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# **BUILD UP SKILLS – CROATIA CROSKILLS**

STATUS QUO ANALYSIS OF  
THE BUILDING SECTOR  
IN CROATIA AND SKILLS  
OF CONSTRUCTION  
WORKERS IN THE FIELD OF  
ENERGY EFFICIENCY AND  
RENEWABLE SOURCES  
OF ENERGY

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# IMPRESSUM

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## **Further information**

More details on BUILD UP Skills can be found at  
[www.buildupskills.eu](http://www.buildupskills.eu)

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

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# 1. Summary

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The reduction of the consumption of energy and the use of RES in the building stock sector constitute important measures for the overall energy consumption reduction and the greenhouse gases emission reduction. The construction sector can significantly contribute to attaining the 20-20-20 objectives by the year of 2020 which have been set by Energy Performance of Buildings Directives (EPBD and EPBD II). The objectives in turn contribute to the state of conformity with the Kyoto Protocol that stipulates the limitation of the global temperature increase to less than 2°C and the reduction of the overall greenhouse gases emission by 20% as compared to the year of 1999 volume [44]. The measures for the energy consumption reduction and an increased use of RES play important role in the energy supply sustainability, the development of technologies and the employment opportunities and the regional development, especially in the rural area

The experience gained by the EU states and by the Republic of Croatia as well has shown that the energy efficient refurbishment and building are presently imposing a great challenge for the construction sector and the related industries as there has been a shortage of skilled workers in the construction sector and the shortage of institutionalized training schemes; moreover, there has been a weak demand for low energy buildings as well [45, 46, 47]. This sort of situation requires changes in the way of thinking and in the qualification structure of workers in the market, i.e. shaping up the workforce that is to feature the appropriate amount of specific knowledge in the field of constructing low energy, passive and almost zero-energy buildings. The construction of new buildings and refurbishment of the already existing ones up to the low-energy and ultra low-energy levels in turn require changes in the existing training programmes and curricula and the development of new, specialized vocations. As it has already turned out, the training of workers for the construction of ultra low-energy buildings is crucial in terms of constructing high-quality buildings. For the purpose of attaining these objectives, changes in the legislation are needed as well as the redefining the programmes, curricula and the direction of the development of education in the field of EE. [48].

There were 78,850 workers employed in the construction sector in Croatia as of the March of 2012. In accordance with the Central Bureau of Statistics, the average number of on-site workers in 2011 was 50,218. The data relates to the construction activity of legal entities employing 5 or more workers.

The crafts provided the total of 13,067 workplaces in the construction sector as of December 30, 2012.

In accordance with Otto and Bićanić (2001), the share of undeclared work in the 1995 GNP amounted at least 25%. The majority of analysts agree, however, that there has been two periods in the amount of the undeclared work, namely before and after the year of 1993. The period after 1993 is less reliable as some data shows an increase and some data a decrease in the share of undeclared work. All investigators agree in turn that the share of the undeclared work is a huge one and that there are no signs that this share might decrease.

Having analysed the share of grey economy in 31 European countries' GNP in 2011, Schneider indicated an increase of the share in Croatia if compared to 1993 and found out that Croatia lead on the list with 29.5 % preceded by Bulgaria and Romania only. It is important to point out that Croatia is far above the European average of 19.3% and, moreover, the average rate of the grey economy is in a constant decrease in all countries except Croatia where the rate has been at a constant value.

The average annual energy consumption in public sector buildings today falls between 250-350 kWh/m<sup>2</sup> and a decrease down to annual 50-90 kWh/m<sup>2</sup> is expected to be attained by means of the EE refurbishment. In 2010, the final energy consumption in buildings amounted 42,3 % of the overall energy consumption in Croatia.

The buildings that were constructed before 1987 feature the average heating energy consumption of 200-250 kWh/m<sup>2</sup>, whereas the EU standard for the heating energy consumption is up to 70 kWh/m<sup>2</sup>. Thus, the mentioned consumption is large and not rational and the EE refurbishment could result in considerable saving of energy and money as well as the protection of environment.

Although the estimates have shown that 80% of the existing residential buildings fall into the worst energy classes (with the heating energy consumption exceeding 200-250 kWh/m<sup>2</sup>), the financial stimuli for improving the current situation are at disposal for some of the public buildings only. The benefits from the EE refurbishment are multiple: the improvement of living and working conditions, a decrease in the overall energy consumption and a boost to the economy as a whole, including the construction sector, the financial sector, the industry sector and other sectors.

The Republic of Croatia has adopted the 20-20-20 objectives up to the year 2020 that have been set by Energy Performance of Buildings Directives (EPBD and EPBD II). The objectives of improving the EE and the RES share as well as the reduction of the overall energy consumption in building stock have been contained in the Energy Sector Development Strategy of the Republic of Croatia and the National Environment Protection Strategy. The construction sector of the Republic of Croatia can significantly contribute to the mentioned objectives. Namely, in accordance with the report by the Central Bureau of Statistics, 2 million square metres of residential buildings are constructed annually whereas there are 2.1 million existing flats and houses. In Croatia, 80 % of residential buildings are privately owned (including the huge residential buildings). This means that the refurbishment of the existing buildings poses a fairly larger task for the construction sector than the construction of new ones implying the need for a large number of skilled workers. The statistical data have shown that Croatia uses energy in a less efficient way than other Western Europe countries. According to the 2010 data, Croatia consumes 14.6% more primary energy per GNP unit than the EU-27 average. The objective is to refurbish 3% of the public buildings annually by means of the EE measures.

In the Republic of Croatia, there are presently no certified crafts to deal with RES, i.e. there are no persons to deal with the installing of the RES equipment and the persons dealing with the installing of RES equipment are mostly air-condition and heating systems installers, plumbers and other craftsmen of the kind. In accordance with the surveys done for the purpose of the Project concerning certificates for installing of the RES equipment, there are installers for "more sophisticated" technologies present in the market, but their training have been "covered" by the companies that are at the same time the producers or dealers of the RES equipment. It is important thus that the education programmes and curricula in VET schools should be (re)tailored (in details) to the acquisition of the knowledge that would prepare the future craftsmen better for the (future) potential installations of the technologies in question. As to the education, it should include, besides the EE, the workers dealing with RES, namely the use of the solar energy, heat pumps, biomass and the wind energy.

In order to attain the main objective of the Project and this is to define and quantify the needs and abilities of the construction sector in Croatia aimed toward the ambitious national EE objectives, the stress in this document lies on determining the number of workers needed for attaining the 20-20-20 objectives by the year 2020.

Table 1-1 shows the basic data on the construction sector obtained by the thorough project analysis

**Table 1-1 Basic data for the construction sector**

Overall number of workers in the construction sector	78.850
The number of workers in the building stock sector	31 540
Estimate of the number of workers for attaining the 20-20-20 objectives	37 600
The number of persons entering the labour market after the initial education	6564/year
The number of persons attending lifelong education courses	-
The needed number of trainers	250

## 2. Introduction

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All the member EU states and the three states that are not EU members to have implemented Build up Skills project have recognized the building stock sector as a field with the largest potential in terms of attaining the objectives known as “20-20-20”, the objectives relating to the adopted 2007 European Commission plan that stipulates the reduction of greenhouse gases emission by 20 %, the increase in the use of RES in the overall consumption and the reduction of energy consumption by 20 percent – in comparison with the 1999 values- by the year 2020.

Similarly, the EU member states and Croatia’s experience have shown that the energy efficient refurbishment and the construction of new buildings with as low energy consumption as possible (low energy, passive, almost zero energy) are presently posing a big challenge for the construction sector and for the whole industry. Based on the data on the tendencies in the construction sector for last 4 years (overall investments, works volume and the number of constructed buildings) and on the analysis of the needs of the domestic population (the number of households related to the number of flats), it is possible to say that it is hard to expect a start of a positive business cycle in this sector and in the field of construction of new flats. However, the state of housing in Croatia and the consumption of energy-generating products by the sector combined with the increasing prices of the energy-generating products in the global market indicate that the EE refurbishment is the field in which the majority of construction works can be expected in the years to come.

As the attached analyses will show, in order to attain the objectives from the EU directives by means of the above mentioned EE works in the building stock, an increase of the number skilled workers in the market is needed, i.e. the creation of workforce (craftsmen, entrepreneurs) featuring adequate knowledge of or specialized in tasks at the performance of which new technologies are used and being able to guarantee for the quality of performance once the works have been done.

It is as well needed to create measures that will provide for the prerequisites of the evaluation of the qualified workforce in the labour market (regulations, recommendations).

Although the additional qualifications for workers constructing passive or almost zero energy buildings may seem unnecessary, the qualifications have proven crucial in terms of the quality of construction works (and even in terms of constructing buildings in accordance with plans and professional rules). The construction of buildings with low energy consumption requires a high quality performance of works by means of a careful performance of even minutest details of the envelope of a building and the technical systems installed.

The beginning of the report provides the explanation of the purpose of gathering the data for this analysis with a stress on the crucial data. Namely, these are the sources of the used, the series of the data used and the way it was interpreted. The shareholders (institutions and bodies) taking part in the Project as partners or strategically important organizations and their respective analyses used in this reports will be explained in more details, as well as their relevance in the Project.

Then, the principles of setting up the questionnaires for craftsmen and companies and for VET schools are explained. Furthermore, the data obtained by these questionnaires are explained in details as well as its analysis in relation to the overall figures and indicators.

Section Four gives the description and the analysis of the construction sector in Croatia. A special care has been taken for: the structural and the chronological analysis of the sector in terms of its share in the GNP and the growth; the analysis of the main actors related to the supply and demand of the works, workforce, technology, materials and alike. By means of analyzing the accessible data, there has been an attempt of providing for a coherent overview on the present market trends and forecast, as well as of underlining the main factors of changes that already have influenced the sector and could do so in the near future. An insight into some estimates of the grey economy in the sector has also been given.

Section Six provides all the relevant data and indicators for the construction sector with the accompanying explanations, which means the building stock sector in particular, i.e. the types of buildings and the dynamics of their construction and refurbishment. As to the EE and the contribution of the building stock to it, an overview has been given of the number of low energy buildings and the annual rate of constructing and refurbishing of the buildings of the kind. This chapter provides as well an overview and an economic analysis of the crafts and companies taking part in the sector and of their features (the number of workers by vocation and qualification levels). The final part of the chapter provides data on the consumption of energy and the use of RES in the building stock.

Sections Five and Seven give a comprehensive insight into the training and education of craftsmen, other on-site workers and the installers of technical systems in the construction sector and it in turn includes the national VET education/training system for the afore mentioned people, the bodies responsible for the VET education/training

and the bodies that issue certificates as well as the institutions that offer VET education and are relevant for the sector. The existing courses and educational schemes for EE and RES in the realm of construction have as well been analysed. Section Eight includes the workforce migration and focuses on certain groups of workers. The objectives are to identify the skills and knowledge needed the future workers will need and to roughly estimate the number of workers in particular activities/sectors that will be needed. The estimates include as well some proposals as to the most convenient ways of training and qualifying, including the necessity of additional trainings and employing instructors/teachers and identifying qualifying and certifying bodies.

Section Nine gives an insight into the preliminary analysis of the obstacles (concerning construction workers) to the attaining of the national and EU 20-20-20 objectives.

Section Ten gives conclusions drawn on the basis of the Status Quo Analysis.

# 3. Objectives and methodology

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## 3.1. Objectives

The main objective of writing the Status Quo Analysis for the Republic of Croatia is to define and to quantify the needs and the abilities of the Croatian construction sector in terms of contributing to the national EE objectives and their attaining. The analysis is firstly oriented toward the existing level of knowledge of the workers in the construction sector within the context of EE technologies and the attitude of managers of crafts and companies toward new technologies and education. The analysis has shown in which way the future construction workers are currently educated within the VET schemes; furthermore, there is an attempt to detect the “soft spots” in the education sector and thus two crucial segments constituting the VET are analysed:

1. The content of the educational programmes and curricula within the VET, i.e. the modules of the theoretical and the practical part of qualification exams in the realm of construction.
2. The existing level of knowledge of construction workers related to EE construction procedures and technologies. The opportunities and programmes of lifelong learning that are accessible to workers have been analysed as well.

The main objective to be attained by means of this analysis is to define – in conformity with other strategic documents at disposal concerning the construction sector and its contribution to attaining EE and energy sustainability objectives- the number of workers needed for performing the key works and, finally, to assess the current education opportunities and to propose the optimal solutions in terms of redesigning the existing programmes and curricula and to implement new ones.

The recommendations this document is to yield are going to be the cornerstones for making the strategic decisions by all the relevant stakeholders in the sectors of construction and education for the purpose of setting up:

- a. a system of education and training of the workforce in the realms of EE and RES
- b. a system of market evaluation of qualified workforce as the guarantee of a long-term upgrading of energy efficiency of the building stock sector in the Republic of Croatia.

## 3.2. Methodology

The report has been written based on the relevant documents at disposal and the data from the public sources that describe the state of the construction sector, the state of energy industry and the education sector with a special stress on the vocational education. Some of the documents analysed relates to the Croatian institutions whereas some are EU documents. The mostly used documents are:

- official databases
- national studies and strategic documents
- action plans and analyses

The documents were used mostly for the purpose of analysing the construction sector in regards with the technologies, the state of buildings and the respective legislative.

The analyses of the VET system and the knowledge of construction workers have been performed by means of analysing the accessible documents and the data obtained from the main stakeholders in this realm; however, the analyses have been based mostly on the analysis of the questionnaires answered by construction workers and of the questionnaires answered by the persons employed at the educational institutions offering VET curricula (teachers, instructors, principals).

In order to survey the knowledge of the construction workers and craftsmen performing works and in order to define “soft spots” and key needs as to further training on the basis of obtained information, craftsmen and other surveyed were given three questionnaires covering various respective fields:

- *Questionnaire A* contained general questions aimed at the description of the structure of the trades performing construction works with all parameters (size, kind of works, number of employees and alike) and aimed as well at determining the level of knowledge and motivation of craftsmen, managers and their workers concerning EE, new technologies and trends in construction. This questionnaire was answered by all the surveyed regardless of the type of work they perform on buildings.



- *Questionnaire B1* contained more detailed questions on the new technologies and their application in the context of EE in the building stock. It relates to the vocations that perform works on the envelopes of buildings (reinforced concrete, bricklaying, roofs, façade, insulation and alike) and joiners.
- *Questionnaire B2* was answered by only those crafts that install heating and air conditioning systems because those crafts are the very crafts that install technologies that use RES (solar energy systems, biomass, heat pumps, wind turbines and alike).

The questionnaires were delivered to the craftsmen directly (via e-mail) and through the system of chambers of trades and crafts and craftsmen associations. Simultaneously, for the purpose of enhancing the visibility of the Project and for the purpose of obtaining the direct information from craftsmen and workers, there were several field visits with educative panel discussions. The field visits were organized in the way that -after lectures EE technologies- provided for discussions from which a more “tangible” insight into the real situation in the field of the construction works was obtained. The questionnaires were as well answered in the course of the visits.

The analysis of the VET schools sector was as well based on two elements, namely on the official data on the number of students and the respective programmes and on surveys as well. Three types of questionnaires were made for the following three types of schools:

- the questionnaire for the technical VET schools of building and crafts,
- the questionnaire for the mixed types of VET schools,
- the questionnaire for the mechanical and/or electrical engineering VET schools

In the end, the education programmes/curricula were analysed in accordance with which exams are taken within the VET education system for the key vocations to perform works on buildings and deal with EE technologies (bricklayers, plasterers, sheet-metal workers, joiners, electricians, gas system fitters, heating and air-conditioning system fitters).

The organizational structure of the institutions constituting the consortium for implementing the CROSKILLS incentive has been set up in the way that anticipates a successful implementation and endorsement of the National Roadmaps. Similarly, the key institutions acting as the partners in the project and/or platform members are the source of a considerable number of the strategic documents, analyses and the integrated data having been used in the Status Quo analysis.

## 4. Characterization of the Construction Sector

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The construction sector is, in accordance with all indicators, an important part of the economy of the Republic of Croatia. It has featured a constant growth in last decade, especially in the period up to the year 2008. In accordance with the analyses at disposal, the overall share of the construction sector in the GNP of Croatia peaked to 7.0% in 2009 and has kept at the levels higher than 6% from 2006 onward. The growth of the share was caused by the investment growth (presumably into the capital infrastructure projects, among which road construction is to be pointed out as the main momentum in the construction sector expansion - with 9.8 billion kn invested- as well as a growth in the residential construction).

Namely, the relatively feasible housing loan conditions and an increased accessibility of housing loans pushed the demand for the residential real estates far above the supply in the market, which gave a rise to an intensified residential construction.

A more significant decline in the construction sector marked the turn of 2008 to 2009 when the overall value of works decreased by 10.4% in comparison with the previous year. The value of new orders dropped by 13.6% (42% in the residential construction and by 58% in the non-residential construction) and the number of workers decreased by 9.94% if compared with the 2008 figures.

The deceleration and the decrease of the growth of economy that have been present from the late 2008 onward have contributed to a drop of activities in the construction sector as well (a lack of important investments and a huge drop in the real estate demand which resulted in a supply of real estate in the market being far above the level of the demand etc).

The decrease in the construction sector has continued for past three years. Generally, all the real estate market segments have been affected by the afore mentioned tendencies. The overall number of building permits issued has been at a constant decrease (except the temporarily mild increases at the annual level caused by the low comparison base from the previous year). In 2011, the stagnation in the real estate market and the continuation of the negative trends in the construction sector resulted in a continuation in the decrease of the annual number of building permits issued (-4,8%). As to the types of buildings, the annual drop in building permits for residential and non-residential buildings of 4.8% continued in 2011, whereas other buildings featured a drop of approx. 5.2% that was caused primarily by a significant annual-level drop in the number of building permits for other buildings that have not been mentioned, such as bridges, sports facilities etc (-24.6%). Along with the decreased investments into infrastructure, there was as well a drop of building permits issued for the construction of pipelines, communication and energy cables last year (approx. 12.5%).

The negative trends continued in 2012 (the records for the two first months showed an average annual drop of 11.6%) and the decrease rate returned at two-digit figures thus indicating an extremely negative trend).

In accordance with the data the Ministry of Economy provided from the Registry of Crafts that the Ministry and the Chamber of Trades and Craft keep mutually, in the late 2012 there were 7514 crafts registered that perform some of activities in the realm of construction.

In the late March of 2012, the number of employees in legal entities in the Republic of Croatia was 1,128.769, out of which 78,850 in the construction sector. If the overall number of employed as of the late December of 2011 is compared to the number of employed in economy, there was a 0.01 % growth, whereas the overall number of the employed in the construction sector decreased by 4.23% (from 82,189 persons). If the first quarters of the years 2011 and 2012 are compared, the overall drop of the employed in economy was 1,20%, whereas the percentage is higher for the construction sector and amounted 5.40%.

All the relevant statistic data indicates that the Croatian construction sector has been undergoing a crisis. One of the main reasons for that lies in a deceleration and lack of investments in both private and public sectors as the result of the recession that has affected the economy as a whole.

# 5. National Policies and Strategies to Contribute to Attaining the 2020 Objectives in Building Stock

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## INSTITUTIONAL AND LEGISLATIVE FRAMEWORK FOR ENERGY EFFICIENCY IN CONSTRUCTION

As the 28<sup>th</sup> EU member state, the Republic of Croatia accepted the principles of the common European energy policies and brought the national policies and legislative in conformity with the unified strategy of energy development and lessening the effects of the climate change at the EU level. The main national documents concerning the national EE policies have been adopted, namely Energy Sector Development Strategy (Official Gazette 130/09), National Energy Efficiency Program 2008 – 2016, The First National Energy Efficiency Action Plan of Croatia 2008-2010 and The Second National Energy Efficiency Action Plan of Croatia up to the end of 2013.

For the purpose of attaining these goals, the Energy Sector Development Strategy stipulates, among other issues, a continual bringing its legislative and regulations in conformity with the EU legal heritage and fulfilling the adopted obligations regarding the use of RES, EE and reducing greenhouse gases emission.

In order to ensure the fulfilling the adopted obligations regarding the EE in construction, the institutional framework for implementing the EE policies in construction has been enhanced by means of establishing the Directorate for Energy Efficiency in Construction, Strategic Planning and International Cooperation within the Ministry of Construction and Physical Planning (the Ministry in further text) in accordance with the Regulation on the Organization of the Ministry that was passed on the Government session of February 23, 2012. The Directorate performs the normative, administrative and professional tasks in implementing the Croatian Government's policy of EE. The Ministry is the central state administration body in charge of transferring and implementing EPBD in the national legislative as well as a part of the obligations stipulated by ESD (the Directive 2006/32/EC on energy end-use efficiency and energy services) and EED (Energy Efficiency Directive of October 25, 2012). In regards with the afore mentioned, the legislative and the regulatory framework is constantly being brought into conformity with the EU legal heritage. The Ministry of Economy of the Republic of Croatia is as well in charge of the full transfer of the EU legal heritage concerning the sector of energy and energy efficiency.

Regarding the legislative framework, Physical Planning and Construction Act (Official Gazette 76/07, 38/09, 55/11, 90/11, 50/12) proposes the promotion of appropriate designing and construction that are to provide for the safety, health, environment and energy features of buildings in the manner that in turn provides for energy efficiency of the buildings. The Act as well proposes that each building, depending on its purpose, should comply with requirements important for the building and with other requirements set by the Act and other technical regulations. One of the important requirements to be complied with by the way of designing and construction is energy saving and thermal insulation. Buildings have to be designed, constructed and maintained (in relation to the local climate conditions) so that the energy consumption generated by the use of heating, air-conditioning and ventilation systems equals the law-prescribed level or less whereas for the persons who use the buildings the appropriate bioclimatic conditions have to be provided for. Furthermore, each building, depending on its type and purpose, has to be designed, constructed and maintained in the way that ensures the energy properties provided by the law.

The technical regulations propose the compliance with the requirements of designing, construction, use and maintenance as well as with other requirements.

The maximal allowed annual heating energy value per unit of the useful area of a residential building (i.e., per unit of the heated volume of a non-residential building) has been set as well as the maximal allowed coefficient of the transmission heat loss per unit of the envelope of the heated portion of a building, the maximal coefficient of heat transfer for particular parts of a building (outer wall, windows, roof etc.), the minimal thermal bridges requirements and overheating protection.

ZUKE (The Act on End-Use Energy Efficiency, Official Gazette 152/08, 55/12) regulates the national EE policy of the Republic of Croatia. The Act governs the activities in energy services based on the agreement on energy effect where the investments into measures of increasing the EE are returned from the

energy savings and provides for the development of ESCO market and starting of the economy investment cycle. As of June 20, 2012 and based on ZUKE, the Croatian Government passed the Regulation on Contracting and Providing Energy Services in Public Sector (Official Gazette 69/12). It governs the procedures of contracting energy services in the public sector for customers that are or are not financed from the State Budget, local (or regional) self-management units, for Energy Services Performance Investments Monitoring Centre and for energy service providers.

According to the Regulation, the provider of energy service binds to provide energy service for the customer by means of implementing the measures of improving EE whereas the customer binds to ensure payments to the provider where the payment is based on achieved and verified energy savings, all of which is set up in details in Energy Effect Agreement. By means of the adoption of the Regulation, the prerequisites are provided for the implementation of the Program of EE Refurbishment of Public Sector Buildings provided by the Ministry. The Regulation in turn provides for the development of the energy services providers market (ESCO) and the entrance to the new market and bidding for interested companies at public tenders for EE refurbishment of the public sector buildings.

Also Based on ZUKE, some other documents were created to further work out the defined policy of EE improving policies, namely the National Energy Efficiency Programme 2008-2016 and the First and the Second National Energy Efficiency Action Plan of Croatia.

As to the energy management sector, ZUKE encourages EE in end-use of energy with the objectives of ensuring a sustainable energy development, satisfying the needs of consumers and providing for the reliability of energy supply.

Based on The Act on End-Use Energy Efficiency, the following ordinances were passed:

- Ordinance on Energy Audits and Energy Certification of Buildings (Official Gazette 81/12),
- Ordinance on the Requirements and Criteria to be met by Energy Auditors and Energy Certifiers of Buildings („Official Gazette 81/12),
- Ordinance on Supervision of the Reports on Energy Audits AND Energy Certificates of Buildings (Official Gazette 81/12).

For the purpose of encouraging EE and removing unnecessary administrative obstacles and complicated procedures, the following changes and addendums to subordinate regulations applied as follows:

- Ordinance on Simple Buildings and Works (Official Gazette 81/12) - some works on an existing building (in accordance with the main or typical construction design) can be performed without the building and location permits if the works are to improve the energy properties of the building (replacement of windows, thermal insulation of floors, walls, ceilings, roofs, equipment, heating/air conditioning systems,...) and
- Ordinance on the manner of calculating the volume of the buildings for the purpose of local tax (Official Gazette 136/06, 135/10, 14/11 and 55/12) – if a building is reconstructed or some works are performed for the purpose of improving EE of the building, the new thermal insulation (including the final layers that improve the energy properties) is excluded from the volume calculation.

The reinforcement of regulations and ordinances includes authorizing experts in energy audit and energy certification of buildings. There are 10 institutions presently in the Republic of Croatia that have been training experts that are to audit and certify buildings. These are universities, community colleges, institutes and professional associations that have been accredited by the Ministry of Construction and Physical Planning to perform the training programmes. The institution mentioned are: The Faculty of Civil Engineering of the University of Zagreb, The Faculty of Engineering of the University of Rijeka, the Community College of Slavonski Brod, the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture of the University of Split, Energy Institute Hrvoje Požar, the Croatian Chamber of Mechanical Engineers, Shipbuilding Institute, Ltd., Zagreb, The Association of University-trained Construction Engineers Zagreb and The Faculty of Civil Engineering of the University of Osijek. Some 1100 architects and engineers have completed the training courses up to now. More than 600 of them, both persons and legal entities have been accredited for energy audits and energy certification of buildings. There have been more than 6,000 building energy certificates issued since 2010.

The database software containing the performed energy audits of buildings, building energy certificates and authorized certifiers has been installed and it is in the testing stage. During the November of 2012, the training took place for authorized persons for the energy certification of buildings in order to test the application of the software... By means of this software, the authorized persons will be able to submit energy certificates of buildings. In this way, they will create a registry with information about buildings that includes a variety of data related to building energy performance and will provide for a more effective control of the quality of issued building energy certificates and performed energy audits of buildings.

By the end of 2013, further activities shall have been performed for the full transfer of the Directive on the energy performance of buildings, which include the definition of reference buildings in accordance with the Croatian directives, regulations and guidelines adopted in the spring of 2012, and it is to define the minimum conditions on the energy performance of the building in accordance with its purpose and thus to define nearly zero energy buildings as well. As a necessary part of these activities, an algorithm was made for calculating the energy performance of buildings and it was published on the website of the Ministry after a public discussion. Energy audits of buildings are performed in accordance with the Methodology of performing energy audits and it is also published in the website of the Ministry. The plan is to create the National software for the calculation of the energy performance of buildings that should be publicly available to all authorized persons by the late 2013. The creation of the national software will contribute to the quality of the work of the authorized personnel, and standardize their operations, facilitate and simplify the control the building energy certificates issued and it is as well to contribute to the quality of the work of architects, construction and electrical engineers in while designing a building.

## PROGRAMS OF EE REFURBISHMENT OF BUILDINGS

The average energy consumption in the buildings of the public sector is now around 200 - 250kWh/m<sup>2</sup> per year, and the EE refurbishment is expected to reduce this consumption below 90 kWh/m<sup>2</sup>. The final energy consumption in buildings in 2010 amounted to 42.3% of the total energy consumption in the Republic of Croatia.

### In buildings, energy is used for:

- Heating and hot water, 80 - 90% of total energy requirements of the building
- Lighting and other purposes (e.g. computers), 10 - 20% of total energy consumption
- Cooling for now a small fraction of the total annual energy consumption, but a steady growth of energy consumption in this sector is expected.

The buildings constructed before 1987 feature an average consumption of thermal energy for heating of 200 -250 kWh / m<sup>2</sup>, while the EU standard of consumption is up to 70 kWh / m<sup>2</sup>, so consumption is highly irrational and the EE refurbishment can achieve great economic and energy savings and contribute to the environmental protection.

In 2010, the total area of non-residential buildings was estimated at 43.38 million m<sup>2</sup> of floor space whereas the floor space in public buildings was 9.58 million m<sup>2</sup>, or 22% of the total area of non-residential buildings.

2010/31/EZ Directive of the European Parliament and the Council of May 19, 2010 on the Energy Performance of Buildings (Energy Performance of Buildings Directive - EPBD) requires that public buildings sector play a leading role in the field of energy efficiency in buildings and should envisage ambitious goals for public buildings.

Directive 2009/28/EC of the European Parliament and of the Council of April 23, 2009 encourages the use RES and requires that the obligatory use of RES should be encouraged at the national and the regional levels in new and refurbished buildings where the public administration buildings on which major reconstruction works are performed should be used as an example from January 1, 2012 onwards.

At the national level, on the basis The Act on End-Use Energy Efficiency, (Official Gazette 152/08, 55/12) the Second EE Action Plan for the period until end of 2013 was adopted and it includes the Public Sector Buildings Refurbishment Plan. The Ministry made the Public Buildings Energy Refurbishment Plan for 2012-2013 with a stress on the buildings owned by the Republic of Croatia (hospitals, children's homes, administrative buildings and the buildings owned by the local self management units (schools, kindergartens, hospitals).

### Objectives of the programme:

- Reducing the overall energy costs in the public sector buildings by 30-60%
- Increasing the share of RES
- Deployment of the advanced energy consumption measuring systems
- Centralized expenses analysis
- Development of the energy service market
- Local economic development
- Reduction of the dependence of the Republic of Croatia on import
- Contribution to the sustainable development (the reduction of CO<sub>2</sub> emission )

The program ensures and encourages the application of economically viable, energy-efficient technologies and measures in the public sector buildings in the Croatian territory with the purpose of developing new business and entrepreneurship, continuous and sustainable energy management, strategic planning and sustainable management of energy resources at the national, regional and local level. The program aims to harness the potential of investing in the public sector buildings in cases where the amount of the investment is less than the benefits to be realized through savings in energy in the future.

The model to carry out the program is the ESCO model, which includes operations in which the provider of energy services (ESCO company) proposes measures to improve energy efficiency by means of its own solutions, which then result in demonstrable savings in energy use. As the application of such a model in Croatia is limited, this program will provide for preconditions for the development of the ESCO market. In this way, investments are developing a market for energy services, introduce the principles of energy efficiency in public procurement, develop an information system for monitoring and power management in the public sector and encourage overall economic investment cycle. The program was launched by the Ministry, and it was conducted in 2012 in its preparation and professional part. In the course of 2012, the Ministry received 1013 completed forms intended for owners / users of the buildings through which the buildings were signed in the Ministry's Programme. The Ministry chose buildings to enter the Programme and financed and organized the project tasks and energy audits of the chosen buildings. The Ministry handed over the audit reports to the Energy Sector and Investments Monitoring Centre. As part of the Programme in 2012, the Ministry made 185 project tasks to which they assigned 2,167,100.00 kn and 111 energy audits of buildings to which they assigned 1,216,700.00 kn - a total of 3,383,800.00 kn. The Investment Monitoring Centre public tenders in which providers of energy services (persons or legal entities) offer a variety of measures to improve EE refurbishment of buildings and provide a guarantee of energy savings. The selected energy service providers enter into energy performance contract with the owners / users of the buildings and then the drawing of designs and the performance of the respective works is to follow.

So far, the Centre has issued tenders for some 40 buildings, concluded the 5 energy performance contracts (5 schools in Varaždin) with the appraised value of investments of 13,750,000 kn + VAT, whereas the contracting has been in process for 8 more buildings, where the estimated value of investments is 10.5 million + VAT. The tenders for further 50 buildings are presently under preparation.

Some of the buildings are in turn going to apply for the ELENA funds to obtain grants for the preparation of designs which will continue to be financed by the ERDF, EEEF and JESSICA funds.

In the course of 2013, a program will be developed for the EE refurbishment of residential buildings and for the commercial buildings sector. The refurbishment works are to be funded via the combination of funds from ERDF, EEEF and JESSICA, but the preparatory activities on creating a database of buildings, collecting documents and energy audits and energy certification of buildings should commence immediately in order for the projects to be eligible for funding as of January 2014. Simultaneously with the preparation of the Programme of EE refurbishment, the setting up of the Registry of buildings on the territory of Croatia will begin and it will be done, in cooperation with the SGA. The Register will be connected with the cadastre. A program of increasing the numbers of nearly zero-energy buildings will be developed in the course of 2013, after defining the reference buildings in Croatia and calculating cost-optimal analysis for the renewal of each of the reference buildings. The program will be continuously carried out with the help of financial instruments from the ERDF, EEEF, JESSICA and other programs for that purpose. Namely, from January 1, 2021 all buildings to be built in the EU will have to be nearly zero-energy ones whereas from January 1, 2019 all public administration buildings will have to be built as nearly zero-energy ones.

## **OBLIGATION OF THE ENERGY CERTIFICATION OF BUILDINGS**

According to Article 15 Paragraph 2 of the Act on Physical Planning and Construction (Official Gazette, 76/07, 38/09, 55/11, 90/11 and 50/12), before issuing a permit, other arrangement for the use of, or prior to a change of ownership or renting a building or part thereof, a certificate of energy performance of buildings shall be obtained (in further text: energy certificate) and it shall be issued by an authorized person, whereas as provided for in paragraph 3 of the same article a buyer or lessee of the building or part thereof shall have access to energy certification before signing the sales contract or lease under special legislation.

The Ordinance on energy audits of buildings and energy certification of buildings («Official Gazette», No. 81/12) (hereinafter referred to as the Regulations) prescribes energy audits of buildings to determine energy performance and the way of energy management in buildings that consume energy and water, establishing measures for improving energy efficiency and their profitability and implementation of energy certification of buildings. The Ordinance governs:

- annual limit value of final energy consumption of the building that used to determine the category of a large consumer of energy,
- the energy certification of buildings and exemption from that obligation
- the obligations of public display energy certificate for buildings
- obligations of investors, owners and occupiers of the building when conducting building energy audits and energy certification of buildings
- the procedure for conducting energy audit of the building,
- The procedure for building energy certification,
- how to determine the energy rating of the building,
- the content and layout of building energy certificate,
- conducting regular inspection of heating and cooling systems and air conditioning,
- Register reports on performed energy audits of buildings and energy certification of buildings.

#### **The obligation of obtaining the energy certificates applies to:**

1. the buildings with (gross) area not exceeding 400 m<sup>2</sup> and buildings intended exclusively for agricultural activities with the (gross) area not exceeding 600 m<sup>2</sup>, which are subject to energy certification under the Regulations, the investor prior to the use of the building / setting it to operation is required to submit the certificate to the authority that issued the building permit along with the final report of the supervising engineer
2. any other new building for which a certificate of occupancy is issued, the energy certificate is attached to the application for the issuance of a use permit.

For buildings constructed under a building permit issued from June 20, 1991 to October 1, 2007, instead of the certificate of occupancy, at the request of the investor and the owner of the building, a use permit is issued. Prior to issuing of the use permit, it is necessary to obtain the energy performance certificate.

A public building or part of a mixed-use building that is as an independent functional unit used for a public purpose must have the energy certificate, as well as any other building or its self-contained unit that is built, sold, leased, given on lease or leased. To fulfil obligations of obtaining energy certificates for existing buildings and their individual usable units that are for sale, rent, lease or give the lease, it is governed that the energy certificate must be available for inspection to the prospective buyer, lessee or renter on the day of Croatian accession to European Union membership at the latest. A public building or part of a mixed-type building that is used as an independent functional unit for a public purpose and if it has a total useful floor area over 500 m<sup>2</sup> (over 250 m<sup>2</sup> from July 9, 2015 onward), shall have an energy performance certificate displayed at a prominent place clearly visible to visitors of the building. The first page of the energy certificate is publicly exposed as the page that contains the basic information about the building and the scale of the energy class, and the third page of the energy certificate with proposed measures to improve the energy performance of buildings that are economically justified for existing buildings and recommendations for the use of the building in relation to the fulfilment of the essential requirement energy savings and thermal protection and fulfilment of the energy performance of new buildings.

Exemptions from the obligation of obtaining the energy certificate are prescribed in Article 8 of the Ordinance.

#### **Public buildings are defined in Article 4 of the Ordinance as follows:**

1. Office building for administrative affairs of legal entities and individuals,
2. Buildings and other state administrative bodies, local and territorial (regional) self-government,
3. Building legal persons with public authorities,
4. Courthouses, prisons, barracks,
5. International institutions building, chambers, business associations,
6. The building of banks, savings banks and other financial institutions
7. Building shops, restaurants, hotels, travel agencies, marinas, tourism and other service activities
8. Building rail, road, air and water transport, post office building, telecommunication centres, etc.
9. Building for preschool, elementary and secondary schools, kindergartens, nurseries, etc., buildings for higher education, research laboratories, etc

10. Building for communities: homes for senior citizens, children, students, workers, and other children's homes that are designed as a temporary or permanent residence,
11. Sports associations and organizations buildings, sports facilities buildings
12. Buildings for cultural purposes: cinemas, theatres, museums, etc.
13. Hospitals and other institutions for health - social and rehabilitation purposes.

**According to the Regulations energy audit of the building is required once every five years for:**

- buildings used by huge consumer (consumer of the industrial sector, whose total annual final energy consumption in a building in which it performs activities over 10000 MWh) to perform its activities,
- public lighting, (which includes street lighting on roads outside a settlement)
- public buildings whose useful (net) area exceeds 500 m<sup>2</sup> (250 m<sup>2</sup> from July 9, 2015 onward)
- the existing buildings or parts of buildings that make up a whole separate useful unit and which are subject to obtaining the energy certification of buildings,
- heating systems in buildings with boiler burning liquid or gaseous fuel with the total nominal power of 20 kW and higher,
- of refrigeration and air conditioning systems in buildings with one or more devices generating heating / cooling power with the total power ratings of 12 kW and higher.

A regular inspection of the heating system boiler with an effective rated output of more than 100 kW shall be performed every 2 years from the date of submission of a regular inspection report, and every 4 years for a gas boiler.

In accordance with a special law, the public sector is obliged to manage the direct energy consumption in the of the public sector buildings and - for the fulfilment of these obligations – to perform energy audits in the prescribed timeframe. An energy audit is used to provide the knowledge of the existing energy consumption of the building, to determine the feasibility of options to reduce the final energy consumption, for issuing energy certificates, and to determine the achieved savings after implementation of energy efficiency measures. The implementation of the proposed measures in the energy certification of buildings to increase energy efficiency is not mandatory; however, it is believed that the owner/user of the building is going to make use of some of the proposed measures.

The energy certificate provides for the owners and users of these buildings to get the relevant information on the energy state of the building and information about the energy situation and energy consumption in these buildings that will be of benefit in creating a national energy policy.

The methodology for performing energy audits of buildings has been envisaged with the objective of an energy audit to be performed by determined steps in order to result in the required information and data necessary to determine the viability of the implementation of measures that are to improve energy efficiency. Methodology was published in the October of 2012 and replaced the existing methodology of performing energy audits of buildings dating from 2009, in the part concerning the performing of energy audits of buildings and the accompanying calculation of the energy performance of buildings up to the required level of thermal energy for heating and it applies from the date of publication. The methodology includes the following parts:

1. The methodology of conducting energy audits of buildings
2. Template reports on energy audit of the building
3. Questionnaire to collect data.

European Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2012 requires Member States to adopt a methodology for calculating the energy performance of the building. The methodology can be made at the national or regional level, and must be in accordance with the common general framework. Under this framework, the energy performance of buildings is determined on the basis of calculated or actual annual energy that is consumed to meet the different needs associated with its typical use and reflect the energy needed for heating and cooling energy requirements in order to be able to maintain temperature conditions predicted building, and the energy required for domestic hot water. For non-residential buildings, it is necessary to include a built-in lighting installation. Methodology must take into account the European standards and be consistent with the relevant EU legislation. Ordinance on Energy Audits and Energy Certification of Buildings (Official Gazette 81/12), provides that the required calculation of the energy requirements of the building carried out in accordance with the methodology for energy audits of buildings. "Methodology" is defined as a set of actions



and procedures for conducting energy audits of buildings containing the algorithm for calculating the energy performance of buildings. The algorithm for calculating the energy performance of the buildings was published on the Ministry of Construction and Physical Planning website in the October of 2012. The algorithm includes:

1. The algorithm for the calculation of energy use for heating and cooling
2. Calculation of the heat flow coefficients for residential and commercial building
3. The algorithm for determining the energy efficiency requirements and thermotechnical systems in buildings (heating systems and domestic hot water)
4. The algorithm for determining the energy efficiency requirements and thermotechnical systems in buildings (cogeneration systems, district heating, photovoltaic systems)
5. The algorithm for the calculation of the energy required for the application of ventilation and air conditioning systems for heating and cooling buildings
6. The algorithm for determining the energy efficiency of lighting systems in buildings (energy requirements for lighting).

## ACTIVITIES IN THE UPCOMING PERIOD

During 2013 activities have been planned to take measures in order to achieve targets in the area of energy efficiency and comply with the directives of the European Union, which will be necessary to strengthen the existing administrative capacity, upgrade and maintain the existing information systems and set up new systems, prepare a professional background to create new and amend the existing regulations and make other plans and programs provided.

Furthermore, with regard to the requirements of the Directive 2012/27/EU on the energy efficiency, there is a need of creating a strategy of EE refurbishment of buildings after 2020 and the first draft of the strategy is to be published by April 30, 2014. Regarding the EED requirement for EE refurbishment of 3% of the public sector buildings from January 1, 2014 year, the plan is to develop a program of EE refurbishment of the public sector buildings.

With regard to the requirements of EPBD in 2013, there is a need of developing a national plan to increase the number of almost zero-energy building, the national program for EE refurbishment of residential buildings and the national program for EE refurbishment of commercial buildings.

Pursuant to the requirements of EED, the making of the Third National Action Plan is to commence. It should be completed by April 30, 2014.

In 2013, the planned harmonization of legislation with the Directive 2012/27/EU on energy efficiency, which will be implemented through amendments to The Act on End-Use Energy Efficiency (OG 152/08 and 55/12) and the amendment of the Regulation on Contracting and Providing Energy Services in Public Sector (OG 69/12).

It is planned that, by the Croatian accession date to EU July 1, 2013, the normative acts are prepared in the sense of a further alignment with the EPBD directive by amending the technical regulation on energy and energy performance of buildings, in part related to the obligation of making EEE applicability elaborate of alternative energy supply systems for all new and existing buildings that undergo major reconstructions. Furthermore, the Technical Regulations should be matched in part related to the obligation of establishing the minimum requirements on the energy performance of the optimal cost-analysis (TOA). It will also be changed in accordance with the requirements of the EPBD Regulations on energy audits and energy certification of buildings, in relation to amendments to the Technical Regulations on energy and energy performance of buildings.

In accordance with the requirements of the EPBD and based on an algorithm for calculating the energy performance of the building and software for the application of the algorithm, the software will be developed for calculating the energy performance of buildings. Furthermore, the plan for the first half of 2013 is the preparation of the Ordinance on the conditions and criteria for determining the quality of services and works for the certification of authorized installers of renewable energy sources. The legal basis for the development of such rules is a tariff system for electricity production from renewable energy sources and cogeneration (OG 63/12 and 121/12). The Ordinance is to be adopted for the purpose of being brought to conformity with the requirements of Directive 2009/28/EC on the promotion of the use of energy from renewable sources. By the end of 2013, In compliance with the EED requirements, the Registry of the central government buildings with a cooled or heated floor area above 500 m<sup>2</sup> shall have been published; the programmes of EE refurbishing of the residential and the commercial buildings are under preparation.

Education and training for persons and the respective actors in economy dealing with EE in construction will be continuously performed. In the classical model of vocational education, there are no facilities or specific subjects that would offer a comprehensive knowledge on energy efficiency in any segment of the vocational theoretical or practical training. It is therefore of great importance that the Croatian institutions have taken part in implementing the

EU Intelligent Energy Europe (IEE) Build Up Skills Project for supplementing the existing or launch some additional education and training of craftsmen and other construction workers and installers of engineering systems, which emphasizes the interaction with existing structures and financial instruments: The lifelong education and the European Social Fund. In regard with this, it is important to adopt the National qualification platform and national guidelines and qualification schemes and implementation of training for craftsmen and other construction workers and fitters. As the EU structural funds will be accessible for Croatia from its accession date of July 1, 2013, a significant stress in creating curricula has been put on upgrading skills, competences, knowledge and the lifelong education of all actors in the EE sector in construction – with the purpose of withdrawing grants from ESF.

## **5.1. National policies and strategies to contribute to the EU 2020 energy targets in buildings in the field of VET education**

### **NATIONAL POLICIES AND STRATEGIES RELATED TO GREEN SKILLS AND JOBS**

Croatia's geographical position and mild climate provides optimal conditions for the use of solar thermal systems. However, due to lack of incentives, the installed area of solar panels falls behind the developed neighbouring countries (four times fewer collectors per capita than neighbouring Slovenia [16]). Experience gained in the UNDP energy efficiency project shows that an investment in a complete system for preparing hot water for an average household costs approximately HRK 25 thousand and the entire amount returns in a period between 5-10 years (through energy savings, depending on the location, frequency of use and fuel used). With 30-40% subsidy of equipment (which is recently available in four counties of the continental Croatia) the return on investment has been reduced to 3-8 years, while further energy price increases, due to the expected liberalization of energy markets, will further reduce the payback time.

New Energy Strategy from 2009 [17] recognizes the potential of solar thermal systems and sets the goal of 35-fold increase in the installed area of solar collectors by 2030 (which would mean 563 m<sup>2</sup> per 1.000 inhabitants, a total of 2,5 million m<sup>2</sup> installed and 12,2 PJ of energy produced in 2030). As an example of such an installation we have the case of Cyprus in 2008, which led with 730 m<sup>2</sup> installed per 1.000 inhabitants (30% more than the Croatian goal for 2030).

The proposed objective under this analysis for solar thermal systems is achieved by 2020. The objective of the Energy Strategy envisages the same by 2030 (ten years ahead of schedule). Based on current prices of equipment, the total investment in such an installation would have amounted to USD 1,9 billion, with an annual turnover of USD 120 million.

Annual emission reduction by the realization of target proposed would amount to 1,6 million tons of CO<sub>2</sub> (at 470 kgCO<sub>2</sub> / MWh from electricity substituted by solar thermal systems). Comparison with recent Austrian experiences [16] show that achieving such an objective (the required 220.000 square meters of collectors per year) would result in 1.300 direct new employees and another 2.000 indirect employees a year by 2020.

Currently there are no incentives or obligations to improve the energy performance of existing apartments or houses. New changes in legislation require that every newly constructed house or apartment meet set energy standards and existing ones, used for rent or sale must obtain their energy card, which will make energy consumption visible. Great potential for job creation in the construction industry lies in the application of better insulation of existing buildings.

An analysis conducted by UNDP in 2010-2011 on the possibilities of green jobs creation [15] attempted to identify priority areas in Croatia as well as their potential of reducing greenhouse gas emissions. The focus of analysis was on retrofitting of buildings and EE/RES technologies that can be produced domestically and so foster local direct and indirect employment, provide local circulation of money, security of energy supply, environmental impact and lower import (fossil fuels).

Due to the high energy consumption in buildings, which is constantly growing, and also the largest potential energy and environmental savings, energy efficiency and green sustainable architecture today is recognized as an area that has the greatest potential to reduce energy consumption at the national level, which directly affects the comfortable and quality living in the building, increasing the durability of the building, and helps protect the environment [18].

Biggest green job creation potential was recognized in three fields: energy efficiency measures in existing buildings (retrofitting), biomass utilisation, and solar thermal systems – more than 14.000 direct and

total of 65.000 indirect and induced jobs (Table 5.1-1). Three types of green jobs were identified: direct jobs (equipment production and maintenance), indirect jobs (auxiliary industry) and induced jobs (new jobs created by daily consumption of directly and indirectly employed workers). With the implementation of energy efficiency in 20% of the total number of housing units in Croatia (280.000) over the next 10 years and with an investment of USD 10.000 for each existing home or dwelling, the total investment would amount to USD 2,8 billion (USD 280 million per year). Experiences gained in the existing UNDP project talk about the required three man-months for a single dwelling unit, which ultimately means creating 7.000 direct green jobs a year and least that many indirect jobs created<sup>1</sup>. It should be however noted that some of this jobs created would be part of Business-as-usual scenario, as not all of this investments are started because of energy efficiency concerns. No detailed calculations were however made on the percentage share of non-qualified or low-qualification blue-collar workers in the estimated sums.

**Table 5.1-1 Opportunity for green jobs creation [15]**

Sector	Goals	Direct green jobs	Indirect and induced green jobs	
Energy efficiency in building	Application of EE measures in 20% existing residential units during next 10 years (until 2020)	7.000	7.000	2.15 billion
Use of biomass	In the next 10 years achieve 2030 goals from the Energy strategy	5.000	55.000	3.5 billion
Solar heating systems	In the next 10 years achieve 2030 goals from the Energy strategy	1.300	2.000	1.4 billion
Wind energy	Produced 1200 MW according to Energy Strategy	1.200	1.000	1.7 billion
<b>TOTAL</b>		<b>14.500</b>	<b>65.000</b>	<b>8.75 billion</b>

An average household in Croatia spends 0.8 toe annually for heating [19]. Achieving this goal (decreasing the energy consumption in 20% of housing units per square meter from 250 kWh/m<sup>2</sup> to 75 kWh/m<sup>2</sup> would mean an annual saving of 150.000 toe (6,3 PJ). With a ton of CO<sub>2</sub> emissions at 0,3 toe per year emissions reduction would amount to 500.000 tCO<sub>2</sub>. In doing so, it is important to mention that the total investment made would pay itself back through savings on heating bills during ten years only (or less, depending on the cost of heating, which is in a constant upward trend).

## THE IMPLEMENTATION OF THE EUROPEAN QUALIFICATION FRAMEWORK (EQF) AND THE EU POLICY IN EDUCATION IN THE CONSTRUCTION SECTOR

As of February 14, 2013, The European Qualifications Framework (EQF) was implemented into the national educational system through the Law on Croatian Qualifications Framework, on which the Ministry of Science, Education and Sports, Ministry of Labour and Social Welfare, the Ministry of Regional Development, the National Council for Human Resources Development and sectoral councils were working. Croatian Qualifications Framework (CROQF) instrument is a regulation of the qualifications in the Republic of Croatia, which ensures transparency, access to the acquisition, established acquisition, progression and quality of qualifications, as well as referencing levels of qualifications in the Republic of Croatia to the EQF QF-EHEA levels of qualifications and indirectly with levels of qualifications frameworks in other countries working on the development of the National Qualifications Framework, which is brought into conformity with the EQF in terms of classification into the 8 levels of educational qualifications, but its approach is however a general one and does not specifically deal with education for construction-related occupations. All future training programs will therefore need to be brought into conformity with EQF. The activities that Croskills has focused on will primarily refer to levels 2, 3 and 4 (vocational training, adult and secondary VET).

<sup>1</sup>An average household in Croatia spends 0.8 toe<sup>3</sup> annually for heating. With 20% of total number of households lowering energy use from 250 kWh/m<sup>2</sup> to 75 kWh/m<sup>2</sup>, it means 150,000 toe saved annually. With emission of one tonne of CO<sub>2</sub> per 0.3 toe, annual emission reduction is 500.000 tCO<sub>2</sub>.

# 6. Statistics related to the construction and energy sectors

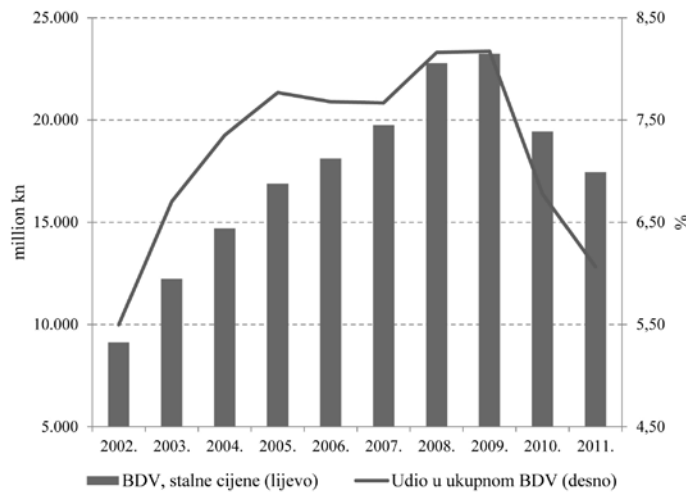
## 6.1. Construction sector

For the purpose of presenting relevant statistics in the construction sector, available data from the Central Bureau of Statistics were used [20]. Regarding that there is no other institution except CBS to perform a systematic analysis- at the national level- of the construction sector as a separate sector within the Croatian economy, for the purposes of this analysis, the results of available research by Raiffeisen Bank centre conducted in May 2012 were used (which is the analysis of the recent data). As stated in the brief description in the second chapter, the construction sector, according to all economic indicators, is an important part of the Croatian economy. As in most countries in Europe, the construction industry witnessed a steady growth in last decade, particularly in the period up to 2008. According to the available analyses, the total share of construction in Croatian GNP in 2009 reached 7.0% and has maintained at levels above 6% since 2006. The share growth has been caused by rising investments (primarily capital infrastructure investments), but also by the growth of residential construction. Similar to other countries in which the construction industry suffered a sharp drop in 2009, one of the main causes of a relatively affordable housing lending conditions and increased availability of housing loans that helped push demand for residential real estate far beyond the available supply in the market, which in turn gave the market a signal for increased residential construction.

Table 6.1-1 shows the tendencies in the construction sector over a 10 year period before deceleration (i.e. before the economic crisis).

**Table 6.1. The value of works and the overall number of the employed in the construction sector, source CBS**

YEAR	Value of works (EUR)	Share in GNP (%)	Number of the employed
1999	1.082.947.144,00	4,5	71.302
2000	936.438.413,00	3,9	65.222
2001	1.178.919.947,00	4,1	65.782
2002	1.553.852.670,00	4,5	71.788
2003	2.140.572.890,00	5,4	78.276
2004	2.254.686.052,00	5,7	81.893
2005	2.406.335.517,00	5,6	85.025
2006	2.926.470.432,00	5,9	93.297
2007	3.312.308.079,00	6	99.257
2008	4.766.970.000,00	6,2	108.260
2009	4.193.472.000,00	7	97.503

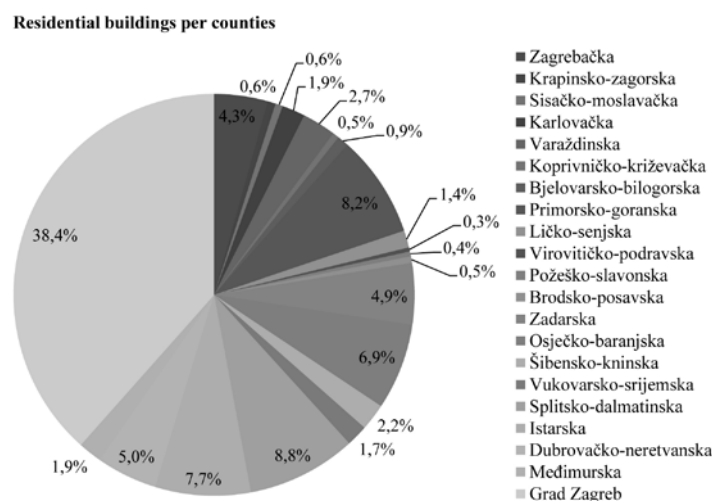


**Figure 6.1-1 The share of the construction sector in the Croatian GNP, Sources DZS, Raiffeisen research**

Figure 6.1-1 shows the movement of the share of construction in gross national product over a 10 year. The Figure shows that in 2010 and 2011 a significant drop occurred in the construction share in GNP which peaked at the level of 6.1% in 2011. Namely, a deceleration first and then a drop eventually contributed to the downturn of the economy and reduction in the activity of the construction sector. The lack of significant investments and a large drop in demand for real estate resulted in a supply of the real estate in the market that was significantly higher than the demand. Although in there were some initiatives in 2012 that directly aimed at the recovery of the construction sector, primarily in the context of EE refurbishment of public buildings, there has not been a significant recovery and, in accordance with all indicators, this trend is going to be continued in the near future.

Given that the statistical data on trends in the construction sector in Croatia are scarce, most of the rating of the developments in this sector is based on data available from the Central Bureau of Statistics. In 2010, the value of construction works amounted 17.9 billion EUR, out of which 9.3 billion related to buildings. 74% of the total value of construction works in the building stock relates to new construction, 21% to the reconstruction, refurbishment and major repairs, and 5% on maintenance and minor repairs.

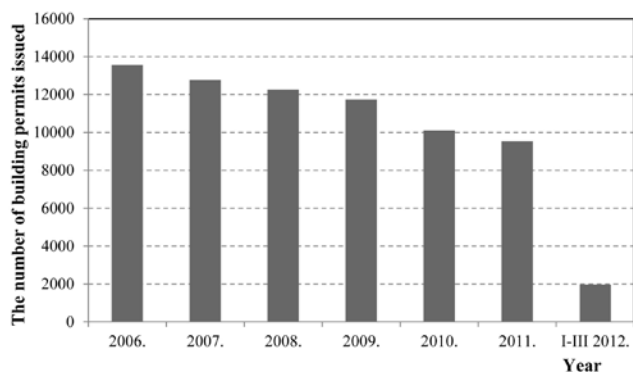
The expectancy of the value of construction works in building stock is the highest in the City of Zagreb, and then in Splitsko-dalmatinska, Istarska and Osječko-baranjska counties (Figure 6.1 2).



**Figure 6.1-2 The value of the construction works performed by counties in building stock in 2010 (source: CBS)**

One of the regular monthly data that is collected at the local government level is the data on permits issued. Information on permits is classified according to the type of construction (includes permits issued both for new construction and refurbishment) and by the type of building (covering both residential and non-residential buildings). Building permits issued for the construction of buildings can be permits for

new buildings, additions and upgrades, conversion and improvement. The number of permits issued indicator is a good short-term indicator in construction. From issuing of building permits to completion of construction of buildings or small commercial buildings (which make up about 80% of total building permits issued) generally takes a year, while in the case of major infrastructure projects, the construction time generally takes several years. In view of the above, the tendencies in the construction sector in the coming year may be assumed in accordance with the number of permits issued. Figure 6.1 3 shows the total number of permits issued annually from 2006 (first available) to the first quarter in 2012 (when the analysis was performed).



**Figure 6.13 The number of building permits issued, sources CBS, Reiffeisen research**

As expected, issued permits follow to a large extent the development of the real estate market, so in the years before the crisis their growth was recorded. The accelerated growth was halted late in 2007 due to the changing conditions in the real estate market. The change is primarily related to the slow sales of residential and commercial real estate (increase uncertainty caused by the economic crisis, exacerbated credit conditions, the rise of the Swiss franc exchange rate - the currency in which a significant number of loans to finance real estate was denominated) and there was as well a lack of capital investments into infrastructure. Slow and difficult sales made the investments in a particular segment of the residential property questionable which cumulatively led to a decline in the number of building permits for construction of new buildings, but also to an even greater fall in the total area of new housing that the permits covers (on average -13, 5% per year). And in 2011 year, the stagnant real estate market and the continued adverse developments in the construction sector resulted in a continued decline in the number of building permits issued annually (-4.8%). Another indicator of economic activity in the construction sector is the index of the physical volume of construction works based on the number of hours worked on construction sites according to the Methodology for short-term business statistics, interpretation and guidance on industry, trade and services [28]. The Analysis of the data shows that up to 2008, the number of hours worked on construction sites is in line with other indicators (the number of building permits issued, the share of construction in GNP), which means that at the times of the expansion of the sector the indicator featured a constant growth. Similarly, the downward trend is reflected in the movement of the indicator as well. The volume of construction works in Croatia has recorded a steady decline since early 2009 with the proviso that in 2010 rate of decline was intensified as was to be expected given that the number of building permits issued featured a constant double-digit decline in the second half of 2009 and in most of the 2010. Although it seems that the rate of decline eased slightly in 2011, these figures were still high so the average annual decline of 9.7% was reported. According to the data from last year (2012., in the first two months, the average annual decline was 11.6% and the rate of decline so returned again to double-digit thus showing an extremely negative trend. Given that at present there is no announcement of major capital investments by the Government and that the program for EE refurbishment of public and private buildings are "on hold" for the time being, it is hard to expect any significant positive developments that could contribute to the recovery of the construction sector.

## 6.2. Employment trends

The short term indicators in the sector related to the volume of work performed, the number of permits issued for the works consequently has an impact on employment trends. In line with the decline in economic activity in this sector, since the September of 2009 a continuing decline in the number of employees in the construction industry has been recorded. The analyses (by Raiffeisen Bank) show that the labour market reacted with a slight lag if compared to the negative trend started in the sector but yet there was an unbroken series of the reduction of the number of the employed until the March of 2012.

In 2010, when the biggest drop in activity was recorded there as well was the highest drop in the number of employees (all the company applied double-digit rates of decline, on average - 12.5% per year). As a result of many years of reducing the number of employees in the construction sector, in the March of 2012 there were 78 850 (5.9% of total employed) workers, which is the lowest level since the February of 2005. In relation to the (pre-crisis) year of 2008 (when the construction industry employed more than 6.6% of the total number of the employed), it represents a decrease of approximately 20,000 employees. According to the Central Bureau of Statistics, the average number of workers on site in Croatia in 2010 was 55 393 (Figure 6.2 1). Data relate to the construction industry entities with five or more employees. There is a drop in employment in comparison to previous years. According to the latest data from CBS, the number of employees at the site in 2011 was 50,218.

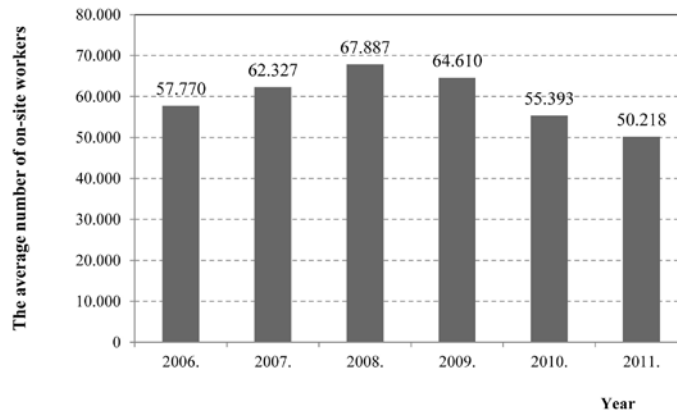


Figure 6.2-1 The average number of on-site workers (source: CBS)

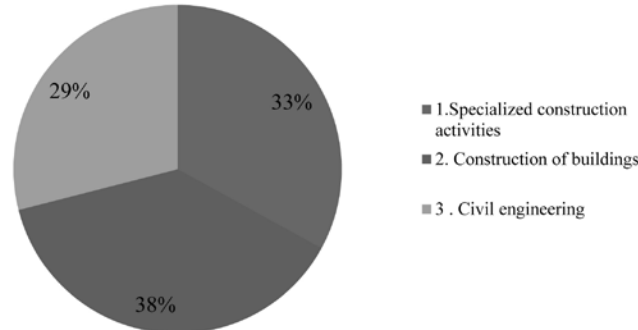


Figure 6.2-2 The share of the number of the employed in overall construction sector, March 2012 (source: CBS)

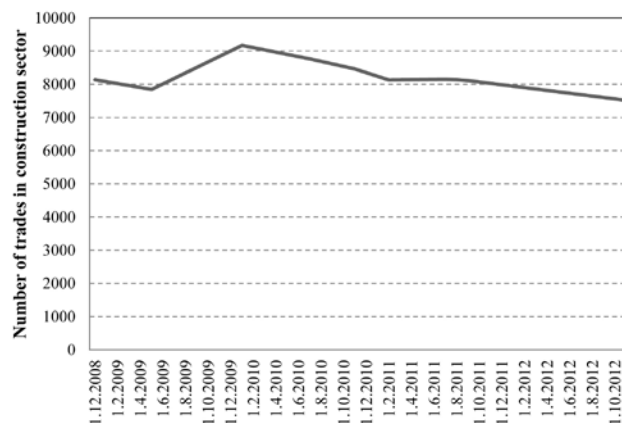
Table 6.2-1 The number of the employed in construction – crafts, Sources: Ministry of Economy, Croatian Chamber of Trades and Crafts, 2013.

Date	Employees – Retirement insured		
	Male	Female	Total
31.01.2008	22328	3517	25845
31.12.2008	22628	3517	26145
31.12.2009	17745	2801	20546
31.01.2010	16679	2675	19354
31.12.2010	13999	2204	16203
31.01.2011	13313	2114	15427
31.12.2012	11414	1653	13067

Table 6.2-1 shows the trend in the number of employees in the crafts that perform activities in the construction sector. Data was derived from the registration of employees at retirement insurance fund by the craftsmen, the business owners. Also, the data on employment is divided by gender. By means of a calculation, the obtained data is more dramatic than the data for the overall sector. Namely, the trades that are by definition small business entities, have seen a loss of even 12 778 employees, which represents almost a half of the total employment in this sector! According to the Central Bureau of Statistics, the average number of employees in construction in 2009 was 140.661 whereas in 2011 the number dropped to 109.803 employees indicating an average decline in the number of employees in the sector of 20%. By 2012, due to a large drop in sales of residential real estate (primarily flats), the largest annual decline in employment related to the construction of buildings, the segment that employs over 38% of total employees in the sector (-14.5% annually in 2010, -11.1% annually in 2011). However, primarily due to the decline in investments earlier this year, the highest annual rate of decline (approximately -15%) was observed in the area of specialized construction activities (as high rates of decline as in whole 2010). According to most expectations, the rate of decline in the number of employees on an annual basis period will slow down if it is taken into account that the construction companies have rationalized their operations, and are already operating with the minimum required capacity. However, the data presented suggest nonetheless worrisome trends and big losses in terms of unemployment that occurred in this sector.

### 6.3. Business entities (Trades and Companies)

At the end of the December of 2011, the number of trades and companies that deal with construction activities totalled 24,675, representing an increase of 2.8% in comparison with the same period last year. However, it should be noted that the number of active businesses decreased by 6.3% and there were 14,784 active ones (of which the largest share, over 97% are privately owned, and over 88% of them employ less than 10 workers). According to the Ministry of Economy and Court Register, along with the Chamber of Trades and Craft, in the Republic of Croatia there were 7514 trades registered that perform activities in the construction sector. Picture 6.3-1 shows the change of the number of registered trades over last 4 years. For the initial year of the measurement the year of 2008 was taken.



**Figure 6.3-1 The number of trades in construction, source: Ministry of Economy, processed by CCTC, 2013.**

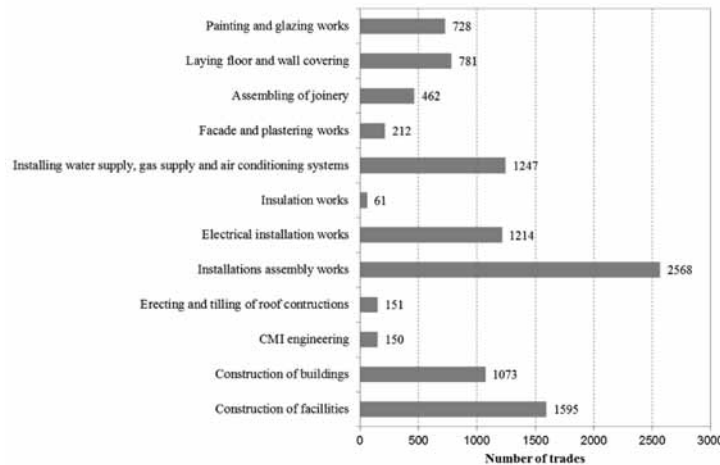
Although data on employment in trades and companies - and especially the data on the movement of employees in trades - shows a dramatic trend of downsizing. Figure 6.3-1. shows that the number of closed trades still follows a paced-down rate. There are several explanations for that. As stated previously, due to the company and crafts are adjusted and rationalize their operations in accordance with trends in the market. Due to the smaller volume of work, they had to lay off some workers, while other jobs, that are safe, are assigned only to a small number of workers. It can also be argued that a certain number of employees (as well as craftsmen, business owners) signed off registered trade and began to perform the unregistered activities for the already well-known customers. Finally, from the perspective of a larger share of work in the field of energy efficiency that are expected in the upcoming period, it cannot be said with certainty what the trends regarding the closure / opening new trades will be. According to the analysis that is presented in this section, it is possible to expect that the economic crisis that occurred after 2008 cleared the market in a certain way and today a number of companies and trades that operate in this sector present a realistic image that will not change for a long time. What can be expected is that the stabilization of the market as well as potentially new jobs (refurbishing of buildings and to a



lesser extent the construction of new buildings) will bring a new employment, and a demand for workers of different profile (with new skills).

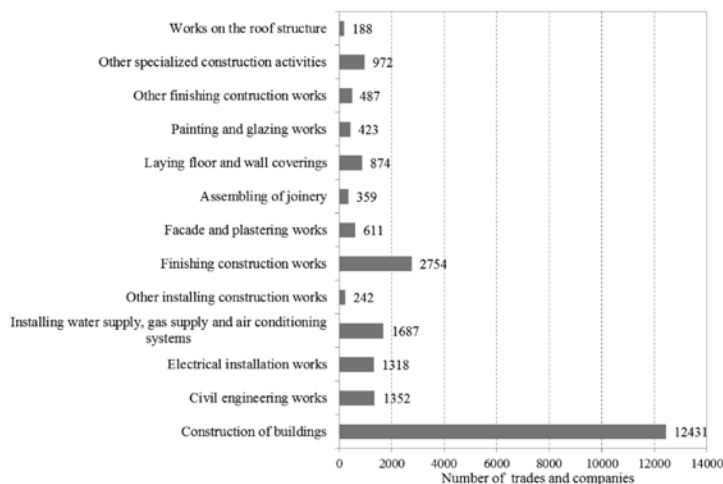
## 6.4. Structure of trades

The overview and distribution of trades according to their activities was made by searching through the Trades Register (Base of all trades), which is jointly managed by the Ministry of Crafts and Entrepreneurship and the Croatian Chamber of Trades and Crafts (CCTC). The search was performed by isolating trades on the basis of their principal registered activity. Figure 6.4 and Figure 6.4 1 2 show the distribution of the number of trades (Figure 6.4 1) and companies (Figure 6.4 2) by activities as listed by NKD (National Classification of Activities) 2007.



**Figure 6.4-1 Trades in construction by activities as of November 31, 2012, 2012-11-31, source: Ministry of Crafts and Entrepreneurship, processed by CCTC, 2013.**

Figure 6.4-1 shows the distribution of businesses in accordance with the main activity criterion. Register of Business Entities of the Croatian Chamber of Commerce is an integrated database of all Croatian companies registered in the Croatian territory.



**Figure 6.4-2. Business entities in construction as of October 16, 2010, source: Biznet.hr, processed by CCTC, 2013.**

As it is evident from the Figure that shows the distribution of trades and businesses by activities, the largest number of subjects reported for the broadest category - construction of buildings, which objectively allows performing of the "majority" of works on buildings. The problem is the fact that –potentially- number of different groups in which the trades or businesses are classified, perform the same specialized tasks related to energy efficiency in buildings. For example, placing a façade is dealt with by all the trades

and businesses that have registered for the construction of buildings, as well as by those who have registered for the finishing works on buildings, other construction works, floor and wall coverings, painters, and finally as well by those who are just registered for the façade and plastering works. The above-described situation points to the fact that, due to the lack of available jobs in the market, most operators are forced to compete for all the jobs that are offered. But such competition has its consequences, as it will be seen from a survey among the craftsmen, namely that a significant number of businesses perform works-upon the investor's request- for which the workers are not fully trained and this leads to unprofessionally performed works (again the façade example). Finally, the situation corresponds to the attractiveness of certain specialized tasks in the context of vocational education, taking into account the very low interest for certain professions (façade again). Within the project Transolar in 2008, Energy Institute Hrvoje Požar estimated that the manufacturing sector, service and installation sales in Croatia employ approximately 200 people, with only 9.000 square meters of solar thermal systems (STS) installed per year. Also, the total area of collectors installed by 2008 was about 70.000 m<sup>2</sup>. A research was done in the course of the implementation of the project and the research showed not only that STS systems in Croatia are mostly installed by air conditioning and heating systems installers, plumbers and related vocations, but as well that the mentioned fitters are not properly acquainted with the peculiarities of installing STS which sometimes results in capacity miscalculations and faulty installed STS.

## 6.5. The structure of employees of trades and companies in the construction sector

Since there are no available analyses to show the structure of the employed in construction trades in terms of age, education structure and other parameters, for the purpose of analysis only available data was used and it provides only for a partial glimpse into the general level and the number of trained personnel in construction companies.

**Table 6.5-1 Masters and workers qualified for crafts, source: Department of Education of the Croatian Chamber of Commerce, 2012.**

Occupation	Qualified	Masters	Masters to take the vocational part of the exam
Plasterer		63	9
Heating and air condition systems installer		498	410
Electrician		551	376
Gas supply fitter		374	273
Glazier		11	18
Carpenter		118	75
Plumber		122	404
Sheet-metal worker		110	94
Roofer		47	19
Bricklayer		565	207
Locksmith		148	196
Electronics mechanic		30	110
Electro mechanic		133	356
Machinist		88	307
Painter		285	
Insulation fitter	120		
Glazier in construction works	207		
Floor layer	253		
Floor-tiler	90		

Table 6.5 1 shows the number of passed craftsman examinations and certificates of competency issued for the privileged and related activities in crafts since the establishment of the master’s exam and qualification institutes. Insight into the number of passed master exam is the total number of qualified employees to perform these activities (in the sense that they passed through the system of vocational education), but also provides an insight into compliance with the actual situation (in terms of number of trades that are registered to perform different operations and the number of qualified people). If in this case the attention is paid to facade (plasterer) one can see that there have been 63 passed master exams in 18 years, while the number of trades and businesses that are engaged in this activity is about a 1000! This points to two facts: the large number of owners or employees in trades or businesses that perform the activities of facade installation have no formal education, i.e. they are not qualified to perform these activities, and the formal control of individual craftsmen on the construction sites therefore does not exist. Also, it is evident from the table that the most wanted jobs, or occupations in which the largest number of master exams has been taken are those that provide for the widest scope of jobs and activities to perform, for example, a bricklayer, painter, plumber. According to the Act on Architectural and Engineering Activities in Physical Planning and Construction in the Republic of Croatia the method of granting approval for the performance of the construction activities is determined and less complex work requiring the issuance of license and those that do not need it are defined. The classes with the requirements a particular craft or company must meet in order to get approval, are defined by the cost of works. The requirements refer to the total number of workers who must be employed in a business or craft, and the number of workers with a proper qualification. Thus, the law itself does not check the technical details (in terms of the equipment companies use, the expertise of workers, professional references, experience), but the requirements sets conditions relating to the number of workers to be employed in the trade / craft. The third column in the table shows the number of master craftsmen who are licensed to train apprentices in their workshops, and who therefore represent an educational capacity for students who opt for vocational education.

## 6.6. The housing sector of the Republic of Croatia

As some points in this analysis state, one of the characteristics of a large portion of the residential and non-residential building stock in Croatia is an irrationally high consumption of all types of energy, primarily energy for heating, but a rising standard has made the cooling energy consumption equally high. Housing sector of the Republic of Croatia- according to the census taken in 1971- totalled 1.19 million units. In 1981., the number of dwellings increased in comparison with 1971 by 16.2%, or by an average of 1.6% annually. In 1991, 1.58 million dwellings were registered, which is an increase of 14.1% if compared with 1981 or 1.4% per year. In the period between the censuses taken in 1991 and 2001, the total housing sector in Croatia, according to available data, increased by 19.1%, i.e. the average annual increase was 1.9%. Total number of dwelling units in Croatia, according to the census taken in 2001, was 1.88 million, or 133.3 million square meters of housing. According to the last census taken in 2011, 2,257,515 housing units were registered in Croatia, which, if compared to the last measuring represents an increase of 20%. According to the last census 1,535,635 households were registered, out of all the listed dwelling units 1,923,522 units are used as permanent residences, while the remainder represents housing units for temporary stay (cottages, apartments).

**Table 6.6-1 Annual rate of new flats construction, source CBS, 2012**

Year	Number of flats	Growth
1971	1 188 743	
1981	1 381 434	16%
1991	1 578 968	14%
2001	1 877 126	19%
2011	2 257 515	20%

The average floor area per person is also constantly growing, and in 2001 it was 27.3 m<sup>2</sup>, while at the same time the number of persons per dwelling unit drops and it is 2.6 persons per dwelling unit. The rising standard of living induced in turn a growth in energy consumption in buildings. From the energy consumption point of view, the construction period is extremely interesting parameter. The division of housing sector in accordance with the characteristics of the construction process is a realm that has

not been paid sufficient attention to and of which in future a lot more care will have to be taken because of the characteristics of the construction and the lack of regulations on thermal protection during the period of the outburst of residential construction from the year of 1950 to the year of 1980 when a number of residential and non-residential buildings were constructed that are now major consumers of energy, with an average consumption of energy for heating more than 200 kWh/m<sup>2</sup>. The average energy consumption in the buildings of the public sector is now in the range of 250-350 kWh/m<sup>2</sup>. The final energy consumption in buildings in 2010 amounted to 42.3% of the total energy consumption in the Republic of Croatia.

In buildings, energy is used for:

- heating and hot water, 80 - 90% of total energy requirements of the building
- lighting and other purposes (e.g. computers), 10 - 20% of total energy consumption
- cooling- for now a small fraction of the total annual energy consumption, but a steady growth of energy consumption in this sector is expected.

The buildings constructed before 1987 have an average consumption of thermal energy for heating of 200 -250 kWh / m<sup>2</sup>, while the EU standard of consumption is up to 70 kWh / m<sup>2</sup>, so consumption is highly irrational and the EE refurbishment can achieve great economic and energy savings and contribute to the environmental protection.

In 2010, the total area of non-residential buildings was estimated at 43.38 million m<sup>2</sup> of floor space whereas the floor space in public buildings was 9.58 million m<sup>2</sup>, or 22% of the total area of non-residential buildings.

Table 6.6 2 shows the dwelling units construction dynamics in last 100 years as related to their share in the overall sector of the existing buildings

**Table 6.6-2 The annual new dwelling units' construction rate, share in overall sector, source CBS**

<b>Year of Construction</b>	<b>Number of units</b>	<b>The share in the existing overall sector</b>
Before 1919	129.901	9,10%
1919 – 1945	104.333	7,30%
1946 – 1960	154.672	10,90%
1961 – 1970	285.451	20,10%
1971 – 1980	329.028	23,10%
1981 – 1990	244.908	17,20%
1991 – 1995	47.911	3,40%
1996 – 2001	70.817	5,00%
Unknown and uncompleted	54.602	3,80%

## 6.7. Undeclared work

In the Republic of Croatia, there have been a certain number of measuring and estimation activities performed in the last 20 years concerning undeclared or (by the official statistics) unseen work.

In accordance with Otto and Bićanić (2001), the share of undeclared work in the 1995 GNP amounted at least 25%. The majority of analysts agree, however, that there has been two periods in the amount of the undeclared work, namely before and after the year of 1993. The period after 1993 is less reliable as some data shows an increase and some data a decrease in the share of undeclared work. All investigators agree in turn that the share of the undeclared work is a huge one and that there are no signs that this share might decrease. The cause of the gray economy rate lies in the inherited tradition of such behaviour (from the times of socialism), in the huge share of the state in economy and in a large tax burden.

Having analysed the share of gray economy in 31 European countries' GNP in 2011, Schneider indicated an increase of the share in Croatia if compared to 1993 and found out that Croatia lead on the list with 29.5 % preceded by Bulgaria and Romania only. It is important to point out that Croatia is far above the European average of 19.3% and, moreover, the average rate of the grey economy is in a constant decrease in all countries except Croatia where the rate has been at a constant value

## 6.8. Energy consumption and the use of RES in building stock

The average energy consumption in buildings in Croatia is about 200 kWh/m<sup>2</sup> and 87% of the buildings are considered to be large consumers of energy. The largest consumers are the buildings constructed between the year of 1940 and the year of 1970 whose consumption range is 200 to 300 kWh/m<sup>2</sup> and these are the most numerous buildings, while buildings constructed between the years of 1987 and 2006 meet the 1987 regulations and their consumption is between 100 and 150 kWh/m<sup>2</sup> [24]. In 2010, Final energy consumption in the buildings in the country increased by 6% and, compared with 2009. so its share in the overall consumption was 42.3%. The share of RES in total energy consumption in 2010 was around 24.2% (using EIHP methodology), or approximately 13.3% if the calculation method of the EUROSTAT is used. Total electricity generation in 2010 amounted to 14 105 GWh, out of which about 61% was produced from RES, including large hydropower plants. The hydropower plants, in turn, contributed with 58.9 percent of the percentage while the rest of 2.1 percent of the electricity was produced from other renewable sources (small hydro, solar, wind, biomass, landfill and biogas). The electricity produced from RES contributed 45.6% of the total energy consumption. The large hydropower plants contributed 44% to the total energy consumption, while the electricity generated from other RES accounted for 1.6% [25]. In buildings, energy consumption intended for heating, hot water and air conditioning makes the most important part of energy consumption (80-90%). The structure of energy consumption in residential buildings is as follows:

- 40-60 % heating
- 15-35 % preparation of water,
- 5-15 % cooking,
- 10-20 % non-thermal needs (lighting, TV, radio, computers and other).

Today, about 83% of buildings in Croatia feature inadequate thermal protection, with an average energy consumption for space heating of 150-200 kWh/m<sup>2</sup>. Due to the characteristics of construction and the lack of regulations on thermal protection during the period of the largest residential construction (1950-1980) a number of residential and non-residential buildings were constructed which are now major consumers of energy, with an average energy consumption for heating and greater than 200 kWh/m<sup>2</sup> [24]. In the period until 2030, the share of fossil fuels will gradually decrease so that the combined natural gas and crude oil share will approximately amount 25%. The remaining three quarters of primary energy will be RES and the share of water power will be about 32%, the share of fuel wood and biomass 19.6%, and the share of other RES 23.6% (Figure 6.8-1). In accordance with Directive 2001/77/EC an Action Plan for RES by 2020 has been prepared as well. According to the Annual Energy Review of the Ministry of Economy - Energy in Croatia 2011 - In 2011, in the general consumption sector, where buildings-household and services-are the largest consumers - there was a slight decrease in The final energy consumption of even 1.0 percent if compared with 2010 (Figure 6.8-1). The final energy consumption in buildings in 2011 amounted 111,40 PJ which is 42.98% of the overall 259.19 PJ energy consumption in 2011. The overall consumption in the general consumption sector amounted 127,25 PJ in 2011.

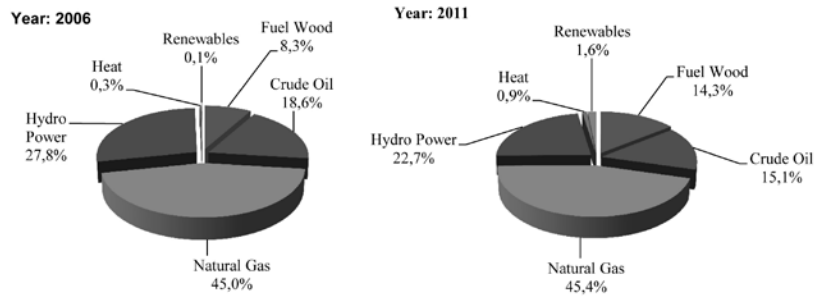


Figure 6.8-1 Shares in the primary energy production in the years 2006 and 2011 Source: Energy in the Croatia. Annual Energy Review, the Ministry of Economy, Labour and Entrepreneurship, 2011.

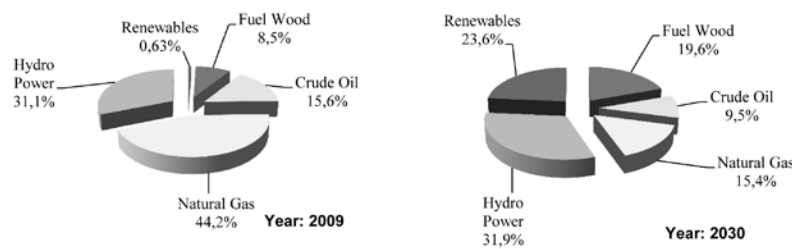


Figure 6.8-2 Shares in the primary energy production in the years 2009 and 2030 Source: Energy in the Croatia. Annual Energy Review, the Ministry of Economy, Labour and Entrepreneurship, 2011.

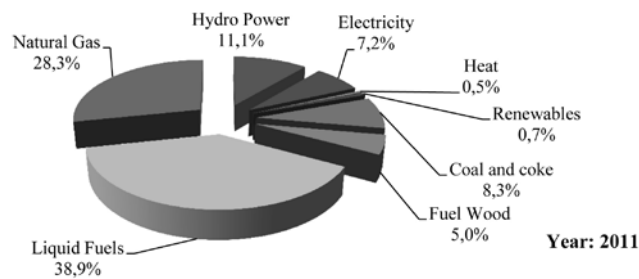
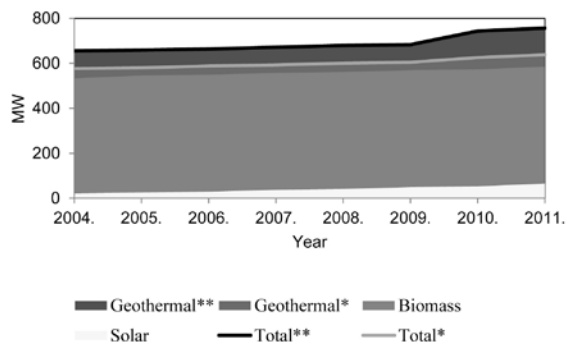


Figure 6.8-3 Shares in the primary energy consumption in the year 2011, Source: Energy in the Croatia. Annual Energy Review, the Ministry of Economy, Labour and Entrepreneurship, 2011

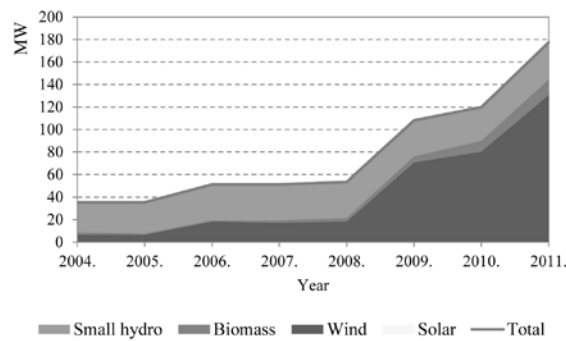


\* geothermal energy for heating

\*\* including the geothermal warm water for bathing

Slice 6.8-4 Capacities for thermal energy production from renewable sources in Croatia in 2011. Source: Annual Energy Review, the Ministry of Economy, Labour and Entrepreneurship, 2011

In interpreting these data on installed capacities for thermal energy production from renewable sources (Figure 6.8-4), it is to be taken into account that there is no reliable statistics on the installed power of the sun and biomass and as to geothermal energy, there are two methods of data monitoring. The installed capacity of solar systems was estimated on the basis of data on the surface of solar panels obtained through EHP surveys, while solar thermal capacity is calculated according to the guidelines of the European Solar Thermal Industry Federation (ESTIF). The data on the heat capacity of biomass boilers only applies to industrial boilers and contains no heat capacity of small boilers for heating and hot water in homes. The data on the installed power of photovoltaic systems differs from official HROTE data since it includes those systems that are not in the status of eligible producer, although it is known to produce electricity. The same applies to the information on the generated energy. The power of autonomous PV systems that are used as electricity supply for those facilities that are not connected to the network (lighthouses, houses, GSM base stations, etc.) is estimated at about 500 kW. It is also known that there is a PV system with installed capacity of 265 kW which is not connected to the network and does not produce electricity because of unresolved technical issues related to the connection port. There is as well a growing trend of installed capacity for production of thermal and electric energy from renewable sources in the period from 2004 to 2011 (Figure 6.8-5 and Table 6.8-1).



**Figure 6.8-5 Capacities for electricity production from renewable sources in Croatia in 2011.**  
**Source: Annual Energy Review, the Ministry of Economy, Labour and Entrepreneurship, 2011**

**Table 6.8-1 Capacities for thermal and electrical energy production from renewable sources in Croatia in 2011.** **Source: Annual Energy Review, the Ministry of Economy, Labour and Entrepreneurship, 2011**

RES	Installed thermal power	Installed electrical power
	(MW)	(MW)
Sun	58,80 *	0,109 **
Wind	0	69,75 ***
Biomass	513,65 *	5,59
Small hydro	0	31,05
Geothermal	36,66 113,90	0
<b>Total</b>	<b>609,11</b> <b>686,35</b>	<b>106,47</b>

Source: EIHP, HEP, Faculty of Forestry of the University of Zagreb: Wood Technology Department, INA Naftaplin WGC 2005 \* estimate \*\* systems connected to the network \*\*\* 42 MW of which are in a test run

**Table 6.8-2 Electricity generation from renewable energy sources in Croatia in 2009, Source: Energy in Croatia, Annual Energy Report, Ministry of Economy, Labour and Entrepreneurship, 2011.**

Type of renewable energy source	Electricity generation
Solar	91.36 MWh
Wind	54.2 GWh
Biomass	24.9 GWh
Small hydroelectric power plants	99.5 GWh
Geothermal	0
<b>Total</b>	<b>178.69 GWh</b>

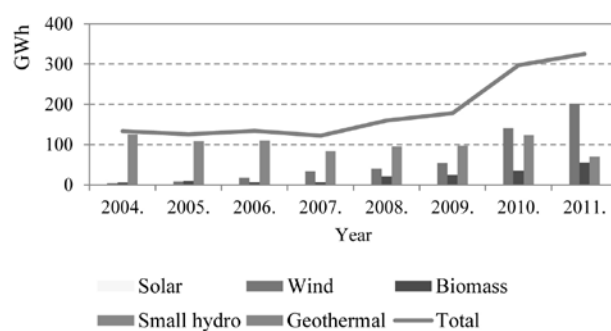
In 2009, electricity generation from renewable energy sources accounted for 1.4 per cent of the total generation, with the exception of large hydroelectric power plants (Table 6.82).

**Table 6.8-3 Electricity generation from renewable energy sources in Croatia in 2011**

Type of renewable energy source	Electricity generation
Solar	136.7 MWh
Wind	201.0 GWh
Biomass	54.0 GWh
Small hydroelectric power plants	67.1 GWh
Geothermal	0
<b>Total</b>	<b>322.,24 GWh</b>

Source: EIHP, HEP

In 2011, electricity generation from renewable energy sources accounted for 3% of the total generation, with the exception of large hydroelectric power plants (Table 6.8-3).

**Figure 6.8-6 Electricity generation from renewable energy sources in 2011 in Croatia, Source: EIHP, HEP (Croatian national electricity company)****Table 6.8-4 Heat generation from renewable energy sources in 2011**

Type of renewable energy source	Electricity generation [TJ]
Solar	253.5
Biomass	19 046
Geothermal*	286.7 <sup>12</sup> 902.03

Source: EIHP, HEP, INA Naftaplin, WGC 2005

<sup>12</sup> Heat generation from geothermal energy sources in 2011 exploited 132.15 TJ only for heating applications, i.e. the total of 555.47 TJ if heating and hot water preparation are observed jointly



Heat generated from the solar systems is calculated as the final usable heat and it takes account of the spatial distribution of solar heat systems, conversion losses and consumer behaviour. Heat generation from both solid and gaseous biomass, including generation in industrial heating facilities and heat generation from firewood for heating and hot water preparation in households, totalled 19 046 TJ. Heat generation from both solid and gaseous biomass, including generation in industrial heating facilities and heat generation from firewood for heating and hot water preparation in households totalled 14 171 TJ.

Although the presented statistics do not currently monitor the use and capacities of renewable energy sources separately for the sector of buildings, and instead the total capacities and consumption of renewable energy sources in all sectors are monitored, according to the estimations of experts from EIHP, the systems integrated in the buildings which determine the design of the building (PV, solar collectors) will have a small impact (<< 1%) on EE relative to the national energy efficiency objectives until 2020, while the technical subsystems using renewables to meet the consumption demands in buildings will account for only 10-15% of the target quantity of renewable energy sources in 2020 (Table 6.8-5).

**Table 6.8-5 Share of renewable energy sources in buildings according to EIHP**

	<b>GNP 2020 PJ/year</b>	<b>Share in buildings %</b>	<b>Renewable energy sources in buildings PJ</b>
Biomass	30	20	6
Biogas	2.6		
Biofuel	9		
Wind farms	9		
Hydroelectric power plants	22		
Geothermal power plants	5	?	
Solar power plants	5	75	3.8
<b>TOTAL</b>	<b>82 (1.95 toe)</b>	<b>11.9</b>	<b>9.8</b>

## 7. Existing VET provisions

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In terms of curriculum, secondary education system in the Republic of Croatia is a centralised system under the competence of the Ministry of Science, Education and Sports as regards the education process for regular students, enrolment and awarding degrees of completed secondary education for four types of schools:

1. Grammar schools
2. Four-year vocational and trade schools
3. Three-year schools for manufacturing and industrial occupations
4. Arts schools

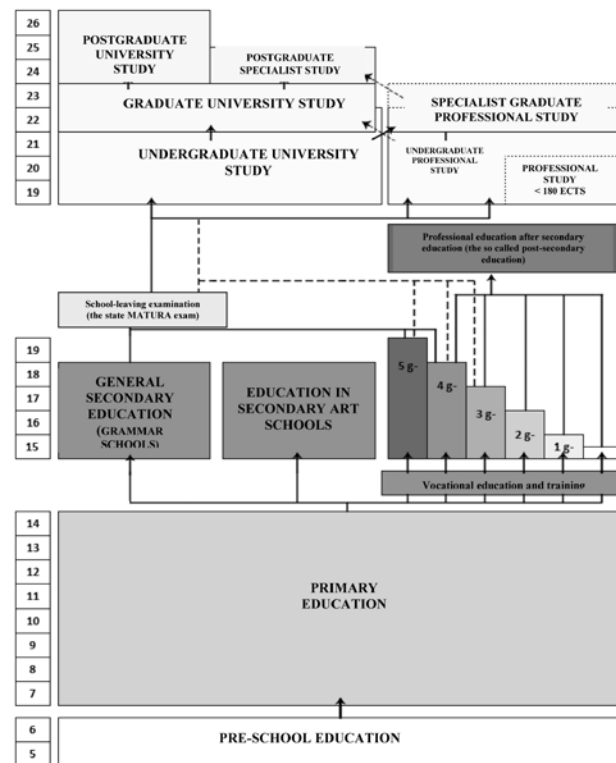
There are separate special programmes and schools for the education of children with developmental difficulties in the duration of three years.

Figures 7-1 show the existing education system in the Republic of Croatia.

There are approximately 48 000 students enrolled in the secondary education system. Of this number, 28% enrol in grammar schools, 68% enrol in four- and three-year vocational schools, and around 4% of pupils enrol in art schools.

As regards four- and three-year occupations which are interesting for the BUILD UP Skills - CROSKILLS Project, approximately 1050 technicians per year enrol in civil engineering programmes, approximately 550 students enrol in three-year courses for construction occupations, 700 students enrol in programmes for mechanical engineering installation works, 500 students enrol in programmes for carpenters and painters, and 1200 enrol in mechanical and electrical engineering technical schools. This totals 4000 students accounting for close to 8% of all enrolled high school students per year.

There is no regional competence over programming and implementation of the vocational education curriculum. The Ministry of Science, Education and Sports (MZOS) is fully responsible for managing the preparation, amendments to and reviewing of the corpus of general education subjects, syllabi and curricula, with the assistance of the Education and Teacher Training Agency. As regards the vocational part of the syllabus in vocational and trade schools, it falls under the competence of and is approved by the Ministry of Economy, but it also has to be confirmed by MZOS and is subject to opinion of the Sectoral Councils (bodies appointed by the minister which analyse the outcomes of education courses, competences within the qualification framework of the respective curriculum and present to the Ministry for adoption an overview of their proposals). Sectoral Councils operate under the Agency for Vocational Education and Training and Adult Education. Moreover, the Ministry of Economy is responsible for the Croatian Chamber of Trades and Crafts (HOK), which proposes amendments to the existing and drafting of the new curricula in the, so called, trades and crafts programmes under the Integrated Education Model (JMO).



**Figure 7-1 Overview of the existing education system in the Republic of Croatia**

However, with the possible overlapping of competence of either Ministry, both Agencies, the exclusion of HOK from programming, implementation and issuance of public documents leads to artificially created ambiguities. For example, according to HOK there are education programmes for masons, carpenters and roofers under the Integrated Education Model, but, at the same time, there are classic programmes for the same occupations which are not controlled by HOK and which is not responsible for issuing public documents. Thus, for example, there is no programme under JMO for dry-liners, tile setters and plasterers, floor setters, although they belong to the trades and crafts occupations.

Overall, there are discrepancies in the work of MZOS and the Ministry of Economy, as well as between the Agency for Vocational Education and Training and Adult Education and HOK, which does not recognise the competence of the Sectoral Councils. This can be a serious obstacle in the adoption of an education model for the implementation of the contents regarding energy efficient construction and application of new renewable energy technologies, which are the subject-matter of this programme.

The field of adult education, as far as curriculum programming for secondary qualifications is concerned, primarily relies on the programmes relevant for regular education of the youth under andragogical conditions, but is adapted to adult groups so it falls under the competence of the Agency for Vocational Education and Training. However, education programmes in the form of training or specialisation do not provide any adult education programmes that are related to regular education programmes. Therefore, it can be concluded that the education programme aimed at the know-how required for energy efficiency construction will have to be divided into two types: those that will train or specialize the already existing contractors to apply new work technologies, and those who will need to obtain the relevant qualification under the programmes comprising the contents necessary to achieve energy efficiency and application of the new renewable energy technologies.

With respect to the structural adjustment, it is important to implement the goals of the programme BUILD UP Skills in the form of quick training provided by the lecturers licensed for technology transfer or who work with acclaimed companies (or at the plants of such companies). For those who enrol in the retraining or additional training programmes education has to be provided by schools with didactical conditions for theoretical classes and at least some practice as part of school workshops or in laboratories.

The certification system comprises master craftsman examination and vocational final examination which allow one to open a privileged craft and trade business (a master craftsman's examination) or related crafts, and they are issued by HOK.

The certificates are also awarded by large construction companies and construction equipment manufacturers through their in-house education programmes, but these are not part of the nationally recognised certification system and do not have institutional value.

As part of their activities of promoting energy efficiency, UNDP joined the European initiative for introducing the certification system of installer of RES systems, which is aimed at systematic recognition of the certificates.

Although there are several exceptions in the secondary education system (vocational schools in Zagreb and Čakovec, Technical School Ruđer Bošković in Zagreb and UNDP Solar Education Centre in Zadar), currently there is no systematic education of construction workers related to energy efficiency and renewable energy sources, despite the fact that the number of construction workers by far exceeds the number of other experts in the field of construction (civil engineers, architects etc.). The Sectoral Council for Construction and Geodesy operates within ASOO and its task is to monitor the development of new technologies, skills and knowledge in order to implement them in the syllabus. The Council is authorised to establish the occupational, qualifications and curriculum standards for the respective education programmes in vocational education. However, due to random work of the Council, adjustment of the curriculum to the new developments in the technology and economic requirements is sluggish.

Considering that until recently Croatia did not have a verified specialisation programme for installers of solar heating systems, this was a serious obstacle to increasing the number of installation of such systems. The first education for solar installers began in Zadar (in 2010) at the Solar Education Centre, in cooperation with the Vocational School Vice Vlatković; in particular for installers of photovoltaic cells and installers of solar heating systems. Later on, a similar education programme was started by the Technical School Ruđer Bošković in Zadar, and preparations are under way for education in the Electrical and Mechanical Engineering School in Varaždin and Technical School in Rijeka. With the exception of these schools, there is currently no accepted secondary education or adult training programme for installing solar systems. The majority of the existing solar system installers are air conditioning and heating installers, plumbers and related vocations, but they are not familiar enough with the specific characteristics of fitting solar heating systems; this can sometimes lead to poorly dimensioned or faulty installed solar heating systems, which in turn results in dissatisfied owners of such systems and creates a negative public figure. This calls for an upgrade in the secondary education system and development of an adult education programme. If there are not enough qualified installers, it is impossible to expect a rise in the number of installed solar heating systems in Croatia. Moreover, there is no certificate for licensed installers (although the foregoing have been certified by the Ministry of Science, Education and Sports), which should be prepared by 1 July 2013 by the Ministry of Construction and Physical Planning.

The Croatian Employment Service participates in the activities of educating unemployed persons in cooperation with educational institutions, with the aim of increasing their competences thus adjusting them to the current and forecast labour market demands. Along with the implementation of the Active Employment Policy Measures relating to the financing and co-financing of employment and education (implementation of education programmes), the Employment Service participates in various projects and initiatives relating to the education of unemployed persons, which are implemented in cooperation with local and regional self-government units – often through different projects funded from EU funds. The planning of education activities is based on the analysis of statistical indicators of labour supply and demand, on the findings regarding employer needs for labour, for additional knowhow of workforce, and on the data obtained in the analysis of the annual Employers Survey.

Along with the need for education, other indicators which are relevant for the assessment of labour market demands are analysed – for example, the number of students graduating from secondary school, information about the possible registration of workforce in the unemployment register etc. Throughout the duration of education, its progress and performance of the students are continuously monitored, the students' satisfaction with the education and self-evaluation of the students concerning the relevance of the knowledge and skills in the process of looking for a job, and their success rate in finding employment after completing education.

Employers' Survey is a research of the labour market which is conducted once a year by the Croatian Employment Service (HZZ) together with the Croatian Chamber of Economy, the Croatian Chamber of Trades and Crafts and the Croatian Employers' Association, with the aim of improving the efficiency of the labour market in the Republic of Croatia, increasing the employment rate and reducing unemployment. The 2012 Employers' Survey conducted by the Croatian Employment Service in May 2012, which included 10.6% of employers engaging in civil engineering activities, was analysed as part of the project. The 2012 survey sample included a relatively large number of employers – 12,036 employers employing 666,651 workers, which represents 45.6% relative to the total number of employment in the Republic of Croatia. Of the surveyed employers, 1,273 or 10.6% of them pursue civil engineering activities. The specific field of civil engineering of the interviewed employers-contractors is not identified, nor is there any mention of the jobs related to energy efficiency. According to employer surveys, the occupations most in demand include masons (154), carpenters (119), welders (106), construction labourers and helpers (38), woodworkers (joiners) (108), reinforcing iron and rebar workers (29), sheet-metal workers (24) and BSc in civil engineering (22).

As part of European projects at both regional and national level there are a number of initiatives the aim of which is to organise the field of civil engineering. Some of them, such as IPA Component IV – Human Resources Development: "Implementation of new curricula", made an attempt to introduce the new curriculum in vocational and trade schools in order to prepare the students for the labour market.

- **IPA Component IV – Human Resources Development:** “Strengthening institutional framework for the development of the vocational education and training (VET) occupational standards/qualifications and curricula”, [1] the main objective of which is to strengthen the Croatian system of vocational education and training to provide the qualifications and competences that are required on the labour market, and its adjustment to the continually changing requirements of the economy. The project underlined the need to develop the tools and mechanisms aimed at diminishing the gap between education and labour market demands. Accordingly, a tool for the planning of qualifications was developed – sector profiles. Among 13 identified sectors, the civil engineering sector has been analysed [2]. These are comprehensive analytical bases which are, for the first time in Croatia, unified in one place and link macroeconomic indicators (information provided by the Croatian Employment Service, the Croatian Bureau of Statistics, the Financial Agency - FINA, E-Register, the Ministry of Science, Education and Sports etc.) to the data in the survey conducted among the employers regarding the required competences, thus providing the basis for planning the development of the education system to adjust it to the labour market demands.
- **IPA IV – Human Resources Development Component:** “Vocational Education and Training (VET) Quality Assurance Development”. [3] The main objective of this project is fostering the development and modernisation of the system of vocational education and training in Croatia. Its main purpose is to support the development of a single and systematic approach to quality assurance in vocational education, with the emphasis on the implementation of this concept in practice, and to encourage the exchange of information regarding quality assurance between vocational education providers and the general public. An IT system VETIS was set up as part of the project, which integrates and allows the processing of all substantial data on schools, students, staff and similar, which are necessary for the analysis, planning and management of vocational education.
- **IPA Component IV – Human Resources Development:** “Comprehensive capacity strengthening of the Agency for Vocational Education and Training and Adult Education”, [4]. The main objective of the project is the strengthening of the Croatian vocational education and training system to provide the qualifications and competences required on the labour market, and its adjustment to the continuously changing needs of the economy. The purpose of the project is to bolster the overall institutional and administrative capacity of the Agency for Vocational Education and Training and Adult Education so that it can perform its fundamental task as the central place for all stakeholders in the system of vocational education and training and adult education. The Documentation Centre or library was set up under the project with the goal of ensuring consistent and regular communication with the media and interested parties in order to assist the development of vocational education and training of adults in the Republic of Croatia, as well as to influence the opinion of people in relation to training and learning.
- **IPA Component IV – Human Resources Development:** “Implementation of new curricula” [5]. The overall objective of the project is to further enhance the system of vocational education and training in the Republic of Croatia in order to improve its relevance concerning the labour market. The purpose of the project is to encourage the introduction of new, high quality curricula and to introduce a systematic approach to the development of an innovative culture in vocational and trade schools – in accordance with the demands of the labour market at local and/or regional level. IPA awarded 30 grants under the project, some of which include: TEHNOTRONIK – Application of the new technologies curriculum at the Technical School Daruvar; Extending the knowledge and information about renewable energy sources – High School Oroslavje with partners the town of Oroslavje and Technical School Ruđer Bošković from Zagreb; Technical School Slavonski Brod - SB Solar Demonstration Centre; Green skills for electrical and mechanical engineering – Electrical Engineering and Transport School Osijek, and Energy Efficiency - KNX Model – Electrical and Mechanical Engineering Trade School (ESOS, Zagreb) together with partners Trades and Crafts School Sisak, Civil Engineering and Technical School Zagreb i and the City of Zagreb, City Office for Education, Culture and Sports.
- **IPA Component IV – Human Resources Development:** “Labour market research”, [6]. The general goal of the project is to ensure continued upgrading of the vocational education and training system in the Republic of Croatia and improve the communication between the initial and additional vocational education with the labour market. The specific goals of the project comprise providing support to the Agency for Vocational Education and Training and Adult Education in the development and planning of the methods to ensure an interrupted flow of information from the economy, which is necessary to coordinate the supply of vocational training with the demand on the labour market. In cooperation of the Project Team and the Agency for Vocational Education and Training and Adult Education, a document was prepared entitled “Methodology and Model for Labour Market Research” describing the process of research, identification and systematic monitoring of the demands on the labour market that are essential to coordinate vocational education and training with the labour market demands. An on-line survey was conducted as part of the project aimed at collecting information directly from the employers in some of

the most frequent occupations and competences in 13 educational sectors regarding the future needs and plans for different types of workforce, and for planning the supply of vocational education. The consortium could not obtain the document "Methodology and Model for Labour Market Research" nor the upgraded labour market research tools on-line application.

- **GTZ-ABU project:** "Labour market oriented vocational education and training, Croatia" [7]. The project lasted 4 years (2006-2010) and it encompassed cooperation between the Ministry of Economy, Labour and Entrepreneurship and GTZ. Based on the evaluation of effects achieved so far, recommendations were given in mid 2009 for the second stage of the project: strengthening of dialogue and capacity of stakeholders in vocational education at national macro level (Ministry of Science, Education and Sports, Ministry of Economy, Labour and Entrepreneurship, Croatian Chamber of Trades and Crafts, Agency for Vocational Education and Training and Adult Education), strengthening of dialogue and social partners' capacity at the local level (counties, chambers of trades and crafts, Croatian Institute of Health Insurance -HZZO, companies, vocational schools and similar), while the micro level encompassed consulting stakeholders from vocational school and licensed crafts which are carrying out pilot programmes, especially regarding curriculum development, teacher training, procurement of equipment and new teaching materials, school networking, encouraging partnerships and career guidance. During the course of the project, good cooperation was noted among the Ministry of Economy, Labour and Entrepreneurship, Croatian Chamber of Trades and Crafts and the Ministry of Science, Education and Sports, while the Agency for Vocational Education and Training and Adult Education has not shown interest in active participation in the project [7].
- **IPA Component I – Transition Assistance and Institution Building (IPA TAIB):** "Croatian Employment Service Labour Market Training Centre", where the Croatian Employment Service Labour Market Training Centre was established with the aim of educating Croatian Employment Service employees and other key stakeholders on the labour market. Within the framework of the project a policy to strengthen employee capacity of the Croatian Employment Service was implemented, as well as other institutions on the labour market for efficient work with clients and implementation of active labour market policy. No information was found regarding the labour market in connection with construction in the field of energy efficiency and renewable energy sources.
- **IPA Component I – Transition Assistance and Institution Building (IPA TAIB):** "Preparation of the Croatian Employment Service for joining the EURES network", the general project aim of which was to foster mobility and free movement of the workers within the European Economic Area market in line with the requirements stated in the negotiation chapter 2: Free movement of workers.
- **IPA Component IV – Human Resources Development (IPA HRD):** Youth in the Labour Market, GOPA – Worldwide consultants, Croatian Employment Service, January 2010 – July 2012, was promoting and encouraging the employment of young people at the regional level (acknowledging partnership approach) through development and implementation of active labour market policy.
- **IPA Component IV – Human Resources Development (IPA HRD):** "CES services to clients: improving lifelong career guidance and ICT support", June 2011 – April 2013, which project purpose is to develop an improved ICT CES system based on an integration model and information exchange among key labour market stakeholders with the aim of providing better and higher quality services to clients and supporting the development of a lifelong career guidance system, the services of which will be available to all citizens of the Republic of Croatia, and which will be based on their needs and in the field of education and career choice, in line with the employment policy and good practice of the European Union. This is an ongoing project.
- **CIP Intelligent Energy Europe:** PVTRIN project (Training of Photovoltaic Installers) addresses market needs by developing a training and certification scheme for technicians who are active in the installation and maintenance of small scale PV systems. Qualification schemes and certified training courses in each Member State rely on the criteria set by the 2009/28/EC Directive (article 14, appendix IV), taking into account the national framework and legislation. The training and certification programme will initially be implemented in six countries: Greece, Bulgaria, Croatia, Cyprus, Romania and Spain. In order to incorporate the genuine market needs and to assure the broadest possible support, the key stakeholder groups are involved in the project's activities.
- **CIP Intelligent Energy Europe:** Monitoring of Energy Demand Trends and Energy Efficiency in the EU. ODYSSEE database encompasses gathering and processing of data on energy consumption in specific consumption sectors (industry, households, services and transport), together with macroeconomic indicators, data on the number of inhabitants and households for the period 1990-2004. Based on the data gathered, a calculation was made of energy consumption indicators and energy efficiency across all sectors, as well as the CO2 emission calculation. 27 European Union Member States are participating in the project together with Norway and Croatia.

# 8. Skills gaps between the current situation and the needs for 2020

## 8.1. Labour force evolution

Since there are no institutions among those which are partners in CROSKILLS project implementation whose activities programme contains an analysis of workforce and implementation of education programmes, for the purposes of this chapter an analysis was used which was conducted by the Croatian Agency for Vocational Education and Training and Adult Education. For the purposes of workforce analysis a document by the Agency for Vocational Education and Training and Adult Education was used in one part, which was made as a result of IPA 2007-2009 project implementation "Strengthening institutional framework for the development of the vocational education and training (VET) occupational standards/qualifications and curricula (EuropeAid/127472/d/SER/HR), and it was published in December 2011.

For the purposes of making the document, unemployment data was used provided by the Croatian Bureau of Statistics, financial data provided by the Financial Agency FINA on business operation of companies according to branches and counties, data on unemployed per occupation from the Croatian Employment Service and E-Register provided by the Ministry of Science Education and Sports (chapter 7.1). The Agency also conducted a questionnaire among employers and institutions of higher education with the aim of identifying competencies required for positions in construction and geodesy. Unfortunately, the questionnaire was not conducted on a larger sample (only large businesses were interviewed), but it represented a sort of an orientation for analysis purposes.

The aim of drafting these materials consists in the need to define analytical methods and tools for recognition of current and future demand for the kinds of knowledge which will be important in reaching positive economic growth rates. Maintaining competitiveness is possible only if such necessary knowledge and skills exist in educational results, standards and qualifications which are provided by education programmes. The structure of conducted analysis consists of two parts:

1. *Analysis of workforce supply*, i.e. the analysis of sectoral and sub-sectoral vocations and the relevance of education programmes for sectoral vocations and their quality standards according to changeable needs of economic entities which are led by development of technologies, market demands and competition
2. *Analysis of workforce demand* by examining a historical series of employment data per occupation at various points in time, as well as with the help of free positions analysis.

### DEMAND FOR WORKFORCE

When analysing the Croatian Employment Service historical data within the construction and geodesy sector, a growing number of unemployed can be seen. According to age structure the biggest percentage (59.72%)<sup>3</sup> belongs to the age group of 50-64 years, which is a somewhat smaller percentage than the one for the same group at state level (65.44%). This age group can hardly be counted on during development of demand for sector workforce.

Although the problem of a high percentage of young unemployed people from the construction sector arises in the examination of sector unemployment data per age groups- as much as 32.6 % from the total number of the unemployed in the sector are persons from the 25-49 years age group, and in the education context this group represents a significant potential of workers who could, after acquiring appropriate knowledge, perform the work of energy renovation of buildings, but they can also serve well as staff to be employed in companies which will provide services of constructing low-energy buildings and passive houses.

However, the number of unemployed from this sector's age group is bigger than the state average shows. The same can be noticed for age group 15-24 years which makes up 7.67 % of the total number of unemployed and inactive sector workforce. As mentioned previously, unemployed from this age group represent a potential for increased demand for sector workforce, but also a reserve for existing workforce substitution (40.27 % of sector workforce from 15-49 years age group).

Regarding the potential and capacity of workforce in the context of energy efficiency, young people from the education system are the only alternative source if the structure of other unemployed and inactive persons is poor, and their labour supply cannot be counted on. The analysis of the Agency for Vocational Education and Training and Adult Education indicates one more important trend. If the demand for workforce cannot be met

<sup>3</sup>Data for 2010- analysis of data from 2011 and 2012 indicates a slight reduction of unemployment numbers in this sector

by the supply of the same within a country, then the workforce demands will be met from abroad. The trend of emigration of young persons highly qualified in these vocations presents an even greater danger in this sense, as well as the fact that the Republic of Croatia significantly lags behind when it comes to inclusion in adult education in comparison with European Union average (we are almost four times under this average, with inclusion of only 2 %), which means that there is a very small likelihood of retraining or additional training of staff with other vocations. It can be concluded that the structure of the employed is somewhat more favourable than the age structure of the unemployed and the inactive in the sector, but there is still a reserve in the structure of the unemployed and the inactive which can enable the substitution of the existing workforce and be a potential for meeting requirements for increased workforce demand from the sector, at the same time not reducing the importance of planning quotas and structure of education sector systems [1].

## **EXPECTATIONS FROM EMPLOYEES**

As previously mentioned, a questionnaire was conducted among employers in the construction sector in which they identified sector vocations which arise from three-year vocational education in the sector and four groups of vocations which arise from four-year vocational education. Although the questionnaire was conducted on a rather modest number of employers in the construction sector, it all the same yields some indicators which concern needs and demands for workforce. Key vocations were also recognized as well as certain regularity in sought-after competencies.

When analysing professional competencies expected of persons who have completed a three-year education programme, the following competencies are clearly pointed out: team work, observance of work procedures and responsibility (among general/social competencies) and work organization, observance of work procedures and general familiarity with principles of profession (among professional competencies). When it comes to professions which require four-year vocational education, employer expectations with regard to competencies are much broader and knowledge of languages and IT is expected.

What can also be highlighted after a conducted analysis regarding what competencies employers expect vocational school students to have, are expectations in terms of more initiative coming from employees, presentation of own ideas and responsibility, which definitely are general or social level competencies, which might not have been all too present so far. Although they do not relate to specific jobs at the construction site which are connected to energy efficiency, in a broader sense they influence the transfer of knowledge and better quality of performed work which should be taken into account in the development of future curricula. In terms of great value for employment increase, employers pointed out practical training with an employer for the purposes of gaining work experience and work habits.

The recommendation of the Agency for Vocational Education and Training and Adult Education pointed out that, in order to conduct a more detailed analysis, questionnaires should be conducted on a bigger employer sample, aimed at key sector vocations, in order to obtain a more detailed description of competencies which would suffice to make guidelines for qualifications and programme standards.

## **WORKFORCE SUPPLY**

The analysis of employed in construction shows that the biggest percentage of the employed workforce in the construction and geodesy sector has completed secondary school education according to education structure – industry and crafts vocational schools (40.7 %). The next in size is the workforce with completed secondary school education – technical and related vocational schools (22.4 %) and workforce with completed primary school (17.5 %). Workers with a university degree or two-year post secondary school qualifications in the sector employee structure make up only 16.9 % of the total number of the employed. During the analysis of education structure of unemployed and inactive persons in the sector of construction and geodesy, it was established that the most numerous group (the same as with the employed) has completed secondary school education – industrial and crafts vocational schools (40.3 %). The next most numerous are persons with completed primary school education (28.9 %). Third place is taken by workforce with secondary school education – technical and related vocational schools (15.5 %). It should be mentioned that this is a relatively narrow basis for vertical mobility within a sector towards higher education, since most young people today are entering three-year course schools which make it virtually impossible to move to higher levels of education.

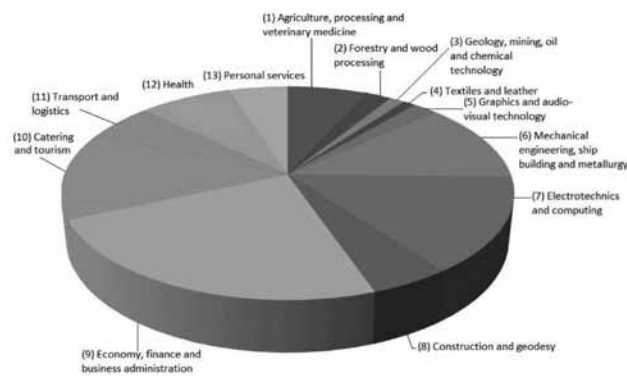
## **EMPLOYMENT AFTER COMPLETED THREE-YEAR OR FOUR-YEAR COURSE SCHOOLS**

In 2008, the Croatian Ministry of Science, Education and Sports drafted a Development Strategy of the Vocational Education System in the Republic of Croatia 2008–2013, as one of several contributions to the need for redefining the entire education system and necessary modernization of the vocational education and training system [12].



Among other things, strategic documents state that, during education programme defining and the planning of enrolment into programmes, insufficient consideration was given to real labour market needs when it comes to vocations, as well as necessary competencies. An analysis of the labour market and their projections, local and regional level economic development plans are still not taken into consideration as a necessary prerequisite for planning enrolment needs. In the same way, when planning enrolment, no consideration is given and frequently there are also no clear quantitative indicators of successful employability in a given vocation and/or continued education. On the other hand, the existing indicators show that a significant number of vocationally educated young people - especially those educated in three-year courses- find it difficult to obtain employment and/or do not find employment within their own vocation. This presents a major burden to both the education system and the employers due to a need for a greater number of retraining.

Figure 8.1-1 shows the structure of enrolled students according to vocational sectors in the school year 2010/2011



**Figure 8.1-1 Structure of students enrolled according to vocational sectors in the school year 2010/2011**

There is reduced or non-existing interest for some curricula due to a lack of interest for these vocations on the labour market and/or insufficient attractiveness of the vocation itself in spite of market possibilities [1].

By analysing the data provided by the Croatian Employment Service and the data on the structure of students completing vocational schools, which was carried out within the analysis of the Agency for Vocational Education and Training and Adult Education, it was established that the employment possibilities for young people with completed vocational education in the construction and geodesy sector was more favourable by ten percentage points for the generations which entered the labour market in 2007 and 2008, but in 2006 and crisis years, this did not deviate from the average in other sectors. From 2006 to 2010, the number of students who enrolled into construction and geodesy sector programmes grew by 1.24 %, which is actually a very positive indicator, because other vocational sectors recorded a decrease (total decrease of 6.56 %).

However, the decrease between 2007 and 2009 is somewhat more significant, and fluctuations are especially pronounced when it comes to young people who have completed four-year courses.

The indicators are in line with the construction sector boost in 2007 and 2008, when the need for sector workforce grew significantly (since the construction and geodesy sector employs the majority of workforce precisely from the sector, and it is not dispersed onto others, as is the case in some other sectors), and with a significant sector drop during the crisis, and the resulting great decrease in demand for sector workforce.

## **TRANSFER FROM THREE-YEAR AND FOUR-YEAR COURSE SCHOOLS TO THE HIGHER EDUCATION SYSTEM**

Since the analysis of the Agency for Vocational Education and Training and Adult Education focused on the period immediately after the emergence of the economic crisis, it is expected that the effect of the results of students who attended three-year or four-year course vocational schools enrolling into universities also depends to a larger extent on labour market circumstances.

In the academic year 2009/2010, the same year as their secondary school completion, 564 young people enrolled into university programmes after having initially completed one of the programmes for technicians in the construction and geodesy education sector. The Croatian Bureau of Statistics data shows that in 2009, 853 young people completed four-year courses in this sector. The rate of immediately ensuing enrolment in academic studies for technical programmes amounts to a quite high 64% of the generation; i.e. continued education is fairly common. What is more important for the Status quo

analysis is the dynamics of registering at the Croatian Employment Service, which is one of the important factors for the assessment of the dynamics of workforce entry to the market in the construction sector. According to described data, approximately 35 % of the four-year course generation registered with the Croatian Employment Service in 2009.

In the context of the labour market dynamics with regard to the construction sector, it should be considered that a large number of the population which enrolls into study programmes (specialist or university) does not obtain a degree and reappears at the labour market as workforce with secondary school education from the sector. In the last few years, there are growing numbers of students enrolling to study after a four-year vocational education programme. Since four-year vocational education programmes give students a fair degree of technical direction, and offer a small number of subjects in other sciences, the percentage of students who decide to continue studying precisely these technical sciences is no great wonder. It is easier for these students to enrol into polytechnic faculties rather than university courses of study since grammar school students are better prepared to enrol into university programmes than students who attended vocational four-year courses [1].

Environmental Management Group of the United Nations Development Programme (UNDP) conducted a survey regarding the status of the Croatian solar heating systems market, which represents a groundbreaking endeavour to gather relevant data and assess the current status. The survey pointed out a clear need for an upgrade of the secondary school education system and creation of adult education programmes, since without a sufficient number of qualified installers it is impossible to expect a bigger number of solar heating systems being installed or their quality operation.

Accomplishing the goals of the 2009 Energy Strategy presupposes average annual installation (from 2010 to 2020) of even 100,000 m<sup>2</sup>, which would, in comparison with the figures related to the situation in 2007, mean that 2,000 more people should be hired in this sector in order for the strategy goals to be accomplished. This is precisely one of the important reasons the mentioned survey was initiated – in order to determine the status, as well as examine the possibilities of further advancement in installing solar heating systems in Croatia.

Due to everything mentioned previously, noticing earlier deficiencies which hinder the development of the solar heating systems market in Croatia, the UNDP together with Zadar County and Vice Vlatković Vocational School has been committed to establishing a Solar Excellence Centre in Zadar, which will, working in synergy with already existing activities, contribute to market status improvement, but also to raising awareness regarding the benefits and advantages of RES technologies use.[49]

Within the scope of the project, a detailed analysis was conducted regarding the number of students attending regular vocational education courses, and the number of students emerging in the labour market after a three-year, i.e. a four-year education programme (2006-2009).

The Table 8.1-1 shows all vocations in the construction and geodesy sector, mechanical engineering for installer vocations, carpenters in wood processing and glaziers in glass processing in terms of the number of students enrolled into classes in the first, second, third and fourth year in a four-year education programme for technicians, as well as vocations in three-year courses, but for two periods:

1. Education courses in the years 2006-2009 - after completing their school education, a part of students continued their education (technicians) or gained employment (probably a smaller number) or ended up registering with the Croatian Employment Service and tried to retrain or is still registered as unemployed today, although these are all without exception jobs in high demand.
2. Education courses in the years 2009-2013 – data which apply as “status quo” state of all enrolled students at this moment from classes one to four when it comes to technicians and abovementioned three-year course occupations.

The Table 8.1-1 also shows the data for adult education participants, because some schools also provide this service, however, what is missing is data unknown to us regarding how many of such students underwent retraining or additional training in construction professions in the period of 3 years, as organized by various community colleges or open universities which perform the same activities and the same education programmes. This is probably a matter of some hundred students which completed their education in 2010 and 2011 in vocational school adult education programmes, but we have absolutely no information as to how many of such students completed or are still being educated at community college or open university programmes.

Table 8.1-1 Number of students attending regular education courses at vocational schools 2006-2013

		REGULAR EDUCATION										ADULT EDUCATION COURSES		
VOCATION		The number of students who attended schools in the 2006 to 2009 period					The number of students who attended schools in the 2009 to 2013 period (schoolyears 2009/10,2010/11,2011/12,2012/13)					The number of adult education courses attendants who have completed or still attending		
		GRADE					GRADE					2010.		Still attending
		1st	2nd	3rd	4th	total	1st	2nd	3rd	4th	total			
Architecture technician		486	477	408	430	1801	522	547	498	459	2026			
Civil engineering technician		339	311	330	292	1272	308	345	356	382	1391			
Geodesy technician		259	224	217	186	886	226	207	195	258	886			
Stone masonry technician		18	11	15	17	59	12	17	15	12	54			
<b>TOTAL 4-year</b>		<b>1102</b>	<b>1023</b>	<b>968</b>	<b>925</b>	<b>4018</b>	<b>1088</b>	<b>1116</b>	<b>1062</b>	<b>1111</b>	<b>4357</b>			
Bricklayer		117	152	140	0	389	104	113	100	0	317			
Stone - mason		17	11	17	0	45	25	27	25	0	77			
Chimney sweeper		0	0	0	0	0	21	18	12	0	51			
Plasterer		0	1	0	0	1	0	0	0	0	0			
Carpenter		29	25	37	0	91	48	44	39	0	131			
Roofer		0	1	6	0	7	10	7	6	0	23			
Bar-bender		2	2	1	0	5	0	3	0	0	3			
Dry-liner		55	48	45	0	148	91	80	67	0	238			
Floor-layer		5	14	17	0	36	10	6	11	0	27			
Tiler		148	139	158	0	445	122	127	134	0	383			
Self-propelled construction machinery operator		133	124	116	0	373	107	102	93	0	302			
Construction and mining machinery mechanic		0	0	0	0	0	7	7	9	0	23			
<b>TOTAL 3-year</b>		<b>506</b>	<b>497</b>	<b>537</b>	<b>0</b>	<b>1540</b>	<b>545</b>	<b>534</b>	<b>496</b>	<b>0</b>	<b>1575</b>			
Hearing and AC systems installer		424	430	466	0	1320	390	353	364	0	1107			
Gas-fitter		186	152	155	0	493	115	107	129	0	351			
Plumber		323	253	269	0	845	191	220	215	0	626			
<b>TOTAL 3-year</b>		<b>955</b>	<b>835</b>	<b>890</b>	<b>0</b>	<b>2658</b>	<b>696</b>	<b>680</b>	<b>708</b>	<b>0</b>	<b>2084</b>			
Wood Joiner		253	254	225	0	712	344	363	309	0	1016			
<b>TOTAL 3-year</b>		<b>253</b>	<b>254</b>	<b>225</b>	<b>0</b>	<b>712</b>	<b>344</b>	<b>363</b>	<b>309</b>	<b>0</b>	<b>1016</b>			
Other House and woodwork painter		191	147	174	0	512	131	113	112	0	356			
<b>TOTAL 3-year</b>		<b>191</b>	<b>147</b>	<b>174</b>	<b>0</b>	<b>512</b>	<b>131</b>	<b>113</b>	<b>112</b>	<b>0</b>	<b>356</b>			
Glass Glazier		2	0	3	0	5	3	4	1	0	8			
<b>TOTAL 3-year</b>		<b>2</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>5</b>	<b>3</b>	<b>4</b>	<b>1</b>	<b>0</b>	<b>8</b>			
<b>TOTAL 3<sup>rd</sup> CLASS</b>		<b>1865</b>	<b>1753</b>	<b>1829</b>	<b>0</b>	<b>5427</b>	<b>1719</b>	<b>1694</b>	<b>1626</b>	<b>0</b>	<b>5039</b>			
<b>GRAND TOTAL 3- and 4-year courses</b>		<b>2967</b>	<b>2756</b>	<b>2797</b>	<b>925</b>	<b>9445</b>	<b>2787</b>	<b>2810</b>	<b>2688</b>	<b>1111</b>	<b>9396</b>			

## 8.2. Skills required to achieve EU 2020 objectives

The capacities of the workforce in the construction branch may be viewed from several different perspectives and taking into account different structures of business entities viewed within that framework. In order to estimate the number of workers that should be educated in the sub-sector/vocation on the skills level and concerning the effect on the energy efficiency objectives of the EU 2020, several factors will be taken into account. The main part of the assessment will be based on the results of a questionnaire, which was distributed among crafts engaged in one of the target vocations in construction, i.e. workers who are working on specific jobs in crafts and the results of a questionnaire distributed in vocational schools (Chapter 3.2. Methodology)

### 8.2.1. ANALYSIS OF THE QUESTIONNAIRE TAKEN BY CRAFTSMEN

The capacities of the workforce in the construction branch may be viewed from several different perspectives and taking into account different structures of business entities viewed within that framework. In order to estimate the number of workers that should be educated in the sub-sector/vocation on the level of skills and as regards the effect on the energy efficiency objectives of the EU 2020, several factors will be taken into account. The main part of the assessment will be based on the results of the questionnaire distributed among crafts involved in one of the target vocations in construction, i.e. workers who are working on specific jobs in crafts.

We examined the knowledge of workers via three versions of the questionnaire with questions, which cover various domains.

#### Questionnaire A - general structure of the craft and its employees

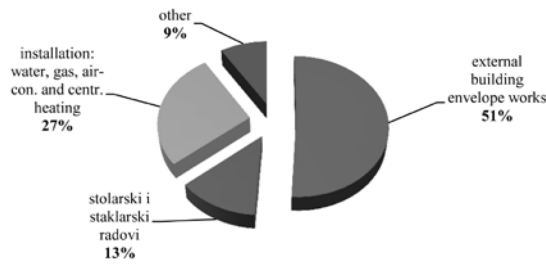
The intention behind the general questions in the questionnaire was to show the structure of crafts that are presently performing construction work, with all the indicators for which statistics do not exist or are not kept (the size of the craft, types of works, number of employees, etc.) but also to assess the level of knowledge and motivation of craftsmen and directors and their employees in education, energy efficiency and new technologies and trends in civil engineering. Said questionnaire was taken by all crafts to which the questionnaire was distributed regardless of the jobs they perform on buildings. In questions that allowed several answers, the number of answers for a particular question was divided by the total number of respondents (180). In questions which didn't allow multiple answers, the number of individual answers to a particular question was divided by the total number of answers to that question. Below is the structure of answers with accompanying interpretations.

Construction workers from all parts of Croatia have been interviewed but most answers were collected from the areas where on-site interviews and data collection were organized: Zagreb, Osijek and Rijeka. The structure is almost entirely composed of crafts (96 %), since the very intention of the Build Up Skills project was oriented on crafts, but also due to practical reasons, since one of the partners in the project is CROSKILLS Croatia, the Croatian Chamber of Trades and Crafts was in charge of collecting data and interviews with building entities. The databases of the Croatian Chamber of Trades and Crafts were used, i.e. the members which delivered their data to the Croatian Chamber of Trades and Crafts were polled.

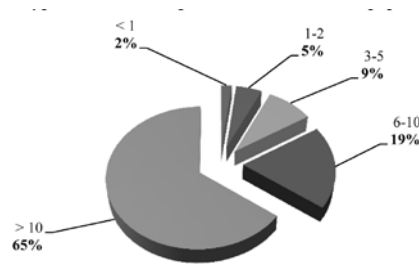
The questions were mostly answered by craft owners, in 84 % of the cases, which corresponds to the typical craft management model where the owner is also the chief responsible person. As to the educational structure, the distribution is somewhat more diverse. Since the institute of master craftsman exam is key for acquiring the rights to establish a craft in the case of many construction vocations, most respondents had passed the master craftsman exam (49%).

The second place, according to the number of answers, was taken by craftsmen with technical educational background of various origins (24%). Engineers in technical and civil engineering professions with university degree accounted for 6% of the respondents and the engineers in technical and civil engineering professions with two-year post secondary school qualifications accounted for 10% of the respondents.

The composition of jobs these crafts are engaged in is similar to the number of answers gotten in each of the submitted questionnaires (Figure 8.2.1-1). The greatest number of craftsmen are engaged in jobs on the external building envelope (reinforced concrete works, bricklaying, roofs, façades, insulation, etc.), followed by installation works (water, gas, air-conditioning and central heating) and carpentry and glazing works). Craftsmen personally specified the works that were not included in this categorization, and these included tiling work, excavation work, gypsum board interior works, concrete cutting, electrical installations, demolition, finishing works, painting work, parquet-floor laying works, equipment production, energy inspections, building maintenance.



**Figure 8.2.1-1 Types of works the polled craftsmen are engaged in**

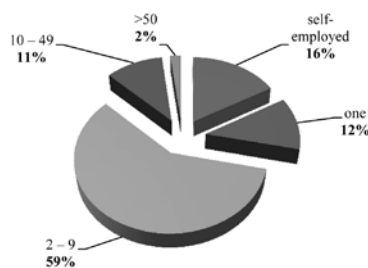


**Figure 8.2.1-2 The structure of polled workers according to the period of existence of the craft**

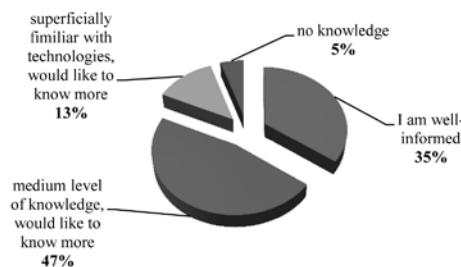
Figure 8.2.1-2 shows the composition of polled craftsmen according to the duration of craft within the activity. As the Figure shows, the greatest number of craftsmen who responded to this questionnaire has been registered in civil engineering works (which can refer precisely to target energy efficiency jobs) for more than ten years (65%), or at least for more than 6 years (19%).

This indicator has important implications for the analysis of those craftsmen who “survived” the economic crisis, which started in 2009. These results show that crafts, which closed in the last two years, were precisely those that were established during the expansion of the building sector that took place from 2005 to 2009. The premise is that the crafts with longer existence had a “reserve” of standard jobs that they performed in order to survive during the times with no great investments.

Figure 8.2.1-3 shows the composition of the number of employees in crafts. Although it was to be expected that a significant number of craftsmen would be self-employed or have at least one employee, most of them have two or more employees (60%), which provides encouragement and food for thought concerning the most suitable forms for the implementation of educational programmes in crafts.

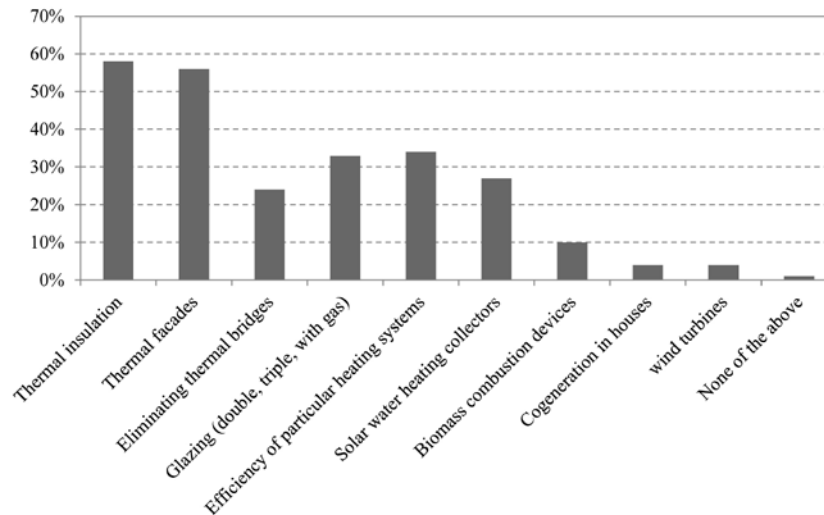


**Figure 8.2.1-3 The makeup of the number of employees in the crafts polled**



**Figure 8.2.1-4 The number of polled crafts that are familiar with EE technologies**

Figure 8.2.1-4 shows that a considerable number of craftsmen points to the fact that craftsmen are well-informed about EE technologies, but this response should be considered with caution, since they might have meant "I've heard about such technologies", and not familiarity in the sense of know-how and proper installation/implementation in construction. However, 60 % of replies that they would like to know more, point to great potential and motivation among craftsmen and their employees for education.



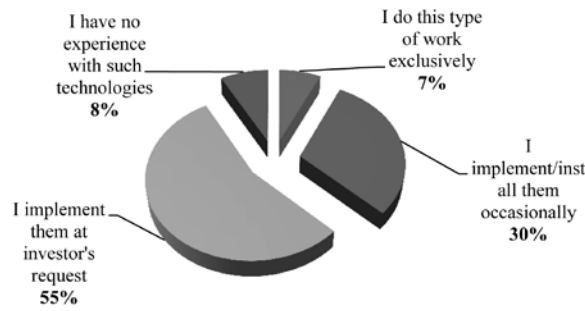
**Figure 8.2.1-5 The distribution of responses regarding the knowledge about the types of EE technologies among the polled crafts**

Figure 8.2.1-5 shows the distribution of responses concerning the knowledge about the types of EE technologies available on the market and applied in building construction. Although the answers reflect the distribution of activities included in this poll relatively well, it is interesting to note a relatively weak knowledge about the issues of thermal bridges (less than 30%). Also, the number of craftsmen who had experiences with some of the technologies which use renewable energy sources and have not been on the market for long (biomass combustion devices, cogeneration, wind turbines) is also relatively small (less than 10% of the respondents). This number can partly be explained by the fact that the demand for these technologies on our market is still small, however, it should be taken into account that among the responses which point to familiarity with these technologies there are those who have heard about said things but have no practical experience with installing them.

The next questions from the questionnaire provide insight into the assessment of the personal potential and capacity of the craftsmen to implement energy technologies, i.e. to which extent the performance of their activity on buildings is in compliance with energy efficiency requirements in building construction.

Also, it is important to see to which extent craftsmen think that they are familiar with the legislation concerning the energy efficiency of buildings in order to be able to assess both their position and knowledge within the given framework.

Figure 8.2.1-6 shows the assessment (by craftsmen) of the share and application of EE technologies in their activities. Although the data from the Figure may point to some level of knowledge about EE technologies (only 8% of respondents said they had no experience with the implementation of EE technologies), through careful interpretation different indicators can be discerned. Specifically, according to the responses from the poll, only 7% of craftsmen deal exclusively with EE technologies implementation. This scope actually corresponds to the number of craftsmen who were trained to implement these technologies, according to some other indicators (only 14 % of craftsmen stated they had a certificate for a completed course in this field). A great majority of craftsmen (85 %) either uses EE technologies occasionally or at the investor's request. Since the implementation of these technologies is sporadic, it can be concluded that, due to a lack of practice or lack of training in this sector, EE technologies are used superficially and unprofessionally. If these data are interpreted in such a way, then a huge area and the need for additional training of the existing workforce is opened.

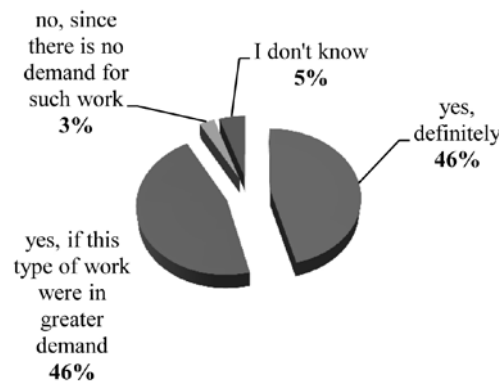


**Figure 8.2.1-6 Assessment of the share of EE technology implementation with the crafts polled**

The indicators of craftsmen’s knowledge about the legislative regulations also confirm the claims that a considerable number of craftsmen (more than half) should be trained in this aspect. More precisely, answering the question on how they would rate their familiarity with legislative regulations regarding the requirements for energy efficiency in building construction, only 4% considers themselves to be well-informed or informed in detail, while others believe to have sufficient knowledge (50%) or no knowledge (36%). Others think that knowing about legislative regulations is not needed in their work.

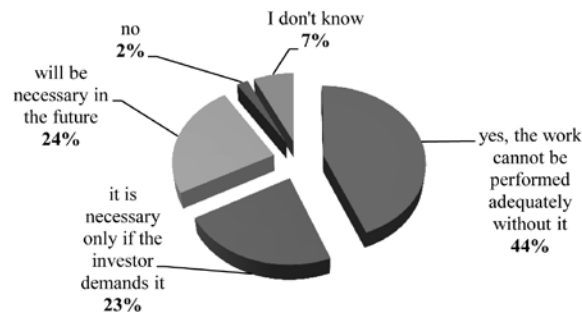
Answers to the following two questions, however, show a different, almost mirror Figure, which shows what is the relationship between the necessity of knowing about the requirements regarding energy efficiency, knowing the legislative regulations covering this area and the craftsmen’s projections on the possibility of further education bringing additional work.

The answers to the previous questions were used to get a sense of the frequency of EE technologies use and since they are mostly implemented at the investor’s request or occasionally, it can be concluded that the knowledge about technologies is not adequate in the case of the majority of craftsmen. Figure 8.2.1-7, gives additional confirmation for these conclusions since almost half the respondents (46%) think that greater knowledge about EE technologies would certainly improve their business. This group definitely includes most of the craftsmen who install said technologies occasionally or at the investor’s request.



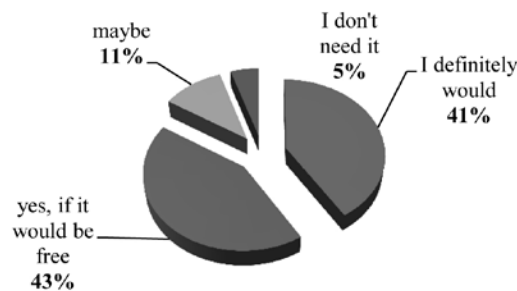
**Figure 8.2.1-7 Assessment of the effect of greater knowledge about EE demands on the business operation of the polled crafts**

The following Figure (Figure 8.2.1-8) depicting the answers to the question regarding the necessity of adapting to energy efficiency requirements in construction activity, also confirms the conclusions that although a portion of craftsmen might implement and install EE technologies occasionally or on request, due to low frequency and, even more due to lack of training, they perform these jobs unprofessionally (and possibly even inadequately). Figure 8.2.1-8 shows that almost half the respondents (44%) believes that without adaptation to EE requirements (which means learning about the implementation, standards and obligations in the use of EE technologies), the job cannot be performed adequately, while 24 % believes that the above-mentioned will be necessary in the future. If we go back to the share of craftsmen who answered they had a certificate for a completed course in this area (only 14%), then it is evident that the need for additional training of employees and craftsmen must extend to include ca. 80 % of the total population engaged, presently or to be so in the future, in said jobs.



**Figure8.2.1-8 The assessment of the necessity of adaptation to energy efficiency requirements by the crafts polled**

The last part of the general questionnaire refers to the craftsmen's impression regarding the importance and the possibility of additional training and their future expectations. Figure 8.2.1-9 shows that almost all respondents want additional training to a certain extent, as well as to become specialized in the field of energy efficiency technologies in building construction. What is even more interesting, as much as 41% would definitely take additional training if there was a systematic way of training implementation, while 43% would be interested in additional training if it would be free. These answers should serve as a basis considering the way to organize the training system.



**Figure8.2.1-9 The respondents' need for training in the field of energy efficient technology**

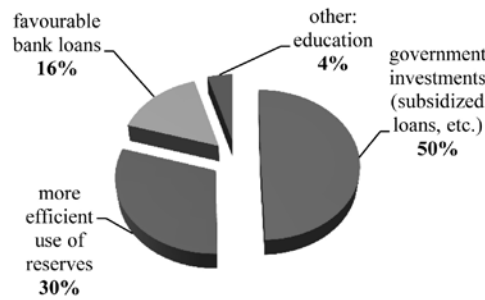
As it has been pointed out several times in this report, the vocational education system in the Republic of Croatia is partly organized so that the practical part of education takes place in licensed workshops. The craftsmen were asked to what extent they would be willing to cooperate with the educational sector in developing new educational programmes and occupations that would be in line with low-energy/energy efficient construction and the answers obtained point to the willingness and openness towards more active participation in educating new human resources. 39 % of the respondents would definitely cooperate with the educational sector and 41% also want to cooperate under the condition that it does not take up too much of their time. Naturally, although the craftsmen mostly show a tendency to actively participate in the educational processes, this could be seriously hindered if only a small number of craftsmen acquire additional training in this aspect or if significant change in the economic activity fails to occur.

The expectations and predictions of the craftsmen regarding the future of the economic activity in construction in relation to the new requirements and tendencies of energy efficiency and the building of passive houses are moderately optimistic. In the next to last question of the first part of the questionnaire, the responses regarding whether they think that the tendencies of increasing energy efficiency will lead to an increase in the volume of their work, 43 % craftsmen thinks they will, and another 30 % thinks that the same could happen with more strict legal provisions.

Figure 8.2.1-10 shows answers to the question on who should take the leading role in initiating wider implementation and installation of EE technologies. Although it was expected that the majority would think that the key factor in initiation should be the government, with subsidized loans, direct investments and adoption of adequate legal procedures, as believed by 50 % of the respondents, there is a surprising fact that (according to the interpretation of the number of answers) as much as 30 % of the respondents sees the importance of more efficient use of reserves as a considerable financial source for potential renovation of buildings and investment into EE technologies.



**Figure 8.2.1-10 The manner of encouraging the use of EE technology according to the respondents' opinion**



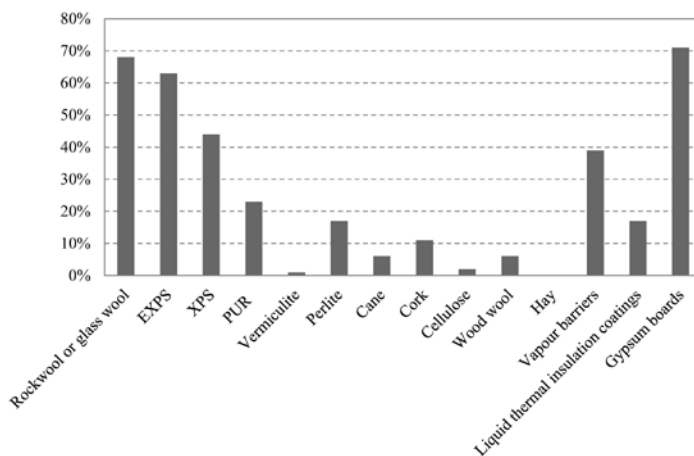
**Questionnaire B1 – general structure of crafts and their employees**

In order to get a more detailed insight into the workers' knowledge about the specific requirements and issues of energy efficiency, special questionnaires were prepared for each area of implementation in buildings. So the questions were organized into three different questionnaires and each one according to the special type of works performed on the building.

Insight into specific knowledge of workers is an important part of this status quo analysis, since based on it we can get a better perspective of the existing potential and capacities of construction workers. Therefore the composition of answers to the questions from these questionnaires will be used in the course of the analysis as an important factor in the assessing the training requirements for new workers and as an important indicator of the gaps, which additional educational programmes should fill in. The number of workers (registered craftsmen and their employees) engaged in the activity to which the specific question refers will be taken as a measure or an indicator of the capacity (craftsmen i.e. employed workers in the construction industry).

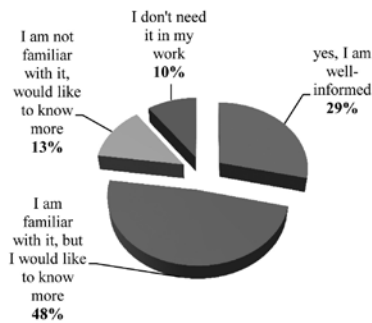
To conclude, for the approximate assessment of the capacity and potential of construction workers to implement the energy efficiency jobs, it will also be important to take into consideration the available documents where certain forecasts are made regarding the planned volume of construction work, their specifications, etc.

Figure 8.2.1-11 shows what construction materials most of the interviewees had experience with. Although it was expected that the greatest number of craftsmen would have experience in working with materials that are used in work often (Rockwool, gypsum boards) and have been present on the market for a long time, the low level of familiarity with some of the traditional materials (cork, cane, cellulose), as well as the relatively low level of familiarity (less than 50%) with technologies such as vapour barriers or XPS and PUR are surprising.



**Figure 8.2.1-11 Distribution of materials that most of the polled workers had experience with**

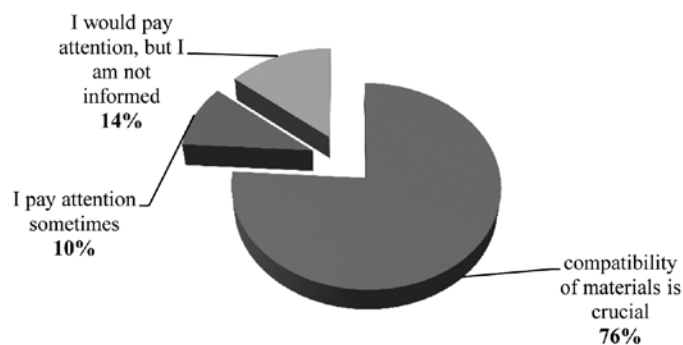
Indicative answers are concerned with the questions on some other technologies used. For instance, a little bit less than 50% of craftsmen had experience, i.e. are familiar with the function of vapour and water barriers. Since this is one of the main features of building insulation and since the knowledge about said influences is important for most of the work in building envelope renovation, the makeup of this answer also points to the direction in which further training should go, as well as to its scope.



**Figure 8.2.1-12 Familiarity of the polled workers with the term “thermal bridge”**

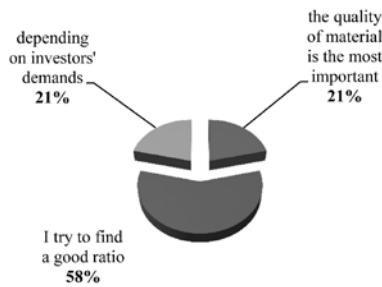
Continuing with the questions about the key factors in insulation, i.e. the loss of thermal energy in buildings, Figure 8.2.1-12 shows the answers to questions regarding the term “thermal bridges” in buildings. Thermal bridges are one of the causes of undesirable consequences of unprofessionally installed insulation (humidity condensation, mould). With proper execution of insulation on the building envelope (walls, roof, floor), most of the thermal bridges will also be insulated and hence the condensation will be prevented in certain parts of the structure. Therefore, familiarity with this technology is one of the key factors in jobs concerning energy efficiency. As it can be seen from the makeup of the responses, only a third is well-informed about the effects of thermal bridges while 48% is not sure about all the consequences and would like to know more. Others are either not informed (and would like to be educated in that regard) or believe that they don’t need it in their operation (although they perform work on the external building envelope).

Nevertheless, answers to some questions, show that a more comprehensive and relatively more responsible approach to the execution of works is present in some segments. Figure 8.2.1-13 and Figure 8.2.1-14 show the makeup of responses regarding the importance of the compatibility of materials, and they also show in what way the craftsmen make decisions between the price and quality of materials installed in the buildings. Figure 8.2.1-13 shows that a considerable number of craftsmen (76%), after all, take care of the way the works that are compatible with the works performed only by them are executed. If these answers are taken with a bit of reserve, the impression still remains that craftsmen are still aware of their issues. However, it is important to establish how many of them need to be transferred from the 76% segment to those 14% who would “pay attention but are not informed”.



**Figure 8.2.1-13 The importance of the compatibility of materials in systems with the respondents**

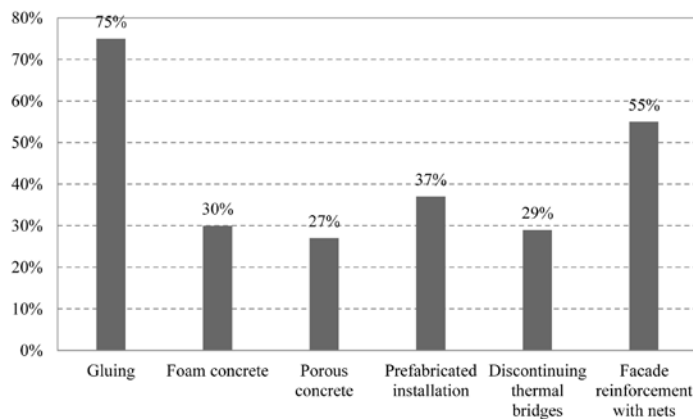
Craftsmen also responded to questions which focused on their understanding of the necessity of installation of quality materials. Here, the answers show that a small number of interviewed craftsmen think that the quality of materials is crucial. Figure 8.2.1-14 which shows the makeup of answers points to one of the factors which should never be ignored and that is that the contractors do business on the market, where, in addition to the level (quality) of performance, they also need to compete with their price, which consequently often reflects on the quality of materials installed. In that sense, the education of investors is equally important as well as the conditioning (for instance in public tendering) of the level of quality of materials which need to be installed. This also brings us back to the previous question and that is the knowledge about the compatibility of several types of materials used, so that materials with the best price-to-quality ratio would be installed after all.



**Figure 8.2.1-14 The importance of price-to-quality ratio for the polled craftsmen**

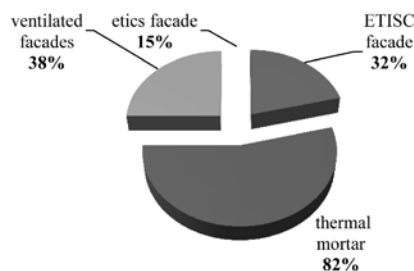
In reply to the question regarding the importance of manufacturer’s instructions in the installation of materials, most (80%) of the interviewed craftsmen answered that they paid great attention to it and the rest (20%) paid some attention to it. The answers, in a way, reflect the way in which the question was asked - it is divined that anything besides the first two questions would imply unprofessional execution, therefore the real situation cannot be deduced from this answer.

The next two Figures point to the technologies used in the execution of walls and the technologies of facade execution familiar to the Croatian craftsmen performing these jobs. It was already evident from the previous answers that the knowledge about the technologies of discontinuing thermal bridges was relatively weak (less than 30%), while approximately the same number of interviewed craftsmen (less than 30%) was familiar with the technology of foam concrete and porous concrete. Prefabricated installation is a technology known to an increasing number of craftsmen, and what’s more, a part of them already specializes in it.



**Figure 8.2.1-15 Familiarity of respondents with wall installation technologies**

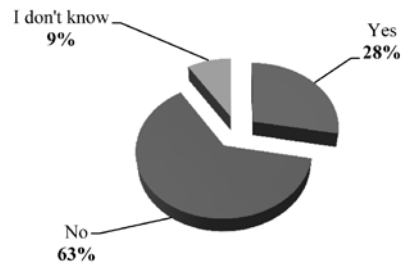
Figure 8.2.1-15 shows the distribution of knowledge concerning modern technologies of facade execution. Most of the interviewed craftsmen (82%) know about the technology of thermal mortar execution since it has been present on the Croatian market for some time and as such it is installed most frequently. A much smaller number of interviewed craftsmen is familiar or has experience with other technologies such as ETICS façades or ventilated façades, 32% and 38% respectively. However, it is important to say the with regard to said technologies (ETICS, ventilated façades) there was progress in terms of training and this consists in the fact that manufacturers/representatives/dealers held courses, on their part, where craftsmen were educated regarding the best ways of installing materials they are manufacturing or distributing, but this was partly done within the scope of promotional activities.



**Figure 8.2.1-16 Familiarity with the state-of-the-art technologies of façade execution**

When talking about new technologies in construction and the knowledge that craftsmen engaged in construction should have in order to successfully carry out the energy efficiency requirements, it is also

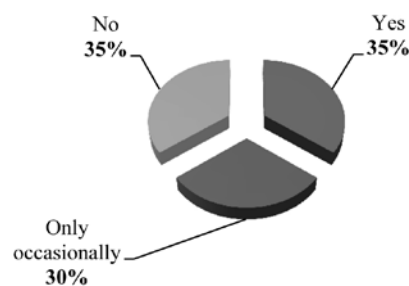
necessary to take into account the tests of building characteristics during which craftsmen would be able to get insight into the actual state of the execution of works on buildings. Figure 8.2.1-17 shows the makeup of answers regarding the knowledge about the purpose, method and results of testing external building envelope (airtightness, thermography...). According to the answers, only 28% of craftsmen came across these tests in the course of their work, which can mean that they know the basic characteristics (method/purpose/results), but also that they know what it is about but are not familiar with the basic characteristics. Still, more than 70% of craftsmen who have not come across this testing confirm that the future training programme for craftsmen and construction workers should certainly include teaching workers about the basic characteristics of testing external building envelope.



**Figure 8.2.1-17 Familiarity with the testing of external building envelope**

Other questions in the questionnaire also referred to new building execution technologies, i.e., particularly, to technologies that are closely related to energy efficiency. Schöck systems for thermal and sound insulation are one of the new technologies for implementing quality energy insulation of non-typical elements in building construction, but they are also increasingly becoming a crucial element of quality building, cost and energy efficiency. Only a few craftsmen came across this type of system (less than ten), which definitely shows that the knowledge of most craftsmen and workers engaged, even exclusively, in energy efficiency jobs is rudimentary and that training programmes need to be designed to include, in a certain way, a greater part of the construction workers population.

Figure 8.2.1-18 shows the answers to the question which was aimed at getting direct insight into the operating methods of craftsmen engaged in a wide range of jobs on building envelope. The question refers to the implementation of sealing of installation outlets (electrical, etc.) on buildings. Gluing and sealing is of the utmost importance for the durability of structures. The purpose of sealing is to prevent undisturbed flow of air, water, chemicals, smoke, etc. with the aim of ensuring the thermal and sound insulation of the facility. Non-permeability of buildings and thus the role of sealing is becoming more and more important for the realization of energy efficiency. Also, the importance of sealing needs to be viewed in the context of building's firefighting requirements. The Figure shows that 35% of contractors think that sealing outlets, even from external walls, is necessary.



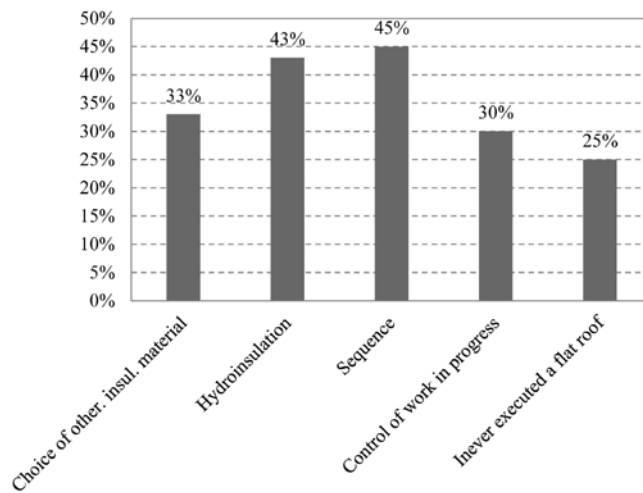
**Figure 8.2.1-18 Importance of sealing for respondents**

The final questions of the questionnaire concern the various executions of roofs as a key element on a building, as well as the parts that are most exposed to various atmospheric influences. Daily temperature and humidity oscillations resulting from meteorological changes on the one side, and living and working conditions on the other side, cause temperature and humidity differences on the inside and the outside of the facility. These differences cause the passing of heat and humidity through the roof structure, where condensation is often the greatest issue. For that reason, roofs, especially those with attic flats, need to be ventilated - the so-called cool roof. Cool roof is a term for the type of roof structure where continuous air flow is enabled in the layer between the roofing tiles and the roof structure. When asked about familiarity with the benefits of cool (ventilated) roofs, 38% of craftsmen responded that they executed and are familiar with the basic functions of these roof covers. 15% of the craftsmen answered that they installed

them but that they didn't know their function (which can potentially point to certain unfamiliarity with all the details, which need to be observed during installation). Others, a little more than a half, have never installed nor know the details of this technology.

Green roofs are often mentioned in the context of energy efficient construction and passive solar architecture since they are characterised by a series of benefits compared to regular roofs: they act as thermal insulators, thus decreasing heating and cooling costs in buildings (for about 20%), they extend the life of the roof, protecting it from ultraviolet radiation, great temperature changes and mechanical damage (e.g. hail). They also absorb sound and decrease the influence of noise, filter air and create a quality micro climate. Having said characteristics they become a staple in contemporary energy efficient building projects, primarily due to their potential for mitigating extreme weather conditions. Within the questionnaire, craftsmen and workers were asked about their experiences in the installation of green roofs. Out of all respondents, only two (2) had experience with their installation. Others either heard about the term (77%) or don't know what the term means 25%. If the Croatian market becomes more oriented energy efficient building in the upcoming years, it is to be expected that green roofs will become an increasingly attractive option for investors. Judging by the answers received in reply to this question, the training needs to start as soon as possible, at least concerning the basics of their installation.

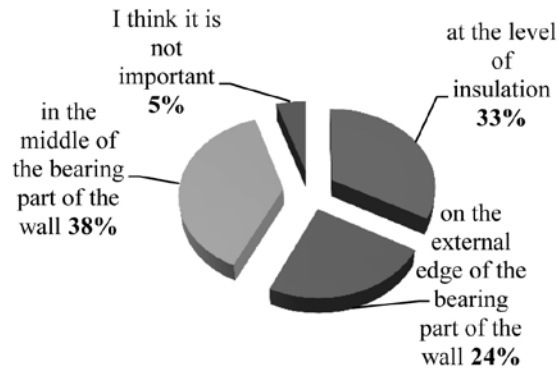
Figure 8.2.1-19 shows the distribution of answers to the question regarding the stages of installation of flat roofs on facilities. Construction damage is a common occurrence in the installation of flat roofs and execution of damp proofing ending details, due to poor technical knowledge and performance. A flat one-part roof (warm roof) is a multiple-layer construction element of a building where each of the envisaged layers has its function and the sequence of installation (load-bearing roof panel, a layer for the roof's slope, vapour barrier, thermal insulation and the finishing layer).



**Figure 8.2.1-19 Respondent's answers regarding the stages of installation of flat roofs on buildings**

In addition to the questions regarding the area of external building envelope, questions answered by craftsmen engaged in the activities of installation and execution of indoor and outdoor carpentry on buildings were added.

It is a well-known fact that windows on buildings (i.e. doors on houses) are the most dynamic part of the external envelope; they are both the recipient letting in solar energy into the space and protection from external influences and thermal losses. The total losses through windows amount to 50% of thermal losses of a building and they are usually ten times greater than those that occur through walls, so the importance of window efficiency in total energy requirements of a building is evident. The questions answered by craftsmen, were designed to get insight into their knowledge about new technologies concerning windows but also the specific knowledge concerning insulation, sealing and the technologies used in this process. These questions were answered by 50 craftsmen engaged in woodwork installation.



**Figure 8.2.1-20 The respondents' method of installing external openings**

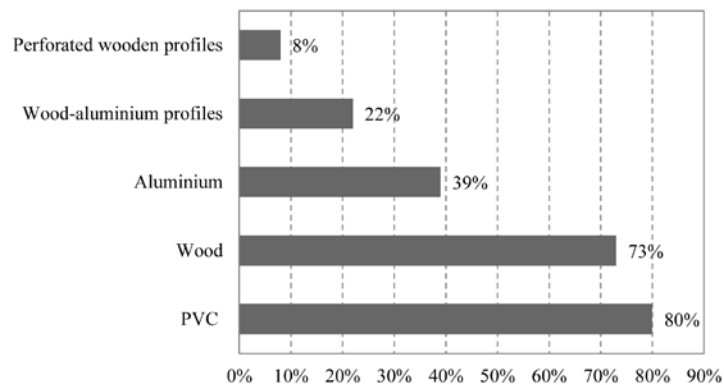
Figure 8.2.1-20 shows the distribution of answers to the question regarding the method of installation of external openings. The distribution of answers shows that only 33% of respondents are familiar with the proper installation of openings for zero-energy and passive houses, while the rest need to be trained in this field.

Roller shutter boxes are potentially the points of great thermal losses and therefore they need to be adequately insulated. With regard to the methods of insulating roller shutter boxes, different answers were given as well. A part of the carpenters insulates roller shutter boxes from outside (30%), some of them both from inside and outside (20%) and the rest insulate both from inside and outside (39%) or they don't install insulation (12%). It is evident that different insulation methods will lead to different results in terms of energy losses (i.e. savings).

As regards the technologies present on the market, that carpenters are experienced with, the results of the questionnaire are also indicative. The largest number of craftsmen had experience with laminated glass (65%) and double glazing (66%) respectively. Only 23% has experience with glass where insulation is achieved via low-E coatings and inert gas filling (20%) respectively.

In sealing external openings during insulation, most frequently used material is Pur foam (59%), which, although it has been present on the market the longest, has certain faults and is not always the best choice to install in buildings. Insulating strips are used by 18% of craftsmen and 15% uses specialized foams.

Figure 8.2.1-21 shows the experience of craftsmen with different types of frames that are installed on buildings and present on the Croatian market. Most craftsmen have experience with wooden frames (73%) which are traditionally installed in Croatia, especially in the coastal area, where they also represent a traditional, Mediterranean type of building. PVC frames (80%), which also represents the most widespread type and the first step in the implementation of energy efficiency in building. A considerably smaller number of respondents have experience with the installation of aluminium (39%) or wood-aluminium profiles (22%). Only a small number of respondents have experience with the installation of perforated wooden profiles (8%).



**Figure 8.2.1-21 Craftsmen's experiences with different types of frames installed on buildings**

### Questionnaire B2

The third part of the questionnaire was delivered to all craftsmen engaged in installation (heating, gas, air-conditioning) since they precisely are responsible for the implementation of works related to energy efficiency, concerned with the use of renewable energy sources (installation of solar collectors, cogeneration, biomass devices, heat pumps, etc.)

In addition to the part of the questionnaire conducted among installers exclusively for the purposes of this analysis, the result of polls conducted by the UNDP were used as well. Since a wider research of the sector was conducted within this poll, these findings were also included in the needs analysis.

A certification system for solar thermal systems (STS) installers still does not exist as such and within the scope of Transolar project (implemented by Energy Institute Hrvoje Požar) it was determined that the persons engaged in the STS installation in this country are mostly air-conditioning and heating installers, plumbers and similar vocations, as well as that that they don't know enough about the specialities of installing solar thermal systems, which sometimes leads to poorly sized or deficiently installed solar thermal systems. The poll conducted by the UNDP clearly pointed to the need for upgrading the high school education system and creating adult training programmes since, without the adequate number of qualified installers, a greater number of installed thermal systems cannot be expected, and neither can their quality functioning.

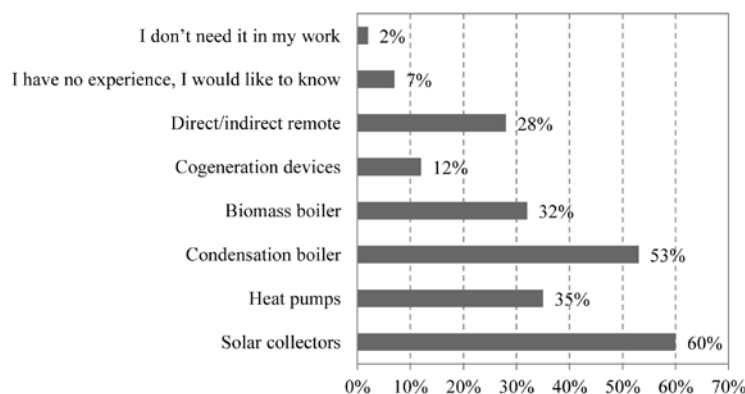
The questionnaire for installers was conducted for the purposes of this report; it is structured similarly as the questionnaire conducted for workers on exterior building envelope and carpenters. A part of the questions refers to general experiences with new work technologies, while the greatest number of questions is indicative for determining the current level of knowledge about the proper installation and maintenance of systems using energy efficient renewable sources and the total processes related to this activity. The questions were answered by 72 crafts registered for performing the activities of water, heating and air-conditioning installation.

In questions that allowed answering multiple answers, the number of answers for a particular question was divided by the total number of respondents (72). In questions which didn't allow multiple answers, the number of individual answers to a particular question was divided by the total number of answers to that question.

The first two questions concern the knowledge about the particularities and influences of using these technologies. Only 60% of craftsmen were informed about the optimal indoor temperatures in heated and air-conditioned spaces, which is a considerable percentage. What is more important for this report is that 40% are not sure of their knowledge and would like to know more.

50% of the interviewed craftsmen are aware of the benefits of low-temperature regime of heating system operation, which is key in the implementation and evaluation of the efficiency and cost-effectiveness of heating systems with heat pumps, while the rest were not familiar with it but would get training if training programmes were more widely available.

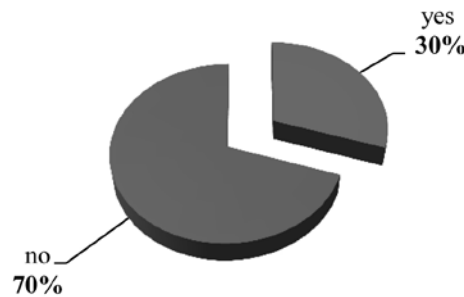
As in the previous questionnaires, an overview and distribution of technologies they are experienced with have been established. As opposed to the previous analyses, Figure 8.2.1-22 gives an overview of experiences with available technologies which point more to the distribution of market demand for it than the acquired level of knowledge application (as opposed to the implementation of modern technologies for instance in building, insulation, etc.). The makeup of answers to this question indicates that the entire questionnaire could indicate the level of implementation and the quality of installation of said technologies better since the level of implementation in total will depend on other factors such as primarily demand, which is influenced by the price of the very technology, then the cost of primary energy sources, available incentives, etc.



**Figure 8.2.1-22 An overview of experiences with available technologies among respondents**

As opposed to previous activities where the execution of works, i.e. the implementation of new technologies in executing works, was not defined by completed seminars, additional educational programmes or courses, for the installation of technologies such as biomass boilers, cogeneration devices and heat

pumps one often needs certificates for completed seminars organized by manufacturers/dealers of equipment that is being installed.



**Figure 8.2.1-23 The number of respondents who did/didn't attend vocational courses for dealing with RES**

Figure 8.2.1-23 shows that 30% of craftsmen who took part in this questionnaire and who perform the activities of installing gas, heating and air-conditioning have a certificate as a proof of their training. Craftsmen also specified in their answers what these certificates were, so it can be determined that in general they are related to companies which represent or distribute devices for cogeneration, biomass, heat pumps (*Bosch Group, Wiessmann, Centrometal, Vaillant*). This points to the fact that installers of more complex technologies exist on the market but that their training is covered by the companies which are at the same time the manufacturers or distributors of these devices. It is therefore important that educational programmes in vocational schools are adjusted (in more detail) to acquiring the knowledge that will better prepare the future craftsmen for potential (future) installing of these technologies. The educational programmes for existing crafts engaged in installation, on the subject of widely available technologies, such as solar collectors, will be more indispensable and more attractive

An overview of the answers to the following questions shows these tendencies with more detail. One of the questions referred to the familiarity with the advantages of drives in pumps and ventilators with continuous rotation speed variation. Although 33% of respondents answered that they were familiar with this, 49% craftsmen who answered the questions are principally informed but would like to know more, while 11% is not informed but would like to know more. These data represent a useful base for the evaluation of future educational programmes and the actual needs of the portion of craftsmen who occasionally or frequently engage in this activity.

The above-mentioned claims are supported by the structure of answers to the following several questions. 19% of craftsmen who answered this question are well or satisfactorily informed about the methods and benefits of using excess heat in heating, ventilation and air-conditioning systems. Only 5% thinks that they don't need to know about this in their work, while 54% knows what the questions refers to but wants to learn more, and 22% doesn't know what this is but knows they need it to perform their activity and would like to know more.

Furthermore, 22% of craftsmen and their employees are well- or satisfactorily informed about the modern management and regulation systems (digital microprocessor technology) and their benefits. As in the previous answer 54% knows what the question refers to but think that they need to (and want to) know more and 19% doesn't know what the question refers to but know that they need it to perform their work. Only 5% of respondents think that they don't need to know about said management and regulation systems in their activity: An overview of responses to these questions is in line with the results of the answers to the question about acquiring additional knowledge in seminars, professional trainings, etc. and it is presented on the Figure 8.2.1-23.

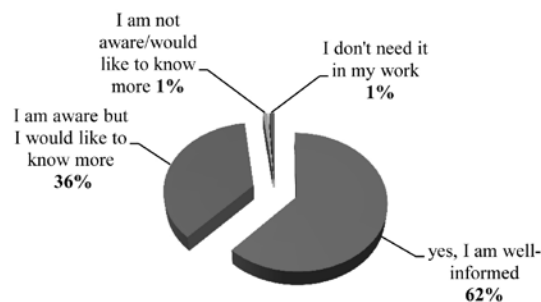
As in the previous questions, craftsmen were asked about the type of equipment and materials they use (considering the level of price and/or quality) and about paying attention to the implementation of manufacturer's instructions regarding the proper installation and use of equipment and materials. However, as opposed to the questions that we asked craftsmen engaged in activities on external building envelope and where craftsmen were more independent in choosing the materials to be installed in building, installers mostly install the equipment ordered by the customer within the scope of their preferences (price, quality, and manufacturer). Hence, although the makeup of the answers is similar to those in the previous chapter, they cannot be interpreted in the same way.

For instance 35% of craftsmen believes that the quality of equipment is the most important, which can mean that they only install such equipment. The remaining 65% tries to find a good ratio, which can also mean that they represent/install only the equipment that is safe, reliable and quality but priced in a way to be competitive on the market.



Also, it is difficult to conclude to what extent and how adequately installers use the manufacturer's instructions for the safe installation of equipment. According to the answers, 65% of craftsmen pay great attention to manufacturer's instructions and 35% pay medium amount of attention. It is possible that among the latter answers there is a certain number of those who were thinking of the installation of equipment depending on the conditions found on the site, which can make drawing a conclusion about the total level of knowledge and potential need for additional training difficult.

In the other part of the questionnaire, craftsmen engaged in the activities of gas, heating and air-conditioning installation answered the questions concerning the interaction with other, complementary activities, i.e. requirements for adequate use and functioning of installed equipment and buildings in which the devices were installed. So, questions about the method of insulation of installed equipment were asked, followed by questions on adequate equipment adjustment to minimize the level of noise it generates while working and the installation of equipment with regard to the characteristics of the part of the building where it is installed (e.g. roof).



**Figure 8.2.1-24 Familiarity of respondents with the consequences of heat loss in non-insulated parts of the installation**

Figure 8.2.1-24 shows the results of the answers to the question about the familiarity with the consequences of heat loss in non-insulated parts of an installation (pipelines, ducts, fittings, thermal reservoirs) in buildings.

As you can see a relatively great number of craftsmen (62%) replied that they were well-informed about the above-mentioned, while others expressed doubts about their familiarity with this issue by expressing their wish to learn more (i.e. that they would potentially wish to get more training if programmes were more widely available).

With regard to the type of materials most frequently used in installing technical insulation (thermal insulation of installations), the first place according to the number of answers was taken by mineral/Rockwool as the most frequently used insulator (60% of craftsmen use it). Polystyrene is used by 47% of the craftsmen, polyurethane is used by 39%, and other materials (e.g. synthetic foam insulation with vapour barrier is used by only 10% of the respondents).

Furthermore, we wanted to determine how much attention installers paid to roof structure and static resistance of all elements during the installation of solar collectors and photovoltaic cells. Although the share of the answers where it is believed to be necessary to check the bearing capacity of the roof (or another component of a building) is 67%, the remaining 29%, if viewed in terms of the total ratio of craftsmen engaged in this activity, think that previous checking of the static is not necessary or who are not sure about it, represent a base which does not possess enough knowledge to adequately implement these technologies.

Nowadays, the noise, i.e. protection from noise produced by the generator for energy transfer is an important element to which more and more attention is paid at the installation of photovoltaic cells on buildings. When asked whether they paid attention to this factor during the installation of equipment, 37% of craftsmen replied that the time of installation they regularly implemented measures for noise protection (it is not specified what they are). The largest percentage (52%) knows about this issue but do not implement any measures to eliminate it. Other respondents (11%) do not consider this to be an issue and consequently do not implement any measures. As to the presented results, the conclusion is that this makeup of answers represents a starting point for thinking about possible educational programmes and their potential attendees.

In conclusion, we were interested in how many respondents came across testing of energy specifications of the equipment and heating systems and air-conditioning (control energy measurements, measuring the composition of flue gas of boilers, measuring the degree of efficiency, temperature measurements, flow measurements, air duct leakage measurements, etc.). Of all the respondents, 29% have

come across these tests and performed them personally. The largest number, 46% knows what the tests refer to, why they are conducted but, apart from that, have no other experiences and would like to know more. The remaining 25% doesn't know what this concerns.

### 8.2.2. Analysis of the poll conducted in vocational schools

The poll that was conducted in high schools was divided into three parts, depending on the type of vocational school in the field of construction.

The first questionnaire was made for technical schools (construction and architectural technicians and future technicians of energy efficient building) in which 14 technical construction schools took part.

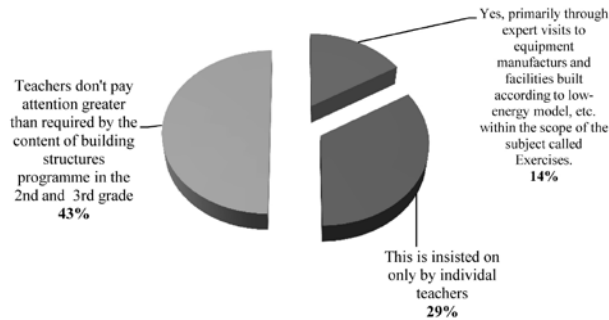


Figure 8.2.2-1 Attaching importance to the need to train technicians in the field of RES and EE buildings

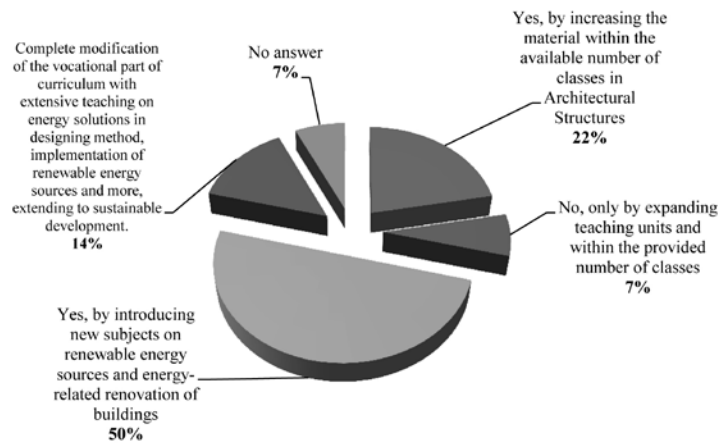


Figure 8.2.2-2 Required number of classes and content in schools to explain EE and RES

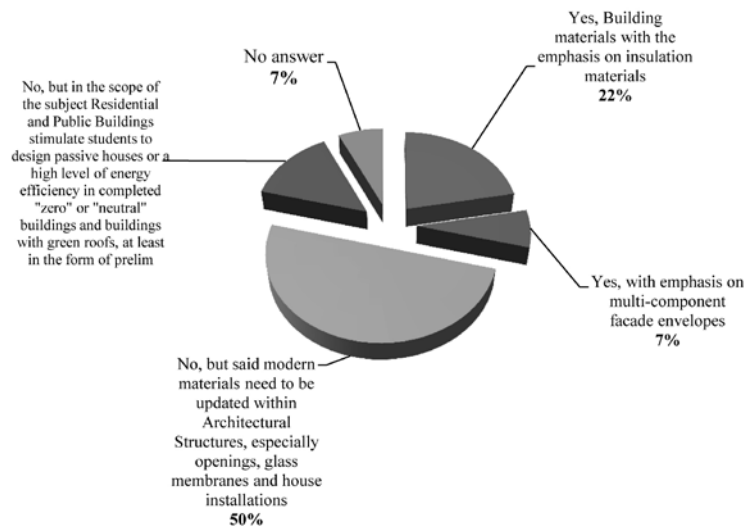
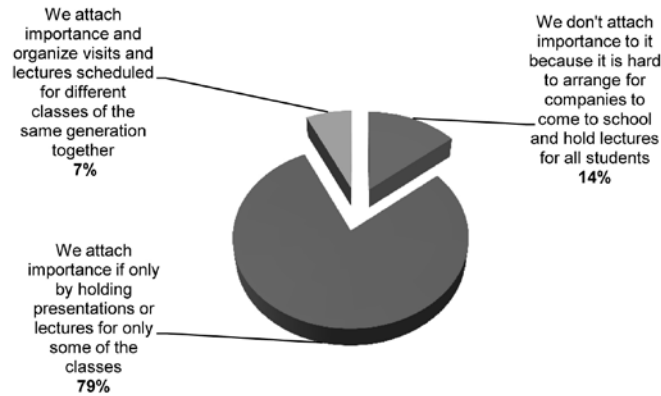
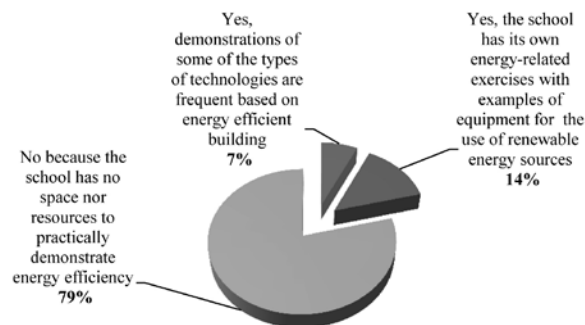


Figure 8.2.2-3 The need for introducing subjects related to EE and RES

The answers of teacher representatives from technical schools show that there is no initiative to revise curricula to a greater extent but there are teachers teaching particular subjects (Architectural Structures, Residential and Public Buildings and similar subjects) which include, in the current framework curriculum, only a small range of content regarding energy efficient building and even less regarding the implementation of RES technologies. On the other hand, the expectation seems to prevail that ready-made solutions may only be offered by the Ministry of Science, Education and Sports and the Agency for Vocational Education and Training and Adult Education. In any case, the majority (almost 50%) is at least in favour of revising the content of the existing subjects with the reinforcement of the unit concerning EE and the use of RES.



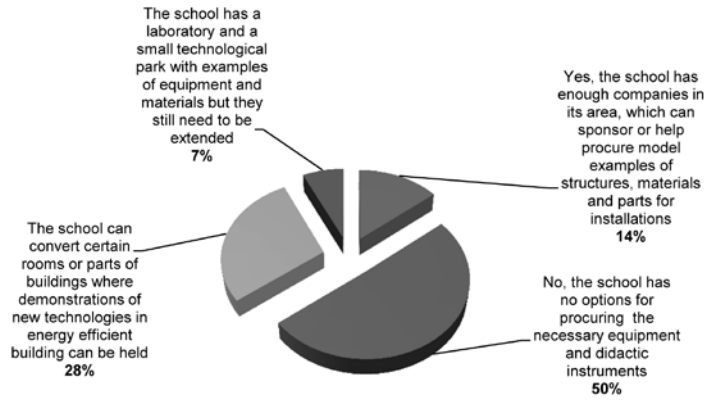
**Figure 8.2.2-4 Attaching importance to cooperative teaching that includes presentations by renowned companies with different types of materials, products and technologies**



**Figure 8.2.2-5 The existence of a space in school for practical demonstration of the execution of external building envelopes and the use of RES, etc.**



**Figure 8.2.2-6 The existence of a satisfactory collection of materials and samples of structures used to achieve EE in schools (horizontal structure profiles, vertical structure profiles, etc.)**

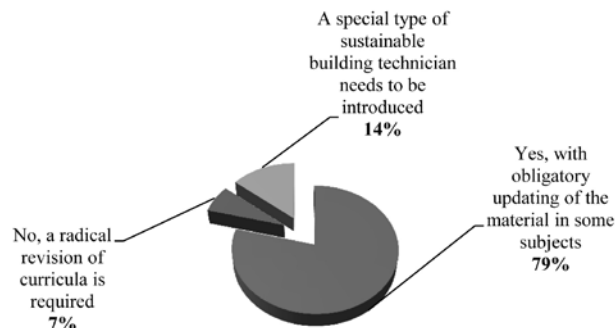


**Figure 8.2.2-7 The possibility of acquiring necessary didactic resources and securing an area for the demonstration of new technologies for efficient building and the use of RES**

According to the analysis of the group of questions opening the subject of acquiring practical experiences in the use of RES or EE technologies, most of the schools states that they neither have the space to provide an exercise area for demonstrations nor have examples of energy efficient solutions in their workbooks with didactic materials and they don't see any possibility of getting both the didactic resources and space for demonstrations or workbooks with materials or devices for RES generation. Most of the schools believe that the current practice of cooperative teaching, i.e. presentations by companies engaged in either the production or installation of materials and RES or EE technologies or in the visits, within the framework of the subject Exercises, to construction sites where such construction solutions are implemented.



**Figure 8.2.2-8 The percentage of students continuing their education according to the opinion of the respondents**

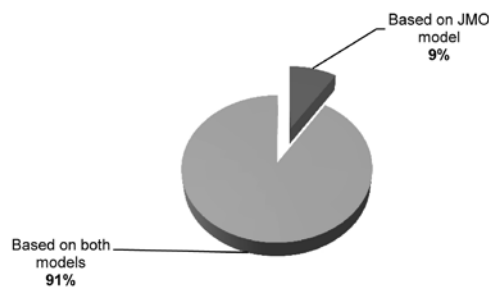


**Figure 8.2.2-9 Current morphology of content in the vocation as a good basis for the continuation of students' education**

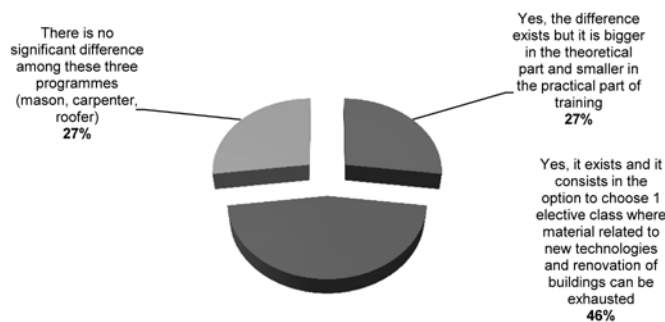
In the last two questions (Figure 8.2.2-8) of the questionnaire for civil engineering schools, it is stated that between 55 and 75% of students are continuing their education on polytechnic faculties or related university studies. In the last question (Figure 8.2.2-9) most of the polled schools and their teachers stated that the results of learning with most of the students are approximately very good and that they represent a good basis for continuing their education and with regard to quality employability, it is necessary, in order to acquire a satisfactory level of knowledge at technician level, to emphasize the programmes in some subjects so the results of education would keep abreast of the new construction technologies.

The conclusion of the questionnaire for civil engineering schools is that vocational teachers are more or less resigned regarding their own initiative in strengthening the content in school subjects where the material can be updated through greater focus of the topic of RES and EE, except those directly teaching Architectural Structures and Residential and Public Buildings, and as regards the practical experience of students in direct contact or demonstration of new building technologies, they don't see the potential projection of increasing spatial, didactic and other conditions besides the possibility of cooperative classes held by professionals from contractor, designer and manufacturing companies engaged in RES and EE.

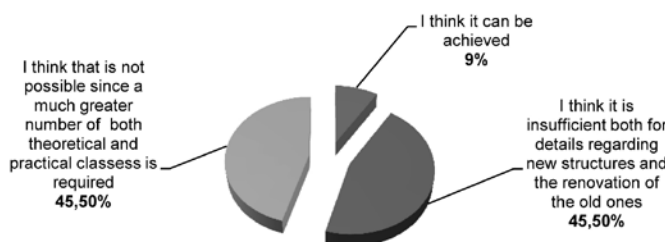
11 schools took part in the questionnaires for mixed-programme schools which hold both four-year and three-year courses in construction



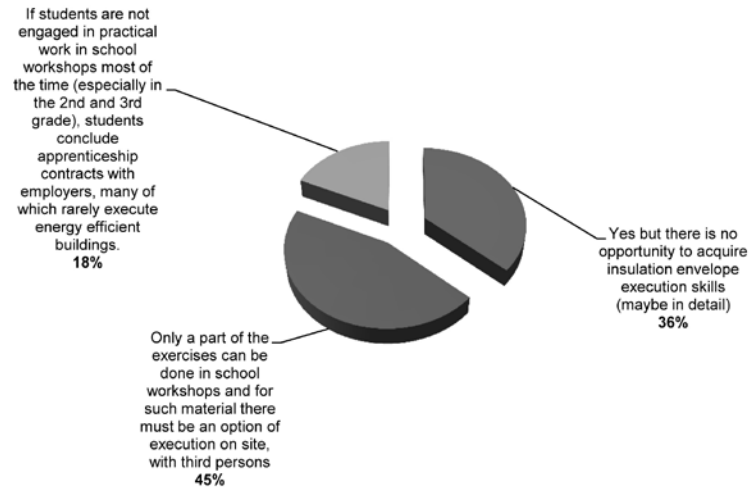
**Figure 8.2.2-10 Curriculum (based on the classic system for craftsmen occupations or JMO model for related crafts according to which the respondents teach**



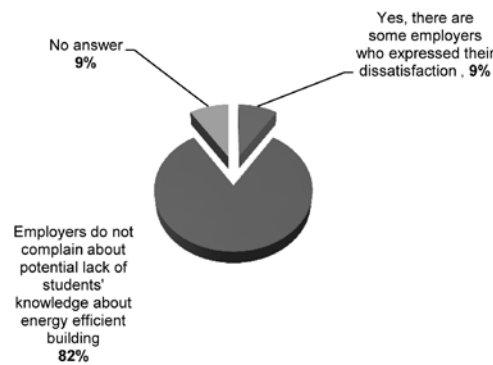
**Figure 8.2.2-11 Differences in the training of masons, carpenters and roofers according to the existing programmes of the classic model and JMO programme according to the opinion of the respondents**



**Figure 8.2.2-12 The possibility of obtaining adequate energy efficiency training in JMO model, with more intense and stronger theoretical classes, content-wise, consisting of one class, within the elective subject Building Technology according to the respondents**



**Figure 8.2.2-13 The adequacy of school workshops for conducting practical work with the demonstration of new technologies according to the polled teachers**



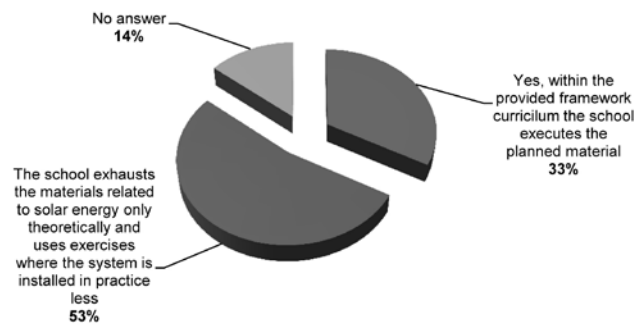
**Figure 8.2.2-14 Employers' satisfaction with the (lack of) knowledge about energy efficient construction according to the opinion of the respondents**

Regarding the classic and Integrated educational model (JMO) and programme differences in the curriculum, most of the schools already stated that it is possible to revise easier curricula in JMO programmes for masons, carpenters, roofers, in terms of reinforcing the content related to EE and RES via an elective subject in the form of one class in the 1st, 2nd and 3rd year of the technology used in the respective vocation. Also more time can be set apart in the practical part to exercise building skills in EE technology. However, with regard to the curricula of the classic educational model for the vocations tiler, floor layer, dry-liner and plasterer there is no room for such extension of the content related to energy efficiency construction but such content can be incorporated into practical classes.

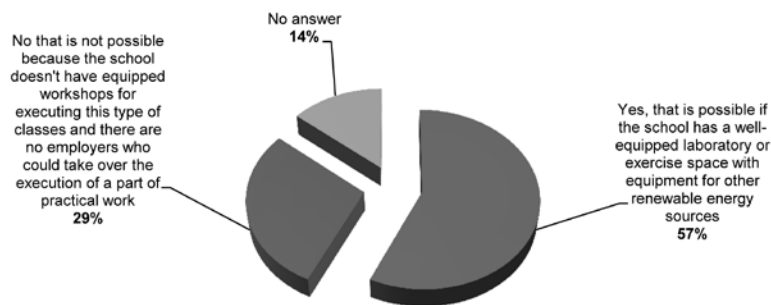
However, the main issue is the practical acquisition of skills in practical work, whether with employers at construction sites, to which they are bound by contracts, (it is even possible that the employer has no jobs based on the principles of RES and EE - small crafts with only a few employees, etc.), or in trade schools which have very limited spatial and material conditions for performing exercises in insulation or building envelopes in school workshops.

This leads to the conclusion that in order to acquire practical experience in technical and trade schools in the field of construction, technological centres need to be organized in available workshops of particular schools according to regions, with trainings for building technologies execution based on EE principles. According to the experience of trade schools, there are no objections by the employers regarding the fact that students are not acquiring the knowledge and skills in new EE construction technologies in theoretical and/or practical part (Figure 8.2.2-14)

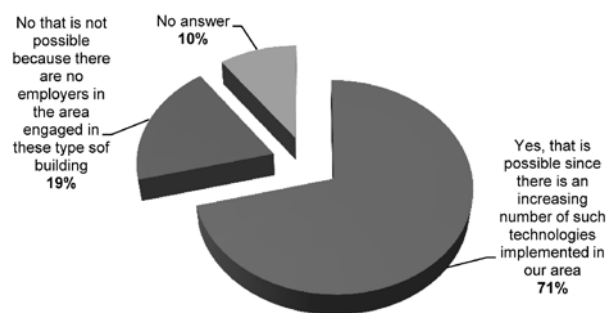
The third questionnaire was made for schools offering three-year courses for occupations in the field of mechanical engineering (installers), in the field of services (painters) and in the field of woodworking (carpenter). The poll included 21 schools.



**Figure 8.2.2-15 School’s dedication to conducting the elective subject Technology of Solar Photovoltaic Systems for the occupations of heating system installer and air-conditioning installer according to the respondents’ opinion**



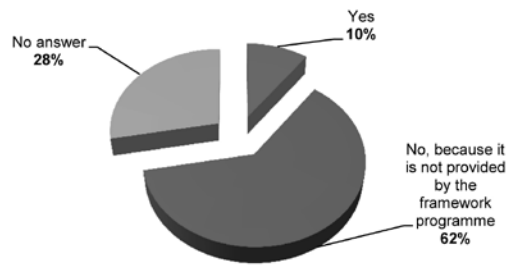
**Figure 8.2.2-16 The potential for widening knowledge and skills in RES in the number of classes (1+2) according to the respondents’ opinion**



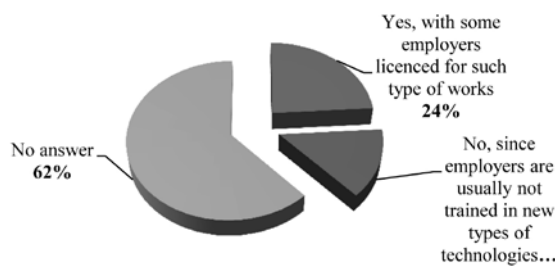
**Figure 8.2.2-17 School practice related to visits and demonstrations of other types of RES systems held for students through construction site visits during installation and visits to plants according to the respondents’ opinion**

In the field of mechanical engineering, within the framework of the three-year course for heating and air-conditioning system installers, an elective programme Technology of Solar Collectors was offered two years ago with 1 class in the second and 2 classes in the third grade, which can, thanks to its nature, approach both the theoretical and practical part of the curriculum in order for the students to acquire knowledge and skills for the construction of solar collectors for the accumulation of thermal energy from solar energy. However, the content which would, in practical and theoretical terms, offer students the knowledge and skills for the execution of other renewable energy sources is missing. The teachers covering these subjects believe that the content from other RES technologies could be incorporated as well, within the framework of the existing number of classes, but only with a well-equipped laboratory for demonstration.

In the field of RES, the only attempt to bring closer at least a part of the content through both theoretical and practical classes is from the field of heating and air-conditioning installation.

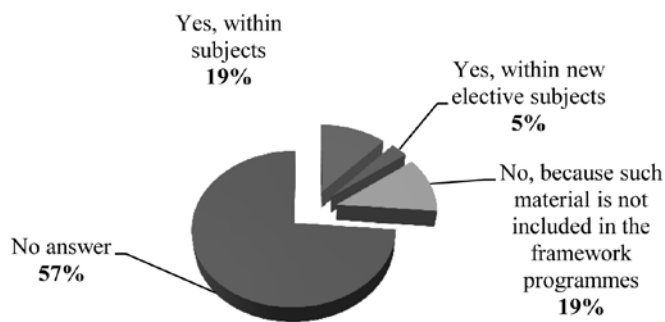


**Figure 8.2.2-18 Implementation of content dealing with new technologies of execution of building envelope insulation in painter classes according to the respondents' opinion**



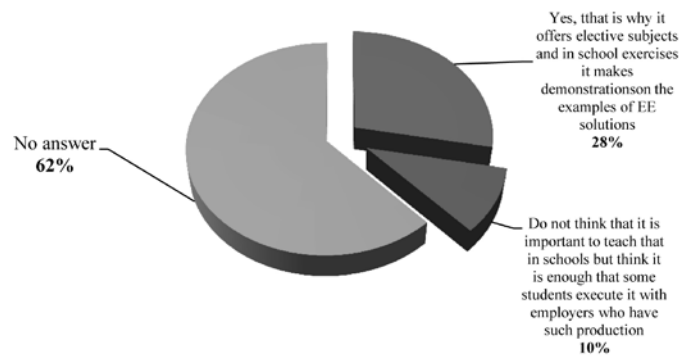
**Figure 8.2.2-19 Vocational training of students in the practical part of apprenticeship with employers engaged in façade work which provides thermal insulation to buildings according to the respondents' opinion**

Figure 8.2.2-18 shows how the majority of schools do not teach content, neither in theoretical nor practical terms, that would provide students with the knowledge and skills for the execution of insulation envelopes around buildings, while Figure 8.2.2-19 shows that most schools stated that students are not trained by employers to carry out energy efficient building technologies since most of the employers are not engaged in such work nor know these new technologies. The conclusion is that due to the character of finishing works and the newly designed solutions, companies specialized in painting and façades will need to implement new technologies for building envelopes. Accordingly, the training of painters within the theoretical curriculum is necessary via offering one elective subject and in the practical classes or technological exercises, content through which they will acquire knowledge and skills in terms of requirements of the new building technologies to be introduced.



**Figure 8.2.2-20 Implementation of teaching material into schools, related to new technologies in making energy efficient openings, for carpenters, according to the respondents' opinion**

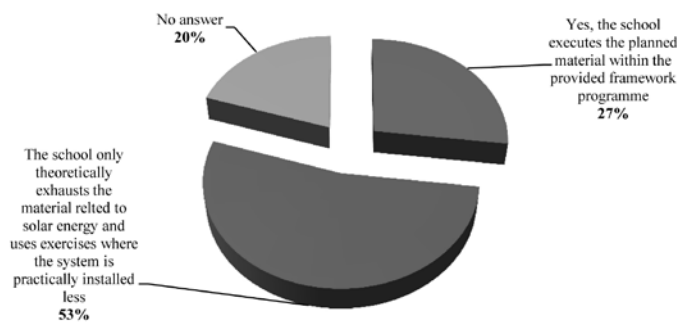




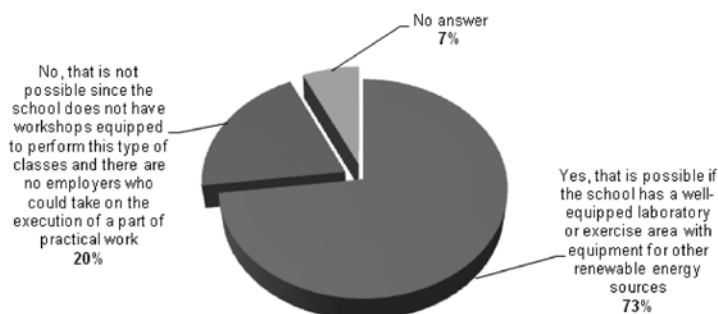
**Figure 8.2.2-21 The importance of school in training students to make and install openings for a whole energy efficient building according to the respondents' opinion**

Most schools that offer training for carpenters stated that they do not teach any material, not even in the elective part of the programme, nor in the practical work, in the field of energy efficient execution of openings since such subjects don't exist in the curriculum and whether this should be done. *Although there is a possibility of offering, through a revision of curricula, a new subject and material, at least in extra technology, which would train students to execute energy efficient structures, schools do not show any initiative to do so and to change the existing curriculum although it is easily achievable.*

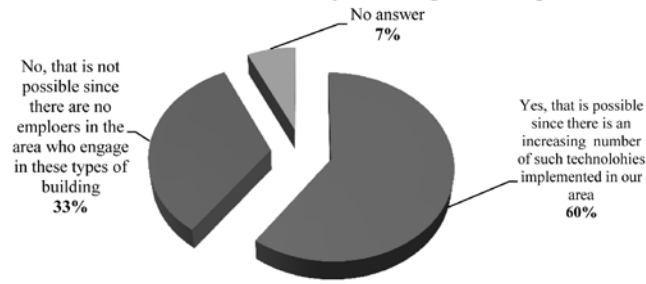
The last questionnaire was made for technical schools in the field of mechanical engineering and electrical engineering and it included 14 schools



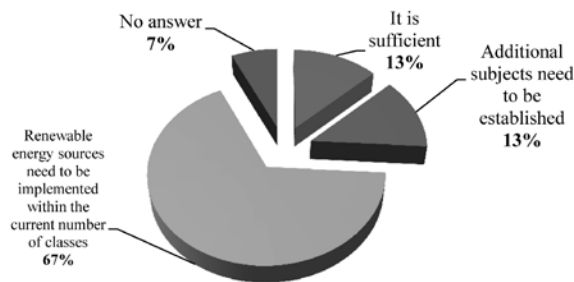
**Figure 8.2.2-22 Importance of conducting the elective subject, Technology of Solar PV Systems, for the occupation of heating system and air-conditioning installer according to the respondents' opinion**



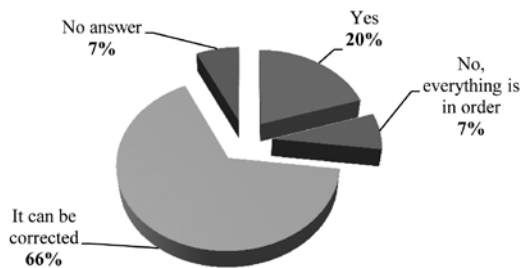
**Figure 8.2.2-23 The potential for widening the knowledge and skills in RES in the number of classes (1+2) according to the respondents' opinion**



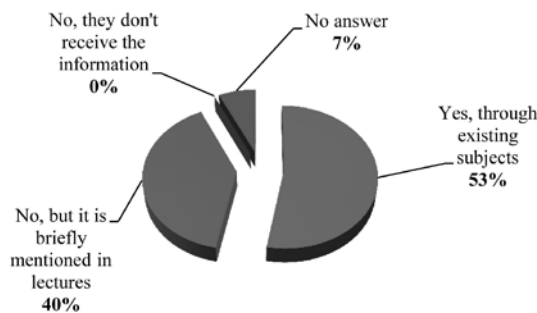
**Figure 8.2.2-24 School practice of visits and demonstrations of other types of RES systems organized for students via visits to construction sites during installation and visits to plant-according to the respondents' opinion**



**Figure 8.2.2-25 The number of classes for subjects related to renewable energy sources is sufficient or insufficient according to the respondents' opinion**



**Figure 8.2.2-26 Lecturing about things that are outdated and not used under the existing programme according to the respondents' opinion**



**Figure 8.2.2-27 Implementation of teaching material related to modern management and regulation systems into curricula according to the respondents' opinion**

As regards the programmes for mechanical and electrical engineers, only within the programme for Electrical Engineer in energetics there is an elective programme on renewable energy sources offered but it has not incited great interest among students. Teachers believe that curricula can be changed and enriched content-wise with new technologies of RES use and new measurement and regulation methods and the methods from other related disciplines (sensory evaluation, integrated micro climate and lighting regulation in buildings, etc.) can be fitted in and refresh the existing fund of subjects. In some schools this novelty in the execution of updated material is already present to a great extent and in some it is in the phase of initial projection of a future school.

Based on the response - primarily of vocational subject teachers and headmasters of vocational schools - we consider the state of education concerning the knowledge and skills in the field of energy efficiency to be in its initial stages. There are individual, very ambitious attempts by some schools, only 7-8 of them, to bring closer to students the information on renewable energy sources in both practical and theoretical terms but this is all done through certain projects for equipment acquisition, which demonstrate particular technologies of renewable sources use, and this is within the scope of implementation of pre-accession funds projects or in the form of occasional excursions and tours of particular manufacturers or dealers of such technologies. Officially prescribed standard subjects which would adequately offer information about this topic are still missing and not to even mention teaching the skills of executing parts or units of certain technological systems. Two elective subjects are an exception, one in the three-year course for heating and air-conditioning installation and the other one as the elective subject for electrical engineers in energetics, in the 4th grade, as an overview of all types of technologies of renewable energy sources. Besides that, in the construction branch, within the subject Architectural Structures, civil engineering physics material is taught, as well as structural assemblies required in absorbing solutions for passive architecture, etc. However, this is still not enough, so this year there was a proposal by the School for Design, Graphics and Sustainable Building from Split and Civil Engineering School Čakovec, for a new curriculum for the Technician for Sustainable Energy Building course, so this will, partially and if adopted, offer small satisfaction that something is happening in the development of vocational education at high school level in the field of energy efficiency training implementation. Only several schools have exercise areas with didactic equipment for the demonstration of new heating and air-conditioning technologies and construction of passive architecture. Within the subject Residential Public Buildings, architectural technicians learn and design in the spirit of such tasks given in the 3rd and 4th grade.

For now it is difficult to expect quick changes from the aspect of the Ministry of Science, Education and Sports to ensure a sufficient number of officials of expert civil engineering profiles. After the meeting in Skopje, it is evident that a series of training mechanisms will need to be launched for employed builders and new-coming high school students within civil engineering schools especially chosen for this purpose and with the option of acquiring practical skills in workshops with sufficient capacity to also hold workers who are retraining for work in building energy efficient structures.

*In addition, vocational teachers also need to be trained, not only those teaching specific subjects that could effectively update new EE building technologies, but all vocational teachers, so they could participate in training the existing construction workers, and according to some estimates this is 150 civil and mechanical engineering teachers. The total surface area of buildings that should be executed by 2020 would require the professional training of at least 250 trainers and educators. These teachers in technical and trade schools would probably need to be joined by trainers and educators from manufacturing and contractor companies that equip buildings with new technologies.*

### **8.2.3. Assessment of the required number of workers**

Through the conducted analyses on green jobs in Croatia [15], we tried to obtain the number of workers required in the residential sector, in three areas: in building renovation (energy efficiency measures), for installation of biomass systems and solar thermal systems and systems using wind energy. The total number of workers on direct green jobs amounts to more than 14 000 (Table 8.2.31). With the application of energy efficiency measures in 20% of the total number of residential units in Croatia (280 thousand) during the next 10 years, and with the investment of USD 10,000 in the existing houses and flats, the total investment would amount to USD 2,8 billion (280 million a year). The experiences from the existing UNDP project point to 3 man-months for a single residential unit, which in total means creating 7,000 direct green jobs a year and at least as much indirectly generated jobs. However, it needs to be mentioned that a part of these jobs would be generated regardless of the investments related to energy efficiency. Said analysis did not include an assessment of the distribution of workers to unqualified or poorly qualified workers.

**Table 8.2.31 The potential for generating green jobs [15]**

Sector	Objectives by 2020	Direct green jobs	Indirect and induced green jobs	Total investment (EUR)
Energy efficiency in building construction	Implementation of energy efficiency measures in 20 % of the existing residential units	7,000	7,000	2.15 billion
Biomass use	Current objectives from Energy Strategy for 2030	5,000	55,000	3.5 billion
Solar thermal systems	To achieve current objectives from Energy Strategy for 2030	1,300	2,000	1.4 billion
Wind energy	Generation of 1200 MW by wind farms	1,200	1,000	1.7 billion

An analysis of the required number of workers for the realisation of 20-20-20 goals was made for workers specialized in building zero-energy buildings but also the renovation of the existing ones (their number will be dealt with in more detailed in Table 8.2.3-2). The assessment is based on the data of the Croatian Bureau of Statistics. The required number of workers in the field of renewable energy sources is given in Table 8.2.3-7 (biomass use, solar systems, and wind energy).

For some data which is required there is no official data so estimates are given.

**Table 8.2.3-2 The estimated number of workers required for training in order to achieve national energy efficiency objectives (according to the data of the Croatian Bureau of Statistics)**

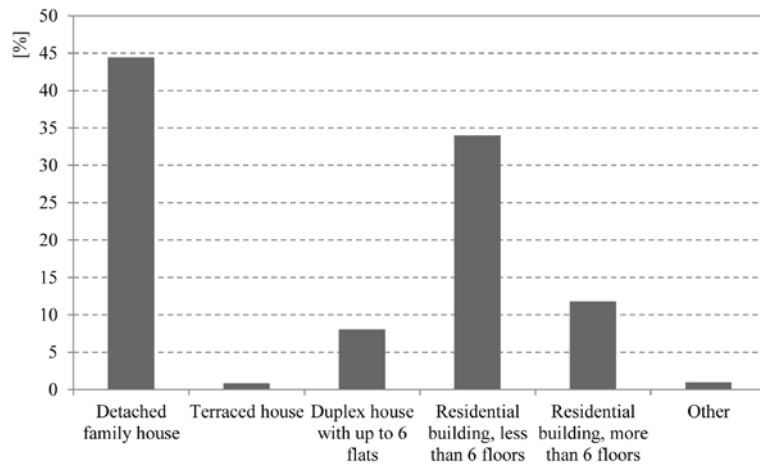
Type of work	Type of building	Total layout surface area	Envelope surface area	Opening surface area (window and doors)	Envelope surface area without openings	Roof surface area for a 30° slope	Planned annual building reconstruction -3% renovation according to EED	No of workers per 1000 m2	Reconstruction duration per unit (of wall, system of 1000 m2)	Total No of workers required for annual building reconstruction	Effective days per year	Average No of renovated units yearly per team	No of workers require for reconstruction/renovation	Total number of workers needed to achieve 20-20-20
		m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup> /god.	-	days	-	days	-	-	
Wall insulation	Residential buildings	149380000	198675400	44814000	153861400		4615842	8	5	36927	220	5	7385	~9400
	Nonresidential buildings	43380000	56394000	13014000	43380000		1301400	8	5	10411	220	5	2082	
Insulation / replacement of roof	Family houses	97097000				111855744	3355672	30	35	100670	220	31	3203	~5700
	Dwellings	1897875				2186352	65591	30	35	1968	220	31	63	
	Public houses	43380000				49973760	1499213	25	25	37480	220	15	2499	
Replacement of doors and windows	Family houses			29129100			873873	42	1	3310	220		3310	~6500
	Dwellings			15684900			470547	42	1	1782	220		1782	
	Public houses			13014000			390420	42	1	1479	220		1479	

Under Energy Efficiency Directive 2012/27/EU (EED) [21], Croatia must renovate 3% of buildings in the public sector a year. It is assumed that buildings owned by the private sector shall be renovated in the same percentage (family houses, flats).

Based on the practical experience, total replacement of external thermal insulation for an envelope surface of 1000 m2 requires 8 trained workers and 5 workdays. In order to obtain the surface area of envelopes the layout surface area was increased by 33%. The assumed surface area of openings is 30 %.

For the repair of roofs on residential buildings, it is assumed that the average surface area of a roof of 200 m2 requires 6 workers and 8 workdays, while the repair of non-residential buildings and the assumed average roof surface area of 400 m2 requires 10 workers and 10 workdays. Since there is no data on the average number of floors in buildings, the results of CENEP [22] poll were taken, which was based

on 1815 respondents and the question of the type of building in which they live was asked and 33,97% specified a residential building with up to 6 floors (Figure 8.2.31). For the assessment of the number of floors, an average of 6 floors was taken for a residential building with two residential units per floor.



**Figure 8.2.3-3 The type of building where respondents live according to the CENEP poll**

For the replacement of carpentry it is assumed that 1 worker can replace 275 windows of the average surface area of 0.8x1.2 m a year which is 264 m<sup>2</sup>/year. According to the Croatian Bureau of Statistics, out of the total residential fund, family houses account for 65%, and residential buildings account for 35% which amounted to the total layout surface area of particular facilities.

For the insulation of external façade on residential spaces (which includes residential buildings and family houses both) it was concluded that 7385 workers were required, which is in line with UNDP estimates on Green Jobs in Croatia [15].

## SOLAR ENERGY

According to the Green Paper of Update/Upgrade of the Energy Strategy of the Republic of Croatia [39] regarding the use of solar energy, the Strategy sets the following two goals:

- The situation with regard to solar heating systems in Croatia by 2020 must be equal to the level in Germany and Greece en par to the population ratio today (objective of 0.225 m<sup>2</sup> per head);
- The situation in Croatia with regard to the state of photovoltaic systems by 2020 must be equal to the situation in Spain today (11.71 W per head), and Germany by 2030 (over 45 W per head).

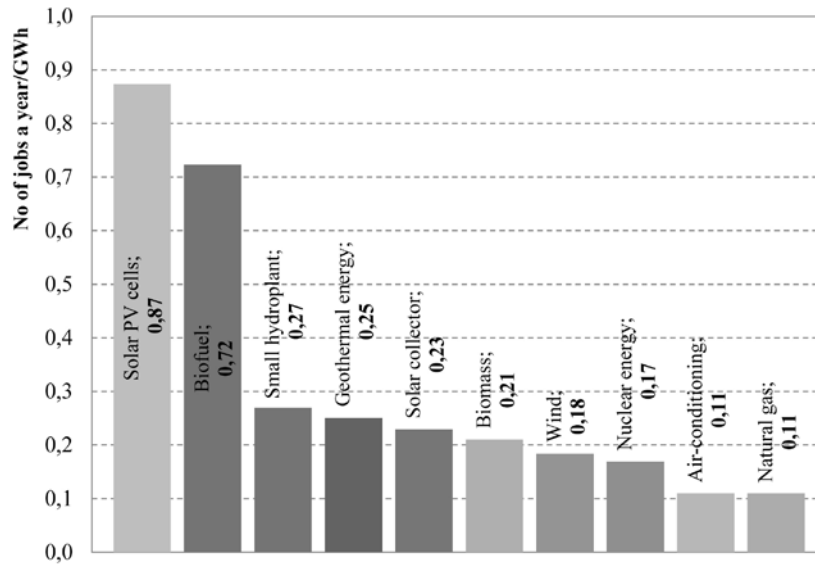
It is presumed that the growth rate in exploiting solar heating collectors will be 47% per annum to 2010 and after 2020, it is expected that this growth rate will slow down to around 10% per annum. It is presumed that the growth rate in exploiting photovoltaic systems will be 68% per annum to 2020 and by 2030 this rate should be around 20% per annum. The total figures in the monitored years are presented in Table 8.2.3-3. Estimates accounted for the average insolation in Croatia equal to 1.37 MWh/m<sup>2</sup>/annum. It is estimated that solar PTV is 1.5 m<sup>2</sup> of solar collectors per head who use these systems and 1,825 hours of peak power in photovoltaic systems per annum (maximum radiation at an average of 5 hours per day all year round) [39].

**Table 8.2.33 Growth in exploitation of solar energy in Croatia to 2030 [39]**

	2010	2020	2030
Solar energy – hot water preparation [PJ]	0.50	4.96	12.21
Inhabitants using solar hot water (1,5 m <sup>2</sup> collector / inhabitant)	67,691	660,000	1,653,017
Average m <sup>2</sup> per 1000 inhabitants	23.80	225.00	563.53
<b>Solar Energy – PV [PJ]</b>	<b>0.01</b>	<b>0.30</b>	<b>1.66</b>
Installed capacity [MWp]	1.52	45.66	252.66

Average W per inhabitant	0.34	10.38	57.42
<b>Solar Energy – total [PJ]</b>	<b>0.51</b>	<b>5.27</b>	<b>13.87</b>

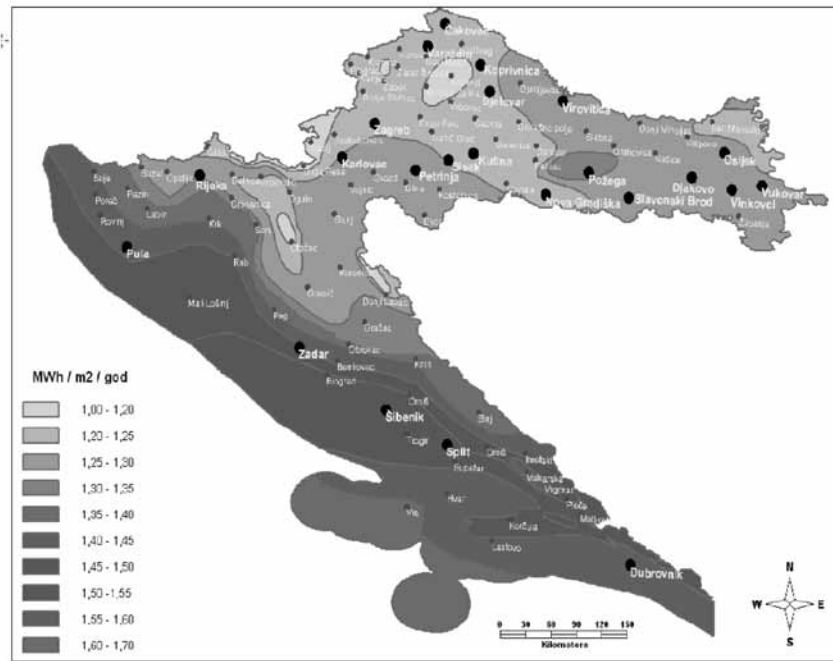
Two scenarios were considered in calculating the required number of workers for solar PV cells. The first scenario adopted from the Green Paper [39] sets the goal for installed power of 45.66 MW by 2020. If we consider that a single installed solar unit generates the average of 1250 MWh a year, the average useful life of equipment is 25 years and that according to Figure 8.2.3-2 average annual employability is 0.87 per GWh for solar PV cells, it follows that 1100 new workers need to be employed for solar PV cells.



**Figure 8.2.3-2 Average annual employment per GWh for different renewable energy sources [41]**

Within the framework for achieving goals for photovoltaic systems of 45,66 MW, on 31 May 2012, Croatia issued a secondary act titled Tariff system for electricity generation from renewable energy sources and cogeneration (Official Gazette 063/2012) according to which the market operator concludes contracts on buying electricity before 31 December 2012 with the project exponent from solar power plant group (solar power plants with installed power of 10 kW, solar power plants with installed power higher than 10 kW to, inclusive, 30 kW and solar power plants exceeding 30 kW) until the total power of such plants subject to the contract on buying electricity pursuant to [40] reaches the value of 10 MW for integrated solar power plants and 5 MW for non-integrated solar power plants. Since said quota was filled up quickly, on 31 October 2012, Amendments to the Tariff system for electricity generation from renewable energy sources and cogeneration (Official Gazette 121/2012) were adopted, which increased the total quota for integrated solar power plants to 15 MW. Said quota of 15 MW was filled out right at the beginning of 2013, i.e. HROTE announced issuing 15 MW value of contracts for integrated photovoltaic power plants. There is great interest on the market, among citizens, regarding the installation of photovoltaic cells. Ministry of Economy, Labour and Entrepreneurship, Department for Renewable Sources and Energy Efficiency keeps a Register of projects and plants for the consumption of renewable energy sources and cogeneration and eligible producers (Registar OIEKPP) which are included in the incentive system, i.e. in the process of acquiring the status of eligible producers, that has power plants or cells with the total power of 88.31 MW have been scheduled or under construction in the last two years. To be on the safe side and it is to be expected that the growth of solar energy consumption will rise, the second scenario will be considered as the relevant one.

In the second scenario for photovoltaic systems a bottom limit is set to 336 MW by 2020 [42]. Said value of installed power from photovoltaic cells was taken over from neighbouring Slovenia as it is situated in a geographical location with similar amount of insolation as the continental part of Croatia (note that the southern part of Croatia has even greater insolation than continental Croatia - Figure 8.2.3-3, and the potential is even greater).



**Figure 8.2.3-3 Solar radiation on the territory of the Republic of Croatia [43]**

Under equal conditions (one installed solar unit generates 1250 MW/h a year, the useful life of equipment of 25 years and annual employment of 0,87 per GWh for solar PV cells), to reach the goal of 336 MW by 2020, 9000 new workers need to be employed for solar PV cells.

In order to achieve the goal set under [39] of installing 990 000 m<sup>2</sup> of collectors by 2020, 3,700 new jobs need to be created (according to Figure 8.2.3-2 annual employment for solar collectors is 0.23 per GWh, average equipment life is 25 years and solar usability in Croatia is 650 kW/h per m<sup>2</sup>).

### BIOMASS ENERGY

The evaluation of biomass potential refers to the use of wood and agricultural waste biomass and the possibility of cultivating wood biomass and it is based on the data of Hrvatske šume (Croatian Forests) with the rest of the wood and timber industry calculated in. Wood biomass obtained from clipping wood in the process of maintenance of water and electric power industry’s facilities (streams, protected corridors for transmission and distribution of electricity) and the protected road corridors and potential agricultural waste are added to it. Agricultural waste can be used only partially (not more than 30%), since the rest needs to be returned to agricultural surfaces for mineral balance. Agricultural waste is complex and it includes the remains left over from clipping orchards, vineyards, olive trees, sunflower husks, hay, etc. Table 8.2.3-4 shows the total estimated potential of wood and agricultural biomass [39].

Table 8.2.3-4 Total estimated potential of wood biomass from forestry, industry and agriculture

No	Type of biomass	Volume m <sup>3</sup> /y	Density kg/m <sup>3</sup>	Mass t/y	Heating value kWh/kg	Energy PJ
1	Cord wood	1 889 551	730	1 379 372	4.90	24.33
2	Wood residue	700 928	700	490 650	4.90	8.65
3	Bark	207 306	550	114 018	4.90	2.01
4	Wood industry waste	138 900	730	1 013 970	4.90	17.89
5	Wate management, Roads and HEP	400 000	680	272,000	4.90	4.80
6	Agricultural waste	2 888 000	450	1 299 600	4.90	22.93

	<b>Total</b>	<b>7 474 785</b>	<b>-</b>	<b>4 569 610</b>	<b>-</b>	<b>80.62</b>
7	Energy forests	1 000 000	730	730,000	4.90	12.88
	<b>TOTAL</b>	<b>8 474 785</b>	<b>-</b>	<b>5 299 610</b>	<b>-</b>	<b>93.49</b>

Currently, there is 6,69 MW of installed power in Croatia and this Strategy sets the objective that by 2030, of the total available biomass potential described above in Croatia, 72% will be exploited for energy purposes and that the use of biomass will as of today, continue to grow. As the application of any new technology requires a period of "a running start", before any major thrust is made on the market it is assumed that by 2010, 22% of potential biomass will be exploited and 32% in 2015 and up to 40% of total potential by 2020 (without accounting for energy forests), which amounts to 32.24 PJ of energy (1,02 GW). It is expected that with the existing incentives and elimination of the existing institutional obstacles the total power of 135 MW will be realized in numerous biomass power plants by 2020.

If according to table 8.2.3-5 total energy generated from biomass is 8200 MW/h a year, annual employment is 0,21 per GWh for biomass (Figure 8.2.3-2), and equipment life is 40 years, it can be deduced that in order to achieve the objectives set for 2020, 9000 new workers need to be employed.

**Table 8.2.3-5 Structure of applying biomass according to the technology use in primary conversion [43]**

No.	Technologies for usage/biomass transformation	Input		Output		Electricity GWh	Power MW	Heat PJ
		Mass	Energy	Mass	Energy			
		t/year	PJ	t/year	PJ			
<b>2010.</b>								
1	Pellets production	41 126	0,73	38 248	0,69	0,00	0,0	0,00
2	Briquettes production	10 282	0,18	9 562	0,17	0,00	0,0	0,00
3	Firewood	616 056	10,87	603 735	10,65	0,00	0,0	0,00
4	Charcoal production (non-energy feedstock)	102 816	1,81	31 873	-	0,00	0,0	0,00
5	Pellets production + cogeneration (heat and electricity)	77 600	1,37	60 528	1,09	11,18	2,2	0,00
6	Industrial cogeneration (heat and electricity)	0	0,00	0	0,00	0,00	0,0	0,00
7	Cogeneration in public heating plants	0	0,00	0	0,00	0,00	0,0	0,00
8	Bio THP	0	0,00	0	0,00	0,00	0,0	0,00
9	Heat production in industrial heating plants	180 281	3,18	0	0,00	0,00	0,0	2,62
10	<b>Total</b>	<b>1 028 162</b>	<b>18,14</b>	<b>743 946</b>	<b>12,6</b>	<b>11,18</b>	<b>2,2</b>	<b>2,62</b>
<b>2020.</b>								
11	Pellets production	274 194	4,84	255 000	4,59	0,00	0,0	0,00
12	Briquettes production	63 351	1,12	58 917	1,06	0,00	0,0	0,00
13	Firewood	260 884	4,6	255 667	3,50	0,00	0,0	0,00
14	Charcoal production (non-energy feedstock)	205 632	3,63	63 746	-	0,00	0,0	0,00
15	Pellets production + cogeneration (heat and electricity)	274 217	4,84	213 889	3,85	39,51	7,9	0,00
16	Industrial cogeneration (heat and electricity)	205 632	3,63	0	0,00	134,67	26,9	2,45
17	Cogeneration in public heating plants	246 759	4,35	0	0,00	289,06	55,6	1,85
18	Bio THP	205 632	3,63	0	0,00	256,94	48,9	0,00
19	Heat production in industrial heating plants	320 023	5,65	0	0,00	0,00	0,0	4,66
20	<b>Total</b>	<b>2 056 325</b>	<b>36,27</b>	<b>847 218</b>	<b>13</b>	<b>720,17</b>	<b>139,4</b>	<b>8,96</b>
<b>2030</b>								
21	Pellets production	362 485	6,39	337 111	6,07	0,00	0,0	0,00
22	Briquettes production	130 292	2,30	121 172	2,18	0,00	0,0	0,00
23	Firewood	148 302	2,62	65 971	1,40	0,00	0,0	0,00
24	Charcoal production (non-energy feedstock)	381 193	6,72	118 170	-	0,00	0,0	0,00
25	Pellets production + cogeneration (heat and electricity)	381 193	8,20	297 330	5,35	61,02	11,1	0,00
26	Industrial cogeneration (heat and electricity)	457 431	8,07	0	0,00	299,57	54,5	5,46
27	Cogeneration in public heating plants	571 789	10,09	0	0,00	669,80	115,5	4,29
28	Bio THP	1 143 578	20,17	0	0,00	1.428,92	238,2	0,00
29	Heat production in industrial heating plants	235 665	4,16	0	0,00	0,00	0,0	3,43
30	<b>Total</b>	<b>3 811 927</b>	<b>68,72</b>	<b>939 754</b>	<b>15</b>	<b>2459,31</b>	<b>419,2</b>	<b>13,18</b>



## WIND POWER

There is 141.25 MW wind farm power installed in the Republic of Croatia at this time. By 2020 Croatia should, with estimated 1,200 MW of installed electricity-generating capacity per installed electricity-generating capacity in wind parks for each 1,000 population head achieve Spain's current level of (348 kW/1000 per population head).

**Table 8.2.3-6 Growth dynamics of installed capacities to produce electricity in wind parks to 2020 (with a view to 2030) [39]**

	2010	2020	2030
Installed power [MWp]	129	1200	2000
Electricity production [TWh]	0.28	2.64	4.4
Electricity production [PJ]	1.02	9.5	15.84

As already presented [15], assessment performed by UNDP Croatia showed that installing 1200 MW in wind energy would contribute in creation of 2200 green jobs.

**Table 8.2.3-7 The estimated number of workers required for training in order to achieve national energy efficiency objectives in renewable energy sources**

RES	Installed power by 2013	Installed power by 2020	Average electricity production	Average useful life of equipment	Average annual employment [42]	Required No of RES workers
	[MW]	[MW]	[MWh]	year	Number of jobs/ GWh	-
PV cells	3.82	45.66	1250	25	0.87	1100
Biomass	6.69	135	8200	40	0.21	9000
Wind farms	141.25	1200	1752	25	0.18	2200
Solar collectors [per m2]	101536	990000	1.39	25	0.23	3700

**Table 8.2.3-8 Estimated number of workers required**

Type of works	Estimated number of workers required to achieve 20 - 20 - 20 objectives
Wall insulation	9400
Roof insulation/ replacement	5700
Carpentry replacement	6500
Biomass use	9000
Solar energy	4800
Wind energy	2200
<b>TOTAL:</b>	<b>37600</b>

Table 8.2.38 shows the total number of workers that need to be trained in the field of energy efficiency and renewable energy sources.

A preliminary estimate of the number of trainers and worker qualifications will be given in the Roadmap.

### 8.3. Qualifications required to achieve EU 2020

At this point a programme for sustainable building technician, prepared by the School for Design, Graphics and Sustainable Building from Split and Civil Engineering School Čakovec needs to be urgently authorized for school students due to a lull in revising and approving of the curricula in the Ministry of Science, Education and Sports. This needs to be done for several reasons:

1. there is a need for professionals of the widest range for future interventions on the existing structures and new buildings since energy consumption from classic sources needs to be significantly reduced and its generation from renewable sources increased as soon as possible.
2. because of the accession to the EU, where we must strive to catch up with other members in training for efficient building, among other things, which will not be possible if training programmes are not revised and this four-year course introduced.
3. The programme is well-balanced both in the general part and vocational part, so it will enable many high school students further quality education in mechanical engineering, electrical engineering, civil engineering and architectural faculties.
4. If students are allowed to enrol as soon as next year, based on a timely decision on verification, then the programme will affirm itself as a quality one and incite even more interest for this important vocation and future development as soon as the next year.

Within the scope of three-year courses, immediate revision of the vocational part of the curriculum needs to be addressed with regard to all building vocations, mechanical engineering installers, painters and carpenters. If this proves impracticable for this school year, then these interventions in programmes need to be made for the enrolment in the next school year. The consortium should start an initiative in the Ministry of Science, Education and Sports to adopt the revision of curricula for all crucial vocations related to this project as soon as possible, still in the PILAR I stage, and special emphasis should be put on urgent adoption of the curriculum for sustainable energy building technician.

In three-year JMO educational programmes for occupations mason, carpenter and roofer, within the vocational part of the curriculum, there is, besides Building Structures in the 1st and 2nd grade, which should be enriched with material related to energy efficiency of buildings, another technology class where the material teaching new technologies used to achieve building energy efficiency can be revised. This class relates to the first, the second and the third year of training, so to evenly distribute the matter regarding this topic, the 1st year could comprise the general issues of building organization and consumption of energy generated from fossil fuels, up to the method of storing generated energy; the 2nd grade would deal with details by which building insulation envelope achieves its airtightness and on the 3rd year (where this subject is intended to include the matter of remedial work and repairs on the existing buildings) there is room for the material concerned with the characteristics of already existing buildings in terms of energy efficiency. Occupations such as floor layer, dry-liner and especially plasterer are in the classic educational model and don't have that third elective subject, so within the 2 theoretical classes in Occupational Technology, radical changes need to be made content-wise, including the field of energy efficiency.

In mechanical engineering for installer occupations and especially for the heating and air-conditioning installer occupation, Solar Collector Technology appears as an elective subject in the 2nd grade with one class and with two classes in the third grade. However, this content is not enough for a whole range of works on RES implementation and students don't get to know them even informatively, this especially goes for heat pumps, wind energy, biomass energy, but this content is closely oriented only on the generation of electricity via photovoltaic panels. However, even with the current number of classes and potential increase by 1 class in the 2nd and 3rd grade, students could also be directed to other aspects of the consumption of energy from renewable sources. The programme for the occupation of carpenter in the field of woodworking and painter has a potential for revision in the vocational part of its programme, within the elective part of the vocational content, i.e. to for increasing the number of classes related to energy efficiency content. The greatest issue by far is the organization of content and material in terms of exercise and acquisition of skills in the execution of insulation envelope or installation of energy efficient carpentry or metalwork, and while in schools with space for conducting exercises, training teams from various companies engaged in energy efficiency or material production can be engaged, a far greater issue is encountered with the students attending practical work with outside employers, which, first of all, don't have to include the material and equipment for energy efficiency implementation in their production programme and who don't have employees nor use modern building technologies. This type of student population will prob-

ably also require - in certain didactic blocks of 10-15 days - practice and execution of envelopes, i.e. installation of different components in the form of courses held by various trainers who can carry it out in their technological centres or in school workshops. In terms of adult training, as it has already been stated, training and skill learning will be necessary and this can only be arranged through courses and trainers in the field of energy efficiency, with exercise sessions performed on site, construction site or technological centres of large material producing companies or in the workshops of related schools oriented on educating these professionals.

Once more we must stress a certain defensive attitude towards the introduction of this very needed occupational training content, so the very top of the educational pyramid will need to be contacted, in agreement with Employers' Association, the Agency for Vocational Education and Training and Adult Education and the Ministry of Science, Education and Sports, also for the purpose of approving urgent revisions of occupational content by Sectoral Councils, which have been pushed aside in the last year for various reasons, intentional or unintentional, and they represent one of the five instruments for the adoption of the Croatian Qualifications Framework.

Although there is market demand, currently there are no certified installers of renewable energy sources. Ordinance on Renewable Energy Sources Installer Certification is in the making and it should be completed before 1 July 2013 and by then, jobs related to renewable energy sources will be performed by electricians (for photovoltaic, which requires an authorized project engineer certificate) and heating and air-conditioning installers.

## TEACHER TRAINING

VET agency has been organizing professional meetings on the subject of energy efficiency and RES, within the scope of professional training for civil engineering teachers since 2008 and the programmes of professional conferences organized by different vocational associations (Croatian Chamber of Architects, Croatian Association of Civil Engineers and Technicians, etc.) are intended for teachers. However, there are no educational programmes for educators in extra-institutional training of the existing construction workers regarding the issues of energy efficiency and RES and they will be assessed in the Guidelines.

## 8.4. MONITORING NEEDS

Based on the analysis so far, there is no systematic monitoring of labour market demands for workforce and skills, which are required for the construction of zero-energy and passive houses in the Republic of Croatia. There are only individual projects and documents, which saw the importance of adapting the educational system to labour market needs on all levels. Apart from that, there are no potential systems for early detection of risks of inadequate or insufficient skills in the field of interest of CroSkills Build up Skills project. IPA project "Sectoral Profile for Construction and Geodesy" [2], provided an analysis within the construction sector, which helps in the preparation of sectoral strategies and assists in identifying the gap between labour supply and demand. An analysis was made only for some occupations within the construction sector but it did not include the analysis of knowledge and skills relevant in achieving national energy efficiency guidelines. Moreover, despite the establishment of the Agency for Vocational Education and Training and Adult Education and above-mentioned institutions that should deal with said issues, no important progress was made in this field.

The project determined that most attention to skills required for installing energy efficient technologies and follow-up over the implementation of these skills was paid by technology producers (e.g. Knauf Insulation, Wienenberger, Bosch Group, Wiessmann, Centrometal, and Vaillant). This points to the fact that monitoring exists in traces: only for the products and technologies represented by big companies or their dealers (company reputation, advertising).

It should be mentioned that there is no accurate yet relevant data on the number of workers and their qualifications operating on the black market from Croatia and neighbouring countries (Bosnia and Herzegovina, Montenegro, Macedonia, Serbia...), which constitutes one of the risks of unsuitable or inadequate skills required for the construction of zero-energy buildings and the renovation of the existing buildings.

Estimates regarding the monitoring of demand for certain skills and the difference between the demand for qualified workforce in the construction sector and the supply by the national vocational education system are based on the analysis of the existing strategic documents and plans.

So far, several projects financed by the European Union have been implemented (Croatian Employment Service, Agency for Vocational Education and Training and Adult Education) including the IPA Component IV – Human Resources Development: "Labour Market Research" [6]. The general goal of the project is to ensure continued upgrading of the vocational education and training system in the Republic of Croatia and better connection of the initial and additional vocational education with the labour market.

Apart from all of the above, there is currently a series of documents specifying the need for monitoring market demand development in the Republic of Croatia:

- Vocational Education Act (Official Gazette 30/09, 24/10), which states that occupational standards and vocational qualifications are regularly harmonized with the needs of the labour market, every 5 years as a rule. Occupational standards and vocational qualifications are issued by the Minister of Science, Education and Sports, based on the proposal of the Agency for Vocational Education and Training and Adult Education, with the previous approval of the relevant sectoral council. [8]
- Strategic Plan of the Ministry of Science, Education and Sports of the Republic of Croatia for 2013 – 2015 period where one of the objectives is to promote the attraction of vocational education and adult education. According to [9] one of the preconditions for promoting vocational education is introducing the final vocational examination and developing vocational curricula that are completely harmonized with labour market demands and which ensure future employment.
- Croatian Qualifications Framework (CQF) represents an important prerequisite for the organisation of lifelong learning, which is the backbone of the society of knowledge and social inclusion. It is based on Croatian educational tradition, it encompasses the current state and the needs for the development of economy, individuals and society as a whole. At the same time it adheres to the frame of reference of the European Qualifications framework (EQF), European guidelines and international regulations, which is a part of the foreign policy of the Republic of Croatia. CQF has a reforming role in the educational system, which also includes educational programmes based on the results of learning and harmonized with labour market needs [10].
- The Act on the Agency for Vocational Education and Training and Adult Education (Official Gazette 24/10) defining the Agency's activity, according to which, among other things, the Agency implements education and professional training of those employed in the vocational education and adult education system, performs analytical, developmental and research work for the activity of vocational education and adult education, prepares occupational standards drafts and gives professional opinion on the drafts made by other proposers, prepares drafts for vocational qualifications standards and gives its professional opinion on the drafts made by other proposers, prepares vocational curricula and gives its professional opinion on the drafts made by other proposers [11],
- Development Strategy of the Vocational Education System in the Republic Of Croatia 2008 – 2013 [12] which specifies that vocational education (including the construction sector) needs to ensure the acquisition of knowledge, skills and competences important for the labour market, as well as the possibilities for progress in further education, particularly in higher education.
- Education Sector Development Plan 2005 – 2010 [13] according to which development objectives of vocational education and training are changes to vocational training in order to make it less specialized and adaptable to the needs of students and the labour market and the adaptation of employment profiles and programs to fit the labour market, social and economic needs, modernizing the content and methods of vocational education and training, and providing opportunities to continue with education following vocational school.
- Strategic Development Framework for 2006 – 2013 [14] one of whose objectives is specified in the chapter "People and Knowledge" and that is to strengthen the active role that institutions of the labour market have in the process of balancing labour force supply and demand.

In the Republic of Croatia, there are also key institutions one of whose goals is continued monitoring of the sector and specific movements on the labour market, forecasts and their related skills and these are:

- Agency for Vocational Education and Training and Adult Education established by the Act on Agency for Vocational Education and Training and Adult Education (Official Gazette 24/10) [9]. The founder of the Agency is the Republic of Croatia and the rights and obligations of the founder are assumed by the ministry in charge of educational activities (the Ministry of Science, Education and Sports). One of the strategic goals of the Agency for Vocational Education and Training and Adult Education is to permanently harmonize education with labour market needs. Within the CARDS 2002 project "Vocational Education and Training: Modernisation and institution building", the Agency for Vocational Education and Training and Adult Education founded sectoral councils in 2006 with the intention of, permanently and competently, presenting to the Croatian educational system, in the name of the users of student knowledge, skills and competences, the current and future needs of the Croatian economy, higher education and the needs of all other components of the Croatian society. Sectoral councils are partner advisory and professional bodies expressing the needs of the labour market, higher education and all other components of the

Croatian society by defining required vocational qualifications, analysing the existing and required competences within the sector and sub-sectors, giving its opinion to the Agency regarding the required content of vocational qualifications, preparing content for parts of vocational qualification standards, promoting the sector and the possibilities for employment within the sector, issuing proposals for the network of curricula and vocational education institutions to the founders of vocational education institutions and defining profiles within a particular educational sector. There are 13 sectoral councils and one of them is Construction and Geodesy.

- Vocational Education Department of the Ministry of Science Education and Sports, which, among other things, monitors the situation in vocational education and participates in the preparation and adoption of development strategy for vocational education and participates in the preparation of methodology and criteria for planning the network of vocational high schools and programmes, striving also to ensure the acquisition of competences required by the labour market, modernization of educational offer and work methods and modernization of teacher education.
- Ministry of Economy, which has Croatian Chamber of Trades and Crafts under its jurisdiction. Croatian Chamber of Trades and Crafts proposes, amends the existing and prepares new education curricula (Integrated Education Model - JMO) for the implementation of educational models.

Having in mind all of the above, the monitoring of skills required in vocational education and on the construction labour market needs to be centralized in a single institution (Agency for Vocational Education and Training and Adult Education), which would implement insufficient skills into education or warn about inadequate skills in the implementation of energy efficiency measures. In addition, the Agency for Vocational Education and Training and Adult Education must consider the opinions and proposals on insufficient or "risky" knowledge and skills by other institutions (Croatian Chamber of Trades and Crafts, Croatian Employment Service, the Ministry of Construction and Physical Planning) which are in close contact with the actual situation in the construction sector, which would contribute to achieving national energy efficiency objectives.

Ongoing harmonization of education and labour market needs means that vocational education has a key role in human resources development with the aim of achieving economic growth, employment and realization of social objectives. In order to achieve 20-20-20 objectives by 2020 in the building construction sector, it is necessary to continuously monitor the demands for qualified workforce and the required skills and occupations needed to implement the energy efficiency plan. Besides, systematic monitoring of potential systems for early risk detection resulting from inadequate or insufficient skills in relevant occupations within the building construction sector. As one of the important steps in maintaining the quality of professional qualifications is estimating the dynamics of demand for skills in construction sector and guiding, as well as effort made by educational institutions to produce the required workforce.

## 9. Barriers

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- Low level of knowledge about energy efficiency among workers

Besides the continuing crisis in construction, one of the greatest challenges that the construction sector is facing is that many workers don't have adequate (or any) training on how to build/renovate energy efficient buildings, neither the knowledge about particular aspects of construction/renovation (roofers) nor as a whole.

- Slow introduction of changes into the educational system (Ministry of Science, Education and Sports)

A potential obstacle is the slowness of introducing changes into the education system due to which required knowledge could not be implemented in the construction sector in time. If we add that the total energy consumption in building construction sector rose, in a single year, from 2009 to 2010, by 6 %, this takes us further away from the mandatory goal to reduce energy consumption by 20 % until 2020, under European directive 20-20-20, which can lead to direct monetary penalties.

- Lack of systematic approach in educational institutions' programmes

Subjects dealing with EE are either elective or not linked throughout the entire education, so we come to another key issue, and that is defining a curriculum for EE content in vocational schools, which would have to be harmonized with curricula in the sector, as well as the possibilities of the vocational education institution on the one hand and EE demands on the other hand.

- Financial instability of the market

As a consequence of the global financial crisis, the Croatian labour market lost around 30,000 workers in the construction sector and even construction companies are not in good standing since their investments into the construction sector have decreased considerably, so the companies are constantly in search of new jobs and cannot afford the time to provide additional training to workers, since they are the most indispensable on the construction site.

- Weak interest in EE training in small and medium-sized companies and crafts

Since there is no mandatory certification of workers or mandatory vocational training (and the possibility of scoring) and additional education does not bring competitive edge on the market, company and craft owners don't opt for training their workers, which then results in low interest for such training on the market.

Senior employer population (mostly traditional family crafts, generation gap) have more difficulty in keeping up with the rate of technological progress.

- Lack of statistical data on the current state and the needs of construction worker education
  - Grey economy - a great number of unregistered workers from Croatia and the neighbouring countries
  - The main contractor has neither insight nor control over the classifications of the employees of numerous subcontractors during the execution of construction works.
  - Certain construction professions trained in vocational schools are not covered by the register of the Chamber of Trades and Crafts
- Lack of coordination between crafts and vocational education

Educational programmes do not follow the market demand, i.e. harmonization and administrative procedures which accompany it are too slow for the market demand, which leads to the employment of inadequately qualified or unqualified workers and reduced competitiveness of such employers

- Space of the exercise rooms in schools is not used for practical work in building construction occupations

Current capacities in vocational schools have a potential to allow, within the framework of practical work programme, the training and education of students in EE and RES, in cooperation with professionals/contractors/manufacturers of building equipment but they are not sufficiently exploited at the moment.

# 10. Conclusions

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“CROSKILLS” project must define and quantify the needs and possibilities of the Croatian construction sector in order to contribute to national objectives concerning energy efficiency. This will be done through strategic planning of education and training for construction workers in the field of energy efficiency and renewable energy sources and through an assessment of the market for such workforce, which can improve the energy specifications of buildings in the Republic of Croatia in the long term.

First, an analysis of the current state was made in order to define the needs and possibilities of increasing qualified workforce in the construction sector with the aim of improving energy efficiency in buildings. The results of the analysis will be a foundation for developing the final document - guidelines that include a strategy with an action plan defining actual measures concerning the education, improvement and assessment of the labour market in terms of energy efficiency and renewable energy sources.

According to the most recent data from the Croatian Bureau of Statistics [20], the average number of workers on a site in Croatia in 2011 was 50,218. The details refer to the construction activity of legal entities with 5 and more employees. A drop in the number of employees compared to the previous period is evident. The value of executed works in 2010 was HRK 17.9 billion, of which 9.3 billion was for buildings. 74 % of the total value of executed works in building construction is for new buildings, 21 % for reconstruction, adaptation and great repairs and 5% for maintenance and small repairs.

The analysis of the vocational education system and the analysis of the knowledge of construction workers was made based on available documents and data of the main stakeholders in this field, but mostly by analysing the questionnaire answered by construction workers and a questionnaire answered by employees in educational institutions responsible for the implementation of vocational education (professors, expert staff and headmasters).

In order to determine the knowledge possessed by workers and craftsmen executing construction work and in order to be able to identify the deficiencies and key needs for additional training based on the existing situation, craftsmen, as well as other individuals were delivered questionnaires with questions covering different areas: general questions about the organisation of the craft, the level of knowledge and motivation of craftsmen, familiarity with new technologies in building construction and questions related to the activity of heating and air-conditioning installation. The structure of the respondents consisted almost entirely of craftsmen (96 %), and the databases of the Croatian Chamber of Trades and Crafts were used. The greatest number of respondents is engaged in jobs on the external building envelope (reinforced concrete works, bricklaying, roofs, façades, insulation, etc.), then installation works (water, gas, air-conditioning and central heating) and carpentry and glazing works.

The indicators of craftsmen’s knowledge about the legislative regulations confirms the claims that a considerable number of craftsmen (more than half) should be trained in this subject. Also, they point to great potential and motivation among craftsmen and their employees for education.

According to the answers from the polls, only 7% of craftsmen deal exclusively with the implementation of EE technologies. According to some other indicators, this is actually the approximate number of craftsmen who, in some way, got training to implement these technologies (only 14% of craftsmen stated that they had a certificate for a course completed in this field). As much as 85% respondents occasionally implement or implement EE technologies at investor’s request. Since the implementation of these technologies takes place sporadically, it can be concluded that, whether due to a lack in practice or to deficiency in education in this sector, EE technologies are used superficially and unprofessionally. Almost all respondents stated that they wanted additional training to a certain extent and become specialized in the field of energy efficiency technologies in building construction. What is even more interesting, as much as 41 % would definitely take additional training if there was a systematic way of training implementation, while 43% would be interested in additional training if it would be free.

A part of the questionnaire was delivered to all craftsmen engaged in installation (heating, gas, air-conditioning) since they precisely are responsible for the implementation of works related to energy efficiency, concerned with the use of renewable energy sources (installation of solar collectors, cogeneration, biomass devices, heat pumps, etc.) The questionnaire for installers is structured similarly as the questionnaire conducted for workers on the exterior building envelope and carpenters. A part of the questions refers to general experiences with new work technologies, while the greatest number of questions is indicative for determining the current level of knowledge about proper installation and maintenance of the systems using renewable energy sources and the total processes related to this activity. The questions were answered by 72 crafts registered for performing the activities of water, heating and air-conditioning installation. As opposed to the previous activities, where the execution of works, i.e. the implementation of new technologies in executing works was not defined by completed seminars, additional training

programmes or courses, for the installation of technologies such as biomass boilers, cogeneration devices and heat pumps, one often certifies for completed seminars organized by companies manufacturers or dealers of equipment that is being installed. 30% of craftsmen that participated in this questionnaire and that are performing the activities of gas, heating and air-conditioning installation have a certificate to confirm their additional education. The above points to the fact that installers of more complex technologies exist on the market but that their education is "covered" by companies, which are at the same time producers or dealers of these devices. Therefore it is important that educational programmes in vocational schools adapt in detail to the acquiring of the knowledge that will better prepare future craftsmen for the implementation of these technologies.

Continuing vocational education and training programmes in the field of energy efficiency in construction in the Republic of Croatia are held only at engineer level [32]. Currently there are no lifelong educational programmes or schemes for licensing workers and craftsmen concerning the work on improving energy specifications of buildings. According to the available data and based on the experiences from several international projects [37], Croatia doesn't have enough workers specifically trained in the field of energy efficiency, even from the perspective of the workers themselves. Although the high school education of workers and installers usually does not exceed 3 or 4 years and many of them are unqualified, vocational high schools for construction workers and schools for adult education are not especially oriented on energy efficiency and renewable sources as a part of their curricula. However, workshops and seminars are occasionally organized on the subject of the construction of low-energy buildings on the national and regional levels but this cannot be considered as a continuing training system. The existing materials for training in the field of energy efficiency are the result of activities of organizations within the framework of various international projects but they are not especially aimed at construction workers nor are they systematically coordinated by the relevant institutions.

Civil Engineering School Čakovec recognized the demand for new vocations, so in its curriculum [38] it specified the need for designing and approving new curricula, in the field of construction – sustainable building technician. It is a profile of a professional who will principally conceive building on the principles of savings and passive architecture and implement systems for generating a micro climate in space based on renewable energy sources. Also, it was concluded that it was hard to expect that the current organisation of vocational education programmes would satisfy the needs for human resources that will immediately find work on the labour market or will be able to adapt itself, via uniform revision of vocational programmes, to labour market needs in all sectors. Due to instability and non-existence of a strategy for economic development, it will be unlikely to directly find employment immediately after graduating high school upon the completed restructuring of production resources although operators with four-year education are very needed, especially in construction (construction and architectural technicians). The school also conducted a series of revisions of current programmes for adults, harmonizing them with the new ordinance on adult education and, based on the revised programmes, especially those for retraining and new correspondence-consulting classes, it will contribute to higher quality of adult education and awareness of the necessity of lifelong education of construction workers [38].

Although there are several exceptions in the high school education system (vocational schools in Zagreb and Čakovec, Technical School Ruđer Bošković in Zagreb and UNDP Solar Education Centre in Zadar), currently there is no systematic education of construction workers regarding energy efficiency and renewable sources.

Consequently, the skills necessary for quality execution of low-energy buildings are very rare among construction workers. One of the potential reasons is a lack of motivation for continuing education. The economic situation does not leave workers or their employers extra funds or time necessary for training. On the other hand, the market still doesn't demand specialized training or special licensing of construction workers, hence there is no particular motivation among workers and employers to invest additional resources into education. Therefore, workers are in a different position from engineers who are becoming more competitive on the market thanks to additional mandatory education.

The next step is preparing guidelines, which should explain how to overcome obstacles and identify deficiencies in different vocations, so as to achieve the 20-20-20 objectives in the construction sector.

The guidelines should include:

- 20-20-20 targets: energy savings and a part of energy from renewable sources in the construction sector,
- identifying qualifications needs and deficiencies in the construction sector, i.e. quantifying the number of workers that need to be trained in each sub-sector, i.e. vocation, on all professional levels,
- identifying priority measures according to the needs of different sectors (new qualification schemes and/or updating the existing schemes) with regard to different vocations in order to meet the set goals,
- defining an action plan for the identified measures at least by 2020., participants who will conduct the implementation, sources for implementation, additional measures required,
- monitoring the progress of proposed activities.



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# 13. Glossary

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<b>ASOO</b>	Agency for Vocational Education and Training and Adult Education (VET Agency)
<b>EE</b>	energy efficiency
<b>RES</b>	renewable energy sources
<b>MZOS</b>	Ministry of Science, Education and Sports
<b>HZZ</b>	Croatian Employment Service
<b>FINA</b>	Financial Agency
<b>JMO</b>	Integrated educational model
<b>HOK</b>	Croatian Chamber of Trades and Crafts
<b>ZUKE</b>	Law on energy efficiency
<b>EPBD</b>	Energy Performance of Buildings Directive
<b>RH</b>	Republic of Croatia
<b>IEE</b>	Intelligent Energy Europe
<b>UNDP</b>	United Nations Development Programme
<b>EQF</b>	European Qualifications Framework
<b>CROQF</b>	Croatian Qualifications Framework
<b>QF-EHEA</b>	Qualifications Framework for the European Higher Education Area
<b>GVD</b>	gross value added
<b>GDP</b>	gross domestic product
<b>DZS</b>	Croatian Bureau of Statistics
<b>STS</b>	solar heating systems
<b>EIHP</b>	Energy Institute Hrvoje Požar
<b>ESTIF</b>	European Solar Thermal Industry Federation
<b>PV systems</b>	photovoltaic systems
<b>HROTE</b>	Croatian Energy Market Operator

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