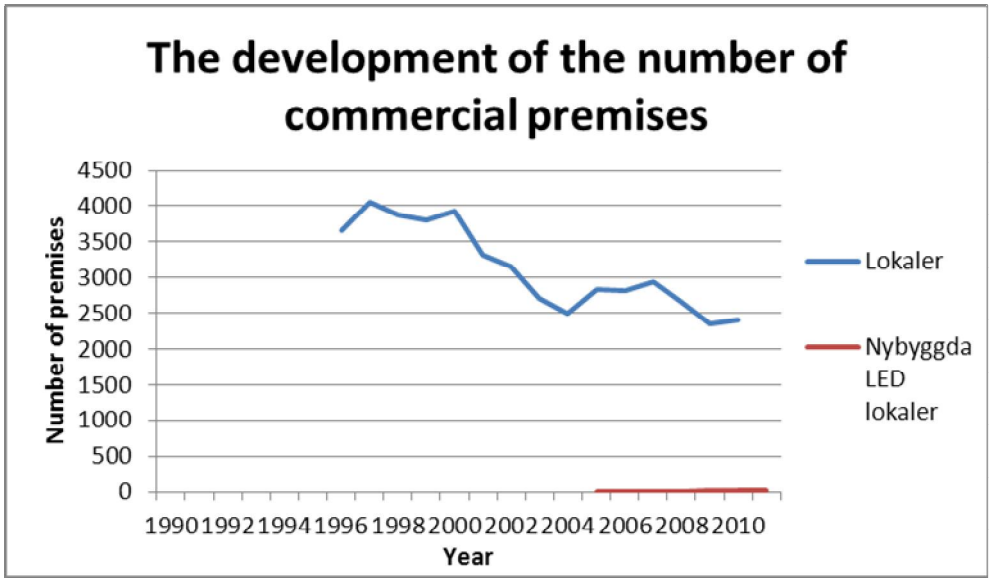

Figure 5.19 The development of the number of commercial premises (Source: (SCB, Boende, byggande och bebyggelse, 2011) (Walhström, Jagemar , Filipsson, & Heinche, 2011) (Nybyggda lokaler = New construction commercial premises; Nybyggda LEB = New construction low energy buildings commercial premises)

Table 5.10 Year of construction of new-built LEB premises (Wahlström 2011).

Year	Preschools	Schools	Univer-sities	Offices	Healthcare buildings	Trade	Hotels	Sports	Total:
2001			1						1
2002									0
2003			1	1		1			3
2004									0
2005			1	1					2
2006		1							1
2007	1	0							1
2008	2	0	1	4		1			8
2009	2	2		9	3	1	1		18
2010	9	3	1	12		2		1	28
2011	6	4	1	2	1				14
Total:	20	10	6	29	4	5	1	1	76

5.7 Renewable energy

In the Kyoto Protocol, Sweden has stated its goal to reduce its carbon dioxide emissions from 2008-2012 by at least 5% compared to the emission levels in 1990 (Naturvårdsverket, 2012). Statistics based on renewable energy are often collated from the starting point of the year 1990. Since 1990, there has been an increase in the proportion of renewable energy in the Swedish energy system, see figure 5.20. In 2009, the proportion of renewable energy in the Swedish energy system increased to 47% and Sweden's goal is to increase this figure to 50% by 2020 (Energimyndigheten, Energiläget 2011, 2011a) (Energimyndigheten, Energiindikatorn 2011, 2011b).

In 2010, renewable energy sources accounted for 65% of heating and cooling systems, 56% of the electricity came from renewable energy sources and the transports at the time were the same figure, approximately 7-8% (Energimyndigheten, Snabbare ökning av förnybar energi, 2011c).

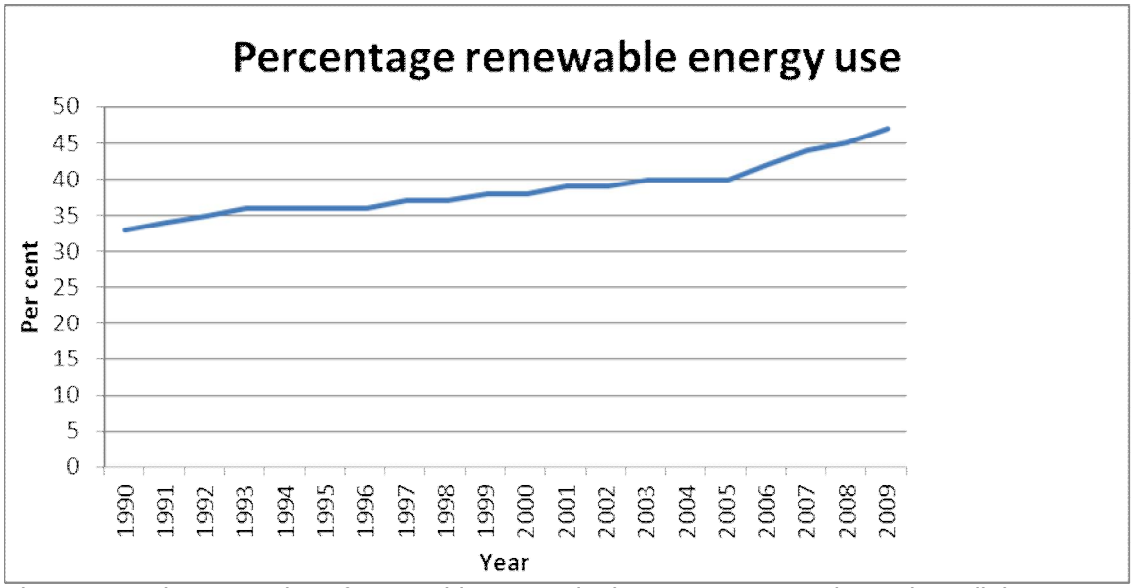

Figure 5.20 The proportion of renewable energy in the energy system (Energimyndigheten, Energiläget 2011, 2011a).

In Sweden, the number of wind turbines that have been built has increased each year since 1990. The first turbines were built in the mid-80s. In 2011, there was a sharp increase within the wind power sector. According to Vindstat, 3.5 TWh of electricity was produced by wind power stations in 2010 and 3.8 TWh of electricity in 2011. During 2012, wind power is expected to expand to produce 7.7 TWh

(Vindenergi, 2011). Sweden has set a target that by 2020, wind power capacity shall be 30 TWh, which corresponds to approximately 43% of electricity consumption today.

At the end of 2010, there was approximately 11.4 MW of installed solar power in Sweden. This represents 0.03% of the total electricity production capacity in Sweden (Lindahl, Dokumentation SolEl-seminarium 9-10 nov 2011, 2011a). In 2010, more solar cells were installed in Sweden than ever before and the primary reason for this is that funding from the support system in 2010 went from the planning phase to installations. In total, 2700 kW_p was installed in 2010, which is four times more than in 2009. It is interesting to note that the increase in demand meant that greater volumes could be ordered. This, in conjunction with falling prices in the world market for solar cells meant that prices decreased in Sweden by about half, from SEK 50/Wp to SEK 27/Wp. The largest solar cell plant in Sweden is found in Rosenlundsbadet in Jönköping (see figure 5.21) and generates 217kW of power, and Malmö is one of the most solar cell-dense cities in Sweden with Europe's first installed solar-powered Stirling engine (Lindahl, Nationell översiktsrapport av solcellsinstallationer i Sverige 2010, 2011b).

Figure 5.21 Rosenlundsbadet solar cells on roofs in Jönköping.

In 2010, 27,000 single-family houses in Sweden had installed solar panels. According to table 5.11, the number of houses with solar panels and the average solar panel area has varied in recent years. In the table, it appears to be a large difference but this does not have to be the case. The figures are the result of a sample survey and the number of houses that solar panels are relatively few. A small variation in the number of houses has a significant impact on the result (Energimyndigheten, Energistatistik småhus 2010, 2011).

Table 5.11 Solar panels on single-family houses 2007-2010.

	2007	2008	2009	2010
Number of houses, in 1000s	19 ± 7	28 ± 9	25 ± 9	27 ± 3
Solar panel area per house	14 ± 5	15 ± 6	22 ± 7	11 ± 1

Source: (Energimyndigheten, Energistatistik småhus 2010, 2011)

Table 5.12 shows the amount of plants, production and installed capacity relating to electricity production from renewable energy sources in Sweden.

Table 5.12 The amount of plants, production and installed capacity per power type.

	2003 May-Dec	2004	2005	2006	2007	2008	2009	2010
Number of plants	1 597	1 759	1 848	1 909	2 075	2 219	2 419	2 711
Water	966	1 040	1 060	1 075	1 094	1 120	1 144	1 164
Wind	543	613	668	706	846	948	1 108	1 371
Biomass, peat	87	105	118	125	131	142	156	163
Solar	1	1	2	3	4	9	11	13
Installed electrical power (MW)	4 049	4 160	4 471	4 766	5 065	5 123	5 934	6 675
Water	491	504	517	540	558	598	602	620
Wind	401	471	530	583	831	1 074	1 440	1 998
Biomass, peat	3 157	3 185	3 424	3 643	3 676	3 451	3 892	4 056
Solar	0,008	0,008	0,011	0,036	0,043	0,309	0,369	0,575
Electricity production - renewable and peat (GWh)	5 638	11 049	11 298	12 157	13 256	15 036	15 569	18 052
Water	964	1 968	1 799	2 019	2 195	2 607	2 442	2 611
Wind	456	865	939	988	1 432	1 996	2 490	3 486
Biomass	4 218	7 671	7 926	8 594	9 049	9 599	9 766	11 163
Peat		545	634	556	580	834	871	792
Solar	0,004	0,008	0,005	0,020	0,019	0,129	0,212	0,275

6. Existing VET provisions

6.1 Training providers

The most important providers of training for skilled workers within the construction industry are upper secondary schools (both public and private schools), independent training providers and educations within vocational college.

The independent training providers seem to work largely within labour market education, adult education at upper secondary level and to some extent within vocational college.

In vocational college, both in-depth training for skilled workers and also supervisor training are conducted.

There are also training companies that work with continuing professional development within the building sector.

In addition to the Upper Secondary School Building and Construction Programmes and construction companies, BYN has listed BYN's "approved training providers" (BYN 2012).

Corresponding compilations can be found at the vocational board of the plumbing and HVAC industry and at the Central Committee of the Electrical Trade for Vocational Training (ECY 2012)

6.2 The national system for vocational training

Upper secondary school

After nine years of compulsory schooling students can choose how they wish to continue their upper-secondary education. A student may choose between 18 national programmes to achieve a 3-year upper-secondary education. The Swedish National Agency for Education is the central administrative

authority for the Swedish national school system for children, adolescents and adults as well as for pre-schools and child-care for school children.

Upper secondary school has three distinct construction oriented educations, that since 2011 are: The Building and Construction Programme, the Electricity and Energy Programme and the HVAC and Real Estate Management. Until Autumn admission 2010, the corresponding educations were called the Construction, Electricity and Programme respectively. However, there are some differences in which targeted profession the programmes lead to. With the Building and Construction Programme, you can choose between five specialisations; construction vehicles, building, ground and construction, painting and plate working. The training primarily prepares students for the targeted professions of construction work, construction machine driver, concrete worker, building and ventilation plate worker, glass technician, floor layer, insulation worker, crane operator, bricklayer, painter, tiler, roofer, and carpenter. The training for installation electricians is conducted at the upper secondary school's Electricity and Energy Programme and the training for HVAC technicians is conducted at the HVAC and Real Estate Management. These different vocational groups are also to some extent educated within adult education. With the upper secondary school's construction-oriented programmes, there are programme committees whose members constitute a wide representation of delegates for the programmes' stakeholders. The committee can, for example, initiate changes in the education.

Educations that specialise in the electrical installation field can also be found within Higher Vocational Education (HVE).

For the vocational group "general skilled workers" within building and construction, there is no vocational training required.

After the upper secondary education is complete, training is concluded in concert with being employed as an apprentice in a company. Following the period of apprenticeship, which varies depending on the profession and approved training requirements (training time/vocational education), you are then considered a fully-trained skilled worker and receive full salary as well as a trade certificate.

Certain vocational groups, such as construction workers, concrete workers, floor layers, brick layers, painters, tilers, roofers and carpenters have the possibility to receive their entire education through company-based training, that is to say, employment as a traditional apprentice in a company under the supervision of a full-trained skilled worker and where the theoretical part of the education is conducted as distance education or with an industry approved training provider.

The construction company Peab has its own upper secondary education with a Building and Construction Programme, which is followed by apprenticeship training in the same way as other upper secondary schools.

Education arranged by the National Labour Market Board

A further alternative is adult education is what can be classified as shortage professions and which are bought by the County Administrative Boards or Employment Offices or independent training providers, upper secondary schools, e.g., Lernia, Byggutbildning Star i Dalarna AB, Installatörernas Utbildningscentrum (IUC), Tranås Utbildningscentrum and more.

Higher Vocational Education (Qualified Vocational Education)

The authority for vocational colleges (The Swedish National Agency for Higher Vocational Education 2012) is responsible for post upper secondary education vocational training and education outside of university. The agency determines which courses and programmes will be included in the educational system and provides government grants to organisers. The agency monitors and examines the educations' quality and results.

Higher vocational education includes two post-secondary educational forms that combine theory with work-related learning: Higher Vocational Education (HVE) and Qualified Vocational Education (QVE).

QVE education is HVE education's predecessor. QVE educations have existed for approximately 15 years, while the first QVE educations started in the Autumn of 2009. Eventually all educations within higher vocational education will become HVE educations but during a transition period (until 2013), both educational forms will be available.

Higher vocational education aims to ensure that there are educations within industries where there is a clear need for labour, which means that the content and specialisation of the educations vary depending on the labour market's needs over time.

Educations within higher vocational education have a strong connection to working-life, have mandatory work placements and are tailor made to suit the requirements of the labour market.

The variety of available courses and programmes to sign up for is extensive and continues to grow. Courses and programmes are available from general levels to specialist levels. Examples of programmes: construction, energy optimisation engineer, solar energy technician with heating system expertise, heating, ventilation and sanitary installations, painting, woodwork, carpentry etc. In Autumn 2012, there are approximately 325 educations granted by 1,200 education applications.

Examples of the educations are:

- the one-year continuing education for construction workers "Conversions and renovations for building craftsmen" at Nässjö Academy (see section 6.7 Local courses.....).

- training for Cooling and heat pump technicians at Installatörernas Utbildningscentrum (IUC),
- training for energy technicians at Tranås Utbildningscentrum (TUC).

Continuing vocational development

Some industry training (continuing vocational development) supplied by different training providers, e.g., internally within the larger companies, within the industry organisation' training operations, in installers' and material suppliers' auspices.

Examples of education providers within continuing vocational development:

- BFAB (Construction and real estate sector's continuing vocational development institute)
- Installatörernas Utbildningscentrum i Katrineholm (IUC)
- EGA, E G Anderson Konsult AB
- Elbranschens Utveckling- och Utbildningscenter, EUU
- Sveriges Byggindustriers Entreprenörsskola

An example of a local continuing vocational development is: During Spring 2010, Lerum's municipality, together with Studieförbundet Vuxenskolan, Sweden's Engineers and Companies Association in Lerum's municipality arranged an education in energy-efficient construction. More than 25 local companies in the building sector provided training. The training was co-financed by Region Västra Götaland.

The Swedish National Board of Housing, Building and Planning has since 1998 been involved in a project entitled Bygga-bo (build a nest) a dialogue with the aim of educating, creating and maintaining a dialogue with the industry to promote sustainable buildings. The dialogue continued to the end of 2010 when it was decided to manage the content of the dialogue with other systems and methods within operations. Currently, the material has not been of use to any extent. The dialogue contained both educations designed to understand the implications of technological solutions, sustainable buildings, and tools for applying dialogue in everyday routines. In recent years the target group also included construction workers. The educational material is still available to the public and anyone who wants to study can study different subject within the Bygga-bo-dialogue.

Vocational boards

The boards are designed primarily to ensure that the quality of higher vocational education within their field of expertise. This can either be an upper secondary education or a placement as an apprentice, i.e., traditional apprenticeship, in a construction company or similar. All programmes begin with basic education (e.g., upper secondary school or vocational training), and continues with on-site education. If the skilled workers are lacking basic education, then a validation can be conducted to evaluate the expertise within the specific profession.

The Swedish Construction Industry Training Board (BYN) is a joint organisation whose main objective is to ensure the quality of the learning period provided by construction companies and other education

providers. The parties that make up the vocational boards are the employer organisations Sveriges Byggindustrier and Maskinentreprenörerna as well as employee organisations Byggnads and SEKO. Their roles are to ensure that there are skilled workers within the Swedish building industry. Together with upper secondary schools that have construction courses and companies in the industry, BYN promotes the Swedish upper secondary school and the subsequent apprentice education period which takes place in construction companies, all to meet the requirements of the industry.

The vocational board of the plumbing and HVAC industry is a joint organisation with the Swedish Association of Plumbing and HVAC Contractors (employer organisation) and Byggnads (employee organisation). The board collaborates with parties within the vocational training field with regard to course planning, apprenticeships, industry exams, recruiting, learning materials, contact with the central authorities and more. The vocational board of the plumbing and HVAC industry establishes operational directives for the regional training supervisors. It is the training supervisors who have contact with the apprentice and the company during the education.

The Central Committee of the Electrical Trade for Vocational Training (ECY) ensures that the electrical educations in Sweden are up to date, so that the industry can employ competent staff. They influence decision-makers and authorities so that those who undertake the upper secondary schools' electrical programmes, or are apprentices, receive the best possible education. There are also local vocational boards (ELY) for assistance. ECY is a collaboration between Elektriska Installatörsorganisationen EIO and Svenska Elektrikerförbundet (SEF).

6.3 Extent of the training

The training of skilled workers has, until 2011, taken the form of national, specially designed, individual programs or independent schools. Until Spring 2014, to additional cohorts will leave upper secondary school from programmes that belong to the previous structure.

There were 1015 upper secondary schools in 2010. The number of upper secondary schools that offer construction-oriented training programmes varies and as well as the type of education they conduct, (see table 6.1). The training of construction workers and installers were divided into three programmes: The Building programme with 221 schools, the Electrical programme which was implemented in 295 schools and the Energy programme that was found in 122 schools.

Table 6.1 The amount of schools with building-related education for the whole of Sweden in 2010 (The Swedish National Agency for Education 2012)

	Type of upper secondary school education								Total number of municipalities and schools	
Programmes or programme-related	National programmes		Specially designed programmes		Individual programmes		Independent (private) schools			
	No. municipalities	No. schools	No. municipalities	No. schools	No. municipalities	No. schools	No. municipalities	No. schools	No. municipalities	No. schools
Total number of upper secondary schools	232	451	195	332	271	444	118	489	278	1015
Building (BP)	131	136	28	29	47	50	58	73	158	221
Electrical (EC)	154	159	17	17	41	41	68	133	172	295
Energy (EN)	57	60	10	10	12	12	48	56	84	122

During the academic year 2010 - 11,6000 students were enrolled in the first year course in upper secondary school's building programme (see figure 6.2) In the past 25 years, the number has varied between 2000 and 6000. The lowest level was in 1998-99 following a gradual decline throughout the 1990s.

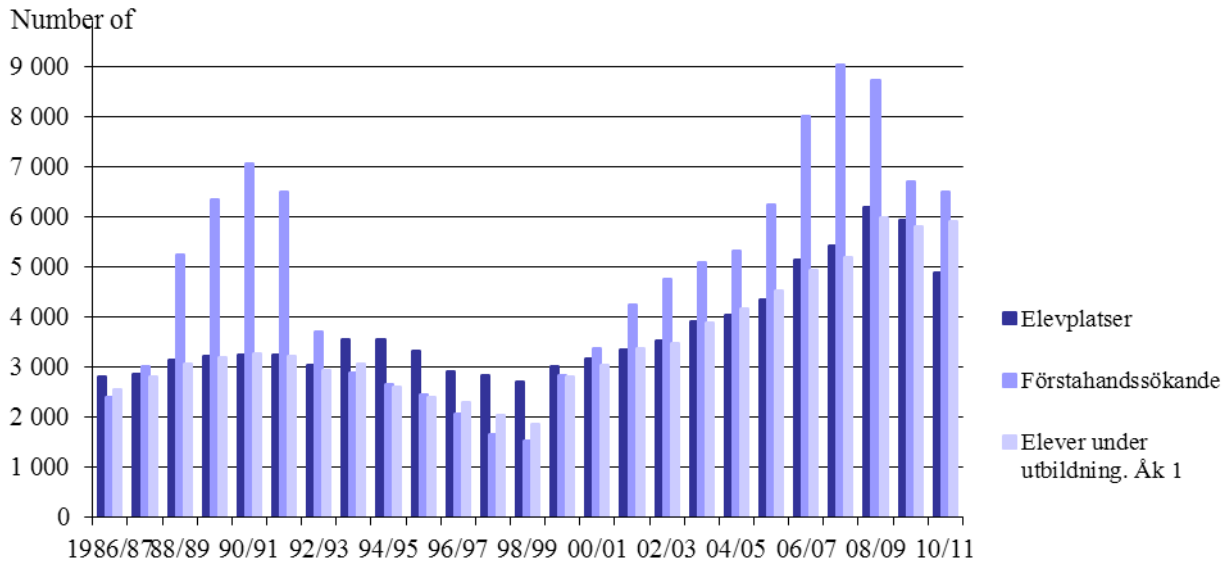

Figure 6.2 Number of students in upper secondary school's building programme (The Swedish Construction Federation 2011, source: The Swedish Construction Industry Training Board) (Elevplatser = students; Förstahandssökande = first choice applicants; Elever under utbildning, Åk 1 = Students being trained, first study year)

The number of students in the Building programme for the academic year 2010-2011 was 16,100, divided into three year courses (see table 6.2). The corresponding number for the Electrical programme is 22,521 and for the Energy programme is 4,191. The total number of students is 42,800, as in 14,000 per year course. In the Electrical programme, however, a large number of students received education in vocational fields outside of the building industry. The number of female students is low for all programmes, lowest for the Energy programme with approximately 2% and highest for the Building programme with approximately 9%. There are approximately 8 teachers per 100 students in upper secondary school.

Table 6.2 SIRIS the quality and results in schools
http://siris.skolverket.se/pls/portal/ris.elever_gy.rapport

Upper secondary education – Statistics on pupils								
Period:	**The academic year 10/11**		**Organisation:**					
			Number of	Proportion of	Proportion with	Number of,	Number of	Number of
			Pupils	women	foreign backg.	pupils,	pupils,	pupils,
Municipality/principal organiser	School	Programme		(%)	(%)	year 1	year 2	year 3
Sum total for Sweden								
Municipality		Building programme	13,367	9	8	4,590	4,251	4,526
Independent		Edu. at independent schools, EN	2,733	11	13	1,119	847	767

Upper secondary education – Statistics on pupils			
Period:	**The academic year 10/11**		**Organisation:**

			Number of	Proportion of	Proportion with	Number of,	Number of	Number of
			Pupils	women	fore. backg.	pupils,	pupils,	pupils,
Municipality/principal organiser	School	Programme		(%)	(%)	year 1	year 2	year 3
Sum total for Sweden								
Municipality		The Electricity Programme	12,193	3	10	3,894	3,980	4,319
Independent		Edu. at independent schools, EC	10,328	7	15	3,592	3,504	3,232

Upper secondary education – Statistics on pupils								
Period:	**The academic year 10/11**		**Organisation:**					
			Number of	Proportion of	Proportion with	Number of,	Number of	Number of
			pupils,	women	fore. backg.	pupils,	pupils,	pupils,
Municipality/principal organiser	School	Programme		(%)	(%)	year 1	year 2	year 3
Sum total for Sweden								
Municipality		The Energy Programme	2,534	2	8	863	851	820
Independent		Edu. at independent schools, EN	1,659	5	11	637	585	437

Information on the proportion of students who complete the education has not been possible to obtain during the project.

During the period 2006-2010, between 3,700 and 7,600 work certificates were issued per year for skilled workers within the building and construction industry, i.e., an average of 5,900 (BYN 2010). The corresponding figure for the electrical trade is between 1,050 and 1,450, i.e., an average of 1,275 (ECY 2011), as well as approximately 600 (VVS-YN 2012b) for the HVAC industry. This implies a total of approximately 7,750 per year.

With regard to educations within higher vocational education, it is more complicated to determine how many are educated per cohort. 300 course were granted in the Autumn of 2012, of which a small portion were aimed at skilled workers within the building industry, primarily focusing on managerial roles. The total number of students that started higher vocation education in Autumn 2011 was 16,500 (The Swedish National Agency for Higher Vocational Education 2012).

6.4 Financing of the education

Financing of upper secondary schools is conducted with 'education vouchers', an amount from tax funds that the municipalities distribute among the schools for each student. Per student, the typical value for education vouchers for building-related education is approximately SEK 100,000 (see table 6.3 and 6.4).

Table 6.3 The base amount for the year 2011 (SEK/student and grant year) for independent upper secondary schools. The figure applies to upper secondary education that had commenced prior to 1 July 2011.

Programme	Including meals
The Building programme	103,100
The Electrical programme	98,200

The Energy programme	105,600

Table 6.4 The base amount for the year 2011 (SEK/student and grant year) for independent upper secondary schools with regard to the new upper secondary school (Gy 2011) Autumn term 2011. The figure applies to upper secondary education that had commenced prior to 1 July 2011.

Programme	Including meals
The Building and Construction Programme excluding specialisation in construction vehicles	102,300
The Building and Construction Programme, Specialisation in Construction vehicles	121,500
The Electricity and Energy Programme	97,900
HVAC and Real Estate Management	102,400

The municipal upper secondary schools are included in the national school system in Sweden. There are also independent schools. These schools have another principal/owner than those schools run by the municipality or the county council.

Financing of the upper secondary schools is comprised partly of government grants that decrease over time. Every municipality receives a government grant based on the number of inhabitants, then the municipalities decide on how they use the grant within the school and social services etc.

The authority for vocational schools (The Swedish National Agency for Higher Vocational Education 2012) is responsible for post upper secondary school vocational training and education outside of university and provides government grants to organisers. Education within the framework of The Swedish National Agency for Higher Vocational Education is funded entirely by the government.

6.5 Certification and accreditation

Several accredited organisations certify skilled workers within the building sector. These certifications are lesser in character, in relation to time and substance, compared to formal education within the upper secondary schools. All certifications require relevant basic education as well as vocational experience and references. Below are examples of certification for individuals related to energy and renewable energy for operating on building sites.

SP SITAC certifies construction workers who have completed and passed the course Passive house builder (see also section 6.7 Local courses….). Certification requires passing the exam, documented general technical knowledge, work experience and experience from passive/low energy house projects. The training takes place over two days, with room for approximately 20-25 trained/certified individuals per year. The certification is issued at two levels, General and Advanced eligibility. Advanced eligibility requires, in addition to General eligibility, practical experience from passive house building with reference objects in accordance with SITAC's certification guidelines.

The Solar Energy Association of Sweden (SEAS) is conducting a voluntary certification of solar heating installers. Membership in the association is required. You should have undergone basic HVAC training as well as company run courses on installing their solar panels, varied length of education.

The vocational board of the plumbing and HVAC industry has developed an industry exam for HVAC and insulation. It is proof that the apprentice has undergone a controlled education and has the expertise needed for the labour market. Regardless of whether the education is conducted through upper secondary school, as a company apprentice or through other adult education, the training is concluded with an industry specific exam. The exam tests theoretical and practical knowledge and takes place over four days. After a completed industry exam, you receive a trade certificate that proves you are a certified HVAC technician, insulation plate worker or HVAC insulator. In order to take the industry exam, you must have worked the required number of hours (8,500 hours for HVAC technicians and 6,800 hours for insulation technicians) and you must have passed the courses that the vocational board of the plumbing and HVAC industry has specified as requirements to taking the industry exam.

The industry organisation Pellsam conducts voluntary certification of pellet boiler installers. Certified individuals are responsible for the work carried out at their location. Certification is exam based. A voluntary two day course is given.

STI, IUC, Mid Sweden University and Swedcert AB certify cooling and heat pump installers. Certification is required to work with fluorinated greenhouse gases, which are common in refrigerants. The education gives 4.5 higher education credits.

The Swedish heat pump association certifies heat pump installers. The certification is voluntary. The education is in accordance with the Course at Mid Sweden University above. The education gives 4.5 higher education credits.

Safe Water installation, authorisation from HVP companies with training as HVAC technicians, approximately 17,000 currently trained, 1,200 companies are authorised. The training takes 1 day.

Approvus trains and certifies responsible well drillers. Certification requires passing exams in "Law" and "Practical Hydrogeology". Approvus also certified well drillers. The training takes 3 days. Certification requires:
- a pass grade for the welding test. (Your own or another employee at the company with welding expertise) - course certificate from ”Hot work” and ”Working on the road”.
- employment certificate proving sufficient experience.
- environmental and third-party insurance.

6.6 Energy efficiency and renewable energy in buildings in the national education.

Training elements that have a particularly pronounced connection to energy-efficient building are still not included in the compulsory parts of the training of skilled workers in the building industry. As shown below, there are only generic formulations in the three programmes' qualitative targets that have a connection to sustainable building and energy aspects. With these formulations, it is possible to conclude that there is already grounds for the students to gain expertise involving the qualifications required to participate as a skilled worker in a project with energy efficient buildings. In the more advanced programme structure, there is a basis in the subjects and curricula for certain parts of the knowledge content necessary for energy efficient buildings.

In the qualitative target for the Building and Construction Programme, the following general goal formulations are included:
"The education will develop the students' knowledge of and skills in building and construction with, for example, new construction, remodelling and renovation. As building and construction work impacts society's infrastructure and the environments in which they reside, the education should impart knowledge of a rational, safe and environmentally sustainable building.
"The students should be able to select, use and maintain materials, tools and machines with regard to safety as well as environment, quality and economy, both when it applies to production and life-cycle costs."

Excerpts from the qualitative target for the HVAC and Real Estate Management: ”This programme will also provide students with knowledge of automatic control and energy optimisation of constructions as well as develop their ability to think systematically. The students will be given the opportunity to see how efficient energy use leads to sustainable development. New construction, conversion of the existing building components, repair, maintenance and installation all require knowledge of the systems and products that are most energy efficient and how to work with the best possibly environmental impact in mind.”

Excerpts from the Electrical and Energy Programme "the education should provide knowledge on electricity and energy technology and automation, as well as the skills to perform tasks in these fields." Examples of vocational output are automation technicians - real estate.

Addition concretisation is found in mandatory subjects and curricula, but these have been designed with a special focus on energy efficient buildings.

In the subject plan for the programme-common subject Building and Construction, it includes, for example, the following wording; "The teachings should give the students the possibility to develop knowledge of the industry's responsibility for sustainable development." In the course Building and Construction 2, it includes the content formulations: ” The building and construction industry's role in society and sustainable development. Use of resources, linked to sustainable development and corporate profitability. For example, the handling of materials, storage, minimising of waste and the sorting of construction waste.

Within the specialisation Building construction, the course Building construction 1 includes the following content: "Energy efficient building construction and building methods." Prospective skilled workers from this specialisation can be expected to participate in the work with energy efficient buildings. In the courses that involve a more in-depth education with a targeted profession in mind, they include knowledge on, for example, insulation work which provides an additional level of detail necessary with regard to efficient insulation.

There are also more general courses that upper secondary school can offer with a more in-depth programme education. Within the Building and Construction and Electrical and Energy- Programmes, as well as HVAC and Real Estate Management, the students will, from 2012, be able to take the general course Environment and Energy Knowledge if the school chooses to offer it. This course includes:

- Renewable and non-renewable energy sources and their origins and use.
- Energy and resource use in relation to foodstuffs, housing, transport and general consumption.
- Energy and resource efficiency through, for example, measurement technology, choice of materials and other technical solutions.
- Energy principles, energy quality and efficiency as well as physical and chemical calculation and reasoning.

6.7 Local course and training programmes on energy efficiency and renewable energy in buildings for the continuing vocational development of skilled workers

Passive House Centre in Alingsås organises the course Passive house builder for construction workers (Passive House Centre 2012). The course provides general and broad basic knowledge of the building of passive houses and energy efficient buildings. Aside from energy efficiency, you learn to regard the building as a system where good indoor environment and good resistance are important properties. The participants should gain a full understanding of energy-efficient building and the requirements of quality and control that are needed, knowledge of the problems that may arise and how they can be prevented, and knowledge of building as a system. The course takes two days. Day 1 includes, the passive house concept, building as a system, certification and requirements, airtightness, moisture, thermal bridges, windows and doors in passive houses, ventilation. Day 2 includes a practical workshop (pressure testing, thermography and moisture measurement), review, discussions and plan, evaluation and a theoretical and practical exam. The number of participants is 20-25 per year.

Reportedly, there is also internal company training for passive house projects.

Individual agents may have their own educations, e.g., NCC has a "Moisture and energy training" of four hours for production staff including: Ongoing climate change, Design of low energy/passive houses, Airtightness, Moisture security, Construction details regarding moisture and tightness, thermal bridges and also lead-throughs.

An example of the individual educations is the one-year continuing education for construction workers "Conversions and renovations for building craftsmen" at Nässjö Academy (Nässjö 2012). The education is for construction workers who want to specialise in renovations and conversions of modern houses and apartments. The subjects are addressed are, for example, energy efficiency, conversion technology, economy, work environment, reception and design.

Other examples include the higher vocational education school in Härnösand, where a two-year education in solar cell installation is offered.

Within a recently started and ongoing project, the aim is to produce continuing vocational development for skilled workers within the building industry. Passive House Centre Västra Götaland (PHC) and SP Technical Research Institute of Sweden (SP) shall, within the project "Capacity building of skilled workers", develop a vocational development programme within the field of energy-efficient building, based on the education of trainers. Knowledge dissemination will therefore largely be conducted through internal training within contracting companies, using course material developed within the project. This procedure creates the possibility to cost-effectively and speedily disseminate knowledge to a large proportion of skilled workers in the building sector. The overall project objective is to develop a vocational development programme within energy-efficient building for skilled workers. This work consists mainly of two parts: the development of a continuing vocational development course for trainers at contracting companies and also the production of training material for this course.

The overall goal of the project is to train approximately 30 trainers engaged in contracting companies with resources to maintain 2-3 internal training sessions during 2012. Through this procedure, one thousand skilled workers should have received training within a few years. The goal is to continue the education of trainers after this project has concluded with the help of the course material. This work will however be funded by course fees. The aim is to reach out to a greater section of Sweden's skilled workers within the building industry by 2019.

Participating/co-financing the project is NCC, Skanska, PEAB, Poseidon, Byggentreprenörerna and the Swedish Construction Federation.

The management of skilled workers may also require continuing vocational development. At Stockholm Vocational Institute of Technology, there is an education in Low-energy buildings Engineer, 400 HVE credits, Stockholm (80 weeks) (Stockholm 2012b). The education is aimed at working as, for example, Construction (Project) Manager.

6.8 Relevant initiatives at the national/regional level supported by the EU

Leonardo da Vinci – for vocational education with the support of the EU programme Leonardo da Vinci, students and the unemployed and employed can undergo internships at companies and training organisations in other participant countries. Partnerships between organisations within vocational education can also receive grants. Approximately 1,400 Swedish on average have participated from 2007 – 2011, of which there is an unknown number from the building industry (Leonardo 2012).

7. Skills gaps between the current situation and the needs for 2020

In 2010, construction activity improved and housing construction increased, with the exception of certain regions (www.arbetsformedlingen.se). This has led to an increased need for qualified labour. There is a steady supply of graduates but it is difficult to get hold of vocational experienced staff (Labour force survey 2010 in SCB). Unemployment among construction workers is currently generally lower than the unemployment average for Sweden with the exception of general skilled workers. Labour shortages are expected to include HVAC technicians, tilers, concrete workers and brick layers. It appears that the labour shortages are being resolved through companies hiring foreign contractors which, in turn, impacts the labour market within the field. Labour mobility within the EU is an important yet complex factor in expertise resource management. Despite construction educations growing in volume, it would seem that the construction work force is still too small with regard to a more long-term perspective (Labour force survey 2010 in SCB).

7.1 Construction labour market by 2020

Approximately 8,000 skilled workers have, in recent years, entered the labour market each year. This is based on issued trade certificates and other certificates. This figure is expected to increase during

the period 2012-2020. Approximately 20% of these skilled workers can be assumed to belong to the plant construction side of the building industry.

A healthy labour market with increased investment in housing, rail and road and also higher retirements, results in it generally being a healthy market environment for construction work within the coming ten years (the Swedish Public Employment Service 2012).

Construction workers
In five to ten years, the opportunities for construction workers will improve as education and training is being conducted in conjunction with employer needs.

Construction machine operators
The Swedish Public Employment Service estimate that the need for machine operators will increase due to increased investments and higher retirement levels. Thus, training for this profession is deemed an asset as there is a shortage of machine operators.

Concrete workers
The need to recruit concrete workers will increase over the next ten years due to, for example, increased building investment and higher retirement levels.

Building and ventilation plate workers
Building and ventilation plate workers are a small vocational group and there are few trained in this line of work. With increased activity, it can therefore be assumed that competition over the next ten years will be lessened.

Floor-layers
The need for recruiting floor-layers will increase over the next ten years, partly due to increased activity, and also due to a shortage of trained vocationals in this line of work. The availability of floor-layers is deemed to be inadequate.

Insulation workers
The need for recruiting insulation workers will increase over the next ten years, partly due to increased activity, but also due to many insulation workers transferring to other professions as well as higher retirement levels in the coming years.

Crane operators
The crane operators' labour market is small and fluctuates depending on activity levels. The need for recruiting crane operators is however expected to be high over the next ten years, partly due to the current market situation, but also due to impending high retirement levels as well as training opportunities.

Bricklayers
The need for recruiting bricklayers will be relatively high over the next ten years. Retirements will be higher than normal in the labour market and there is increased investment in housing and renovations. The availability of trained bricklayers will, to a large extent, be satisfactory due to well-structured education.

Painters
The need for recruiting painters will be high over the next ten years due to a significant need for housing construction and renovations, as well as high retirement levels. The Swedish Public Employment Service estimates that the availability of trained painters will not be sufficient in the long-term, as there are not enough people trained in this profession.

Tilers
The increase in housing construction will most likely lead to a continuing healthy labour market for tilers with little competition on the job - however, with regional variations.

Roofers
The recruitment need for roofers will increase over the next ten years due to an increase in new builds, rebuilds and repairs, as well as many roofers transferring to other professions. The availability of

trained roofers will however be sufficient, as the number of training placements are adequate and also the fact that employers conduct their own roofer training when necessary.

Woodworkers/Carpenters
The need for recruiting woodworkers will increase over the next ten years, but availability of woodworkers will nevertheless be sufficient as the number of individuals in the Building Programme that specialise in woodwork is also increasing.

HVAC technicians
The need for recruiting HVAC technicians will increase slightly over the next ten years, due to increased investment in building as well as a number of HVAC technicians moving to other work each year. Therefore, the availability of trained HVAC technicians will not be sufficient and the Swedish Public Employment Service estimates that HVAC technicians will have increased opportunities in the labour market.

Installation electricians
In the long-term, it is considered that the opportunities for installation engineers will decrease and the Swedish Public Employment Service estimates that there will be stiff competition for jobs.

General skilled workers within building and construction
There is a lack of information on general skilled workers' labour situation over the next ten years, but there will most likely be a continued relatively high unemployment level with stiff competition for the available jobs.

There will be a shortage of craftsmen to renovate the environmental programme. Rolf Persson (CEO for Industrifakta, building industry 21/12/2011) estimates that there will be a need for a 25,000 yearly work force in the next five years.

The solution Rolf Persson advocates is labour immigration, in combination with increased efficiency in building, and also that tenants get involved in renovations.

7.2 Competence shortfall and requirements

The skilled workers suggest the following problems and obstacles at construction sites to energy-efficient building (Blomsterberg 2012):

- Complicated solutions in energy-efficient building (can be perceived of real problems)
- Engineering drawings (blueprints) for energy-efficient building (implies probably that the drawings may be improved).
- New technical solutions in energy-efficient building.
- Technology to improve high airtightness in energy-efficient building.
- New products and materials in energy-efficient building.
- Prejudices against energy-efficient building.
- Suitable materials for energy-efficient building.
- Accuracy requirements for energy-efficient building.
- The order of various operations in energy-efficient building

In previous sections it was established that the national education of skilled workers does not include mandatory elements of energy-efficient building. There are only a few general energy formulations in the qualitative targets. Therefore, basic education and continuing vocational development initiatives need to be developed in order to provide a general and broad base knowledge in the building of energy-efficient buildings and low-energy renovations, as well as renewable energy sources and systems (Blomsterberg 2012, Dehlin 2012). Aside from energy efficiency, you should learn to regard the building as a system where good indoor environment and good durability are important properties. The aim should be to gain a full understanding of energy-efficient building and the requirements of quality and control that are needed, knowledge of the problems that may arise and how they can be prevented, and knowledge of building as a system. The various vocational groups involved within building production must understand how they contribute to energy efficiency and how their work impacts the work of others. The keywords for the finished buildings are a very well insulated and

airtight climate shell with negligible thermal bridges, very energy-efficient installations and that a large proportion of the energy needed is renewable.

A low-energy building must be constructed with high quality. This requires a focus on quality, where an important departure point is a holistic view of both theoretical and practical aspects. At the same time, it requires an insight into the practical problems connected with the building process and production.

In addition to the above-mentioned basic knowledge, more in-depth expertise needs to interact with the various fields of operation:

- Bricklayers' knowledge on, detailed solutions for airtight constructions, how moisture damage can be avoided, different types of well-insulated, heavy climate shells, as there are many alternatives and several that are being developed, for example, for additional insulation of existing buildings' climate shells.
- Concrete workers' knowledge of different types of well-insulated, heavy climate shells, detailed solutions for airtight constructions, how moisture damage is avoided.
- Construction woodworkers', interior carpenters', etc., knowledge on detailed solutions for airtight constructions, how moisture is avoided, different types of well-insulated, light climate shells with high airtightness requirements, as new insulation materials have been developed and are under development.
- Roofers' knowledge of different types of well-insulated, light climate shells with high airtightness requirements.
- Insulation workers' knowledge of different old and new insulation materials, as well as how they are integrated in climate shells with high airtightness requirements.
- Glaziers' knowledge of advanced window constructions.
- HVAC technicians knowledge of energy-efficient and advanced ventilation, heating and heat recovery systems, including systems for renewable energy, as new systems have been developed and are being developed, e.g., effluent heat exchangers, shower heat exchangers.
- Installation electricians and fitters' knowledge on advanced ventilation aggregates, heating systems, heat recovery systems, lighting systems and therein relevant control and monitoring systems, particularly a development of lighting and building automation systems are taking place.
- Steel construction fitters' and sheet iron fitters' knowledge of different types of well-insulated, light climate shells with high airtightness requirements and advanced ventilation systems.

If 25% of all new builds and 40% of all renovations in 2015 are to meet the NZE requirements in accordance with the Swedish Energy Agency's proposal, then approximately 1/3 (30,000) of the potential skilled workers involved in energy-efficient building will have to undergo continuing vocational development over 4 years, divided into even categories (see table 7.1, and also table 5.4). This is based on new construction per year being unchanged, the same applies to the pace of renovation. If the extensive renovation of environmental programme houses gets underway, then the need for continuing vocational development increases. By 2020, 100,000 potential low-energy skilled workers should have received continued vocational training. At least 500 instructors will be required for this.

Table 7.1 The forecast for the number of people needing continuing vocational development in energy-efficient building, 2012-2015.

Craftwork within building operations and manufacturing	
Miners and mountain miners, stonemasons	
Bricklayers etc.	2,400
Concrete workers	1,250
Construction woodworkers, interior carpenters etc.	9,700
Construction workers	
General building and construction workers	
Roofers	600
Floor-layers	
Insulation fitters	450
Glaziers	450
HVAC technicians etc.	4,000
Ventilation fitters (separate information for HVP companies)	2,550
Coolant technicians (separate information for HVP companies)	1,400
Installation electricians and fitters etc.	7,100
Caretakers	
General construction tradesmen	
Painters and lacquerers	
Chimney sweeps and sanitation workers	
Sheet metal workers	
Steel construction fitters' and sheet iron fitters	100
Sum	30,000

7.3 Suggested qualifications

Specific qualifications for skilled workers involved in the building of energy-efficient buildings:

Knowledge	Skills	Abilities (expertise)
Knowledge of society's energy goals and the underlying intention of energy-efficient building. Basic knowledge of energy requirements in a building and how the climate shell design, ventilation and different types of installations affect this. Knowledge of proper workmanship in normal architectural constructions, given highly insulated and airtight constructions. Knowledge of proper workmanship in normal installations given efficient distribution of heat and ventilation with heat recovery, as well as sources for renewable energy. Knowledge of the consequences of flawed construction.	Be able to perform a thorough job with insulation and air-sealing, and also the accurate installation of heating and ventilation systems.	Determine when there is a risk that a solution could jeopardise the preconditions for an energy-efficient climate shell and an energy-efficient heating and ventilation system. Supervise colleagues who lack specific training in NZE.
Excerpts from EQF level 4 - as support for the descriptions of qualifications above		
Factual and theoretical knowledge in broad contexts within a work or study field	A range of cognitive and practical skills required for solutions to specific problems within a work or study field	Exercise self-management within the guidelines for the work or study context which are usually predictable but can be changed. Monitor the routine work of others with some responsibility for the evaluation and improvement of work or study operations.

The description is adapted to the European framework for qualifications, EQF, which is being introduced in Europe. Level 4 corresponds to the Swedish upper secondary school education.

It means the continuing vocational development of skilled workers within the building industry, but also that the basic education of skilled workers needs to be supplemented with a view to low-energy buildings. The first step is to educate the trainers, i.e., approximately 1,500 teachers within upper secondary school. In upper secondary school's building-related programmes, there are approximately 5000 teachers, some of which also should be able to help with continuing vocational development. This is based on the assumption that 1/3 of all teachers/instructors of skilled workers will receive continuing profession training and that there are approximately 8 teachers per 100 students in upper secondary school.

Building site management will also need to undergo the same training. This group represents an unknown portion of 25,000 engineers, 15,000 according to a rough estimate.

Continuing vocational development should hitherto be able to be provided by various current providers, e.g., internally within the larger companies' training operations and in material suppliers' auspices. Their capacity would need to be multiplied.

7.4 Monitoring requirements

There is every reason to continuously monitor the supplementation of basic education of skilled workers in order to cover the expertise needs of regarding energy-efficient buildings. This could be done by the vocational boards. This also applies to continuing vocational development for equivalent expertise, where a certified low-energy construction worker could be certified in the same way as a certified passive house builder. Continuous monitoring also requires that there are a sufficient number of trained and educated individuals to meet the needs. This could also be done by the vocational boards.

8. Barriers

An identification and initial analysis of obstacles to the 2020 climate objectives related to qualifications of skilled workers has been conducted. By obstacles, it is primarily referring to barriers to the implementation of expertise building in work on construction sites. This can apply to both the availability of training and the ensuring of attendance in training. These obstacles can be classified in categories such as laws/regulations, economic, institutional, cultural, social, educational.

Obstacles due to any deficiencies in qualifications of construction workers are described in section 4.7, 6.6 and 7.

8.1 Obstacles to the supplementation of basic education

Laws/regulations: Assumed not to pose any obstacle.

Economic: Who pays for the continuation of vocational training?

Institutional: Who is responsible for the continuation of vocational training? Programme committees for the upper secondary schools can initiate the supplementation, but the Swedish National Agency for Education can question the rationale for changing the existing subject/course plans. Many Departments have interests regarding new low-energy buildings and low-energy renovations, e.g., the Department of Education, the Ministry of Employment and the Ministry of Enterprise, Energy and Communications, and coordination between them may cause some difficulties.

Educational: Shortage of instructors/teachers with expertise in the area of energy-efficient building.

Other: Currently, there are too few low-energy buildings being built and too few low-energy renovations being conducted, that is to say, the demand for low-energy expertise exists but not to the extent to achieve 20-20-20 (see section 4)

To help overcome obstacles, a broad reference and steering group has been formed to influence all relevant stakeholders.

8.2 Obstacles to continuing vocational development

Laws/regulations: Assumed not to pose any obstacle.

Economic: The major construction companies should have an economy that allows for continuing vocational training of skilled workers. There are, however, a large number of small construction companies that may have limited economic possibilities. So far, very few skilled workers have been offered the opportunity for continuing vocational development.

Institutional: Unclear who can provide the training. Continuing vocational development should hitherto be able to be provided by various current providers, but they probably do not have the sufficient capacity. Currently, continuing vocational development is conducted internally within the larger companies, within trade organisations' training operations and under the auspices of installers and material suppliers

Cultural: Unknown number of foreign skilled workers and foreign contractors who have a limited knowledge of Swedish. The number is, however, not yet that high.

Social: Motivation is probably lacking for many construction companies so long as there are not a sufficient amount of low-energy buildings being built or many low-energy renovations.

Educational: Shortage of instructors with expertise in the area of energy-efficient building. Prejudices against energy-efficient building (Blomsterberg 2012). Knowledge of educational opportunities is low (Dehlin 2012). Low demands for continuing vocational development (Dehlin 2012).

Other: Lack of time to participate in training. Currently, there are too few low-energy buildings being built and too few low-energy renovations being conducted, that is to say, the demand for low-energy expertise exists but not to the extent to achieve 20-20-20 (see section 4).

To help overcome obstacles, a broad reference and steering group has been formed to influence all relevant stakeholders.

A survey shows a great interest in continuing vocational development among civil servants and skilled workers (Dehlin 2012).

9. Conclusions

The building sector is, to a certain extent, fragmented into different branches and organisations. Internationalisation can be seen in the increased number of foreign building trade companies operating in the Swedish market. It is, however, not easy for foreign companies to establish themselves in the Swedish market. The foreign workforce in Swedish construction sites has increased. There are no statistics to be found on how common it is for foreign labour to be hired.

The building industry employs many people. In 2010, it was 305,000 workers, which corresponds to approximately 7% of all gainfully employed. It is estimated that there are approximately 100,000 people working as skilled workers on construction sites and thereby they can influence how energy-efficient building will be when they are newly built or renovated. Some of these can also have an effect on the systems for renewable energy. Many building companies are very small, basically one-man firms. The number of such companies is estimated at 11,000.

The building industry has a large turnover. In 2010, building investment rose to SEK 266 billion, which was new builds and renovation investments in real estate as well as investments in construction, which corresponds to 8 per cent of the BNP.

Within the building sector, there are illegal workers, but payments to them are however estimated to amount to less than 4 % of the total investments made in the construction industry.

The main stakeholders in the building industry are the developers/administrators, consultants/architects, contractors and manufacturers, most of whom are represented in different trade organisations. The majority of those employed within the construction industry are trade union-affiliated.

Many believe that activity within the building industry will increase steadily over the coming years. This should mean that the number employed in the building sector will also increase. In addition, a large recruitment phase will be necessary due to the number of retirements. According to a forecast by the Swedish Public Employment Service, there will be an expected 5-10 year period shortage of building and ventilation plate workers, insulation workers, bricklayers, roofers, woodworkers/carpenters, HVAC technicians and installation electricians. This is to name a few professions that can contribute to a building being more energy efficient.

The proportion of low-energy buildings in new production is still low, on average under 2 %, or 350 apartments per year and, on average, under 0.25 % or 8 commercial premises per year from 2000-2010. This percentage is expected to rise in coming years - in 2010, 7 % of new homes were low-energy buildings. Up to now, the number of annually renovated apartments is 24,000, but in only a very small number of these has the energy performance been considerably improved. Many operators within the building sector believe however that there will be an increasing demand for energy-efficiency, both from authorities and private purchasers.

Currently, there are very few government subsidies for energy-efficient building. Those that do exist are for the installation of solar cells and panels. Regional incentives for low-energy buildings can sometimes be found in municipal and county council plans and in the local environmental programmes. A number of developers/administrators are already in the process of building low-energy buildings or are conducting low-energy renovations. Above all, that last type of project is currently quite scarce.

For a long time, an active energy policy had been implemented with informative, financial and normative policy instruments. The results up to now show that the total energy use for heat and hot water in buildings has not changed to any great degree, despite the increase in terms of square metres floor area. New buildings have a lower energy use then old buildings, but the total area of buildings has increased. On the other hand, electrical consumption, primarily in commercial premises, has been increasing since the 1970s.

According to the proposals of the Swedish Energy Agency, the introduction of nearly zero energy buildings would mean that the current minimum energy requirements for new buildings, in accordance with the building regulations of the Swedish National Board of Housing, Building and Planning, would be halved. As a first step in this process, it is proposed that 25 % of all new builds should be nearly zero energy buildings in 2015. The target for major renovations is proposed to be set at 80 % of the current requirements of the Board's regulations and the first interim objective, for 2015, is that 40 % of major renovations reach this target. Since a great deal of time will pass before all buildings are replaced with new builds, existing building must be made more energy-efficient so that the overall climate goals can be achieved.

The Government has drawn up a communication based on, inter alia, information provided by the Swedish Energy Agency, in which it is principally current nearly zero energy buildings that are defined as those that satisfy the energy requirements found in the regulations of the Swedish National Board of Housing, Building and Planning. Closer adherence to these regulations is to be progressively implemented, with checks to be carried out in 2015. A number of promotional measures to facilitate the implementation of the requirement for near zero-energy buildings are proposed, i.e. more demonstration projects and initiatives that improve the skills of certain key groups. It is not yet clear when promotional measures will be implemented and the scope involved.

Since 2009, a decision was reached that the proportion of renewable energy by 2020 would be at least 50% of the total energy use. This is being implemented with a focus on wind power, grants for solar cells and solar panels. The basis for this is generally financial policy instruments, such as carbon dioxide tax, international emissions trading and certificates for renewable electricity. In 2009, the proportion of renewable energy had already risen to 47%.

There are still no regional energy policies or strategies stating how the 2020 goal is to be achieved. However, there are municipal and county council plans and local environmental programmes with strict requirements for low-energy buildings. This makes it more difficult however for the building industry to produce uniform concepts for low-energy buildings.

The current building code, from 2012, does not impose requirements on NZE buildings. However, the committee states that a low-energy building is a building with an energy use of 75% of the building code's requirements, and that a building with a very low energy use has an energy use of at most 50% of the building code's requirements.

There is currently no policy or strategy regarding higher vocational education for achieving the 2020 energy targets. There is, however, elements of energy efficiency and renewable energy for buildings in the new upper secondary schools' building-related programmes. The most important educators for skilled workers within the building industry are the upper secondary schools, independent trainers and vocational colleges. None of the educations have connections to NZE buildings. There are some local examples of educations that include energy efficiency.

Some continuing vocational development is provided within companies such as Sveriges Byggindustriers Entreprenörsskola, trade organisations' training operations and in installers' and material suppliers' auspices. Some of the educations deal summarily with energy efficiency and renewable energy for buildings. Passivhuscentrum holds a two day course in passive house

construction for building workers, which attracts 20-25 participants per year. There is also a recently started and ongoing project which is aimed at producing relevant vocational development for skilled workers within the construction industry. Participating in this project are NCC, Skanska, PEAB, Poseidon, and the Swedish ConstructionFederation. The challenge is to train the large number of employees at the great many small companies working on construction sites and not least to educate the instructors.

The quality of the construction education is ensured by the Swedish Schools Inspectorate but also for example, the vocational boards, i.e., the Swedish Construction Industry Training Board, the vocational board of the plumbing and HVAC industry and the Central Committee of the Electrical Trade for Vocational Training, to name a few have an informal influence.

There are already a number of accredited organisations that certify skilled working within the building sector. Some certifications are related to energy-efficient building and renewable energy.

The majority of skilled workers require further training with respect to new low-energy buildings, the renovation of low-energy buildings and the use of renewable energy. In principal, everyone will have to undergo continuing vocational education. If all new builds are to satisfy the NZE requirements and all rebuilds are to be improved so that they meet the minimum requirements with regard to energy performance by 2020, this means that approximately 100,000 tradesmen will have to undergo continuing vocational development over the next 8 years. According to a first analysis an acceptable period for education is thought to be 1-3 whole days. At least 500 instructors will be required for this. The need for training is based on new construction per year being unchanged, the same applies to the pace of renovation. If the extensive renovation of environmental programme houses gets underway, then the need for continuing vocational development increases as well as the need for labour.

The basic training for skilled workers needs to be supplemented with regards to low-energy buildings. The first step is to educate the instructors, i.e., approximately 1,500 teachers. In upper secondary school's building-related programmes, there are many teachers, some of which also should be able to help with continuing vocational development. A first step has been taken by Passive House Centre in a small scale.

Building site management will also need to undergo the same training. This group represents an unknown portion of 15,000 engineers.

Competence supplementation of the basic education and continuing vocational development must provide a general and broad understanding of energy-efficient building and also provide an understanding of how their own work contributes to and affects the work of others. In-depth training, connected to their various fields of operation, needs to be placed in separate categories. Monitoring of the training is best conducted by the vocational boards. An important precondition for ensuring that a building is energy-efficient is that it is planned by architects and project-managed by project developers for energy efficiency. An important condition of ensuring energy efficient construction is that requirements are made and that architects and engineers plan and design for energy efficiency.

Potential obstacles to the implementation of the training are financial (where is the funding coming from?), institutional (who is responsible for providing the training?), cultural (foreign labour), social (motivation), as well as a lack of time, in addition to the fact that too few low-energy buildings are being built and too few low-energy renovations are being conducted. However, a slight increase is noticeable. A high demand for energy efficient buildings would contribute to overcome these potential obstacles. A step in that direction has been taken by the BELOK or BEBO purchaser group for commercial premises resp. residential buildings (see chapter 3.2) by promoting successful energy efficient demonstration buildings.

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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 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 to deliver renovations offering a 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 in order to meet the targets for 2020 and beyond.

II. Based on these roadmaps, the second step is to facilitate the introduction of new and/or the upgrading of existing qualification and training schemes.

Throughout the whole duration of the initiative, regular exchange activities are organised at EU level to underline the European dimension of this important initiative and to foster the learning 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 interactions with the existing structures and funding instruments like 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.