

BUILD UP SKILLS ROADMAP
FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY SOURCES
IN THE MACEDONIAN BUILDING SECTOR



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Abbreviations

MEA	Macedonian Employment Agency
EARM	Energy Agency of the Republic of Macedonia
GDP	Gross domestic product
CC	Construction Company
EE	Energy Efficiency
RES	Renewable Energy Sources
AEC	Adult Education Center
VET	Vocational Education and Training
Medu	Ministry of Education
IE	Informal education
ktoe	kiloton oil equivalent
RM	Republic of Macedonia
SVE	Secondary vocational education
SW	Skilled worker
IPA	Instrument for pre-accession assistance

0. Foreword

Working together to achieve the European energy objectives is all about taking over responsibility for maintaining the living conditions not just of current generations, but also of future generations.

The intention of this *Build Up Skills Roadmap for Energy Efficiency and Renewable Energy Sources in the Macedonian Building Sector* is to contribute in meeting the national energy targets by providing qualified workforce in the building sector for energy efficiency and renewable energy sources. The document identifies the required skills for the various occupations of the building workers and the barriers that are to be overcome in order to provide the necessary number of skilled workers, directly involved in construction.

The Skills Roadmap for Macedonia was developed in dialogue with the main stakeholders in Macedonia, members of the project's Steering Committee.:

1. *Energy Agency of the Republic of Macedonia*
2. *Ministry of Economy*
3. *Ministry of Environment and Physical Planning*
4. *Ministry of Education and Science*
5. *Adult Education Center*
6. *Macedonian Employment Agency*
7. *Ministry of Transport and Communication*
8. *Ministry of Labor and Social Policy*
9. *Economic Chamber of Macedonia*
10. *Faculty of Electrical Engineering and Information Technologies*
11. *Civil Engineering Institute Makedonija*
12. *ZBK Kreacija - Skopje*

1. EXECUTIVE SUMMARY

NATIONAL ENERGY TARGETS

By 2018 the Republic of Macedonia aims to save 9% of energy and by 2020 to save 14.5% of energy compared to the average consumption in the period of 2002-2006. This would mean 237.31 ktoe less consumption in 2020 or savings in the amount of €137,995,765.00 per year (1 ktoe is estimated at € 581,500.00).

The building sector's share will be 36.13% of energy savings, of which: 24.08% in households (57.14 ktoe or €33,226,910.00) and 12.05% energy savings in the commercial and service sectors (28.6 ktoe or €16,630,900.00). The total share of the building sector in 2020 is to be 69.19 ktoe or € 49,857,810.00 per year.

INVESTMENTS PLANNED FOR MEETING THE ENERGY TARGETS

In order to meet the 2020 national energy targets, there are € 562.7% million in investments planned, of which: € 95 million for the application of energy efficiency measures in public buildings, € 256.9 million in private buildings and € 120.3 million in the commercial and service sectors.

NEED FOR RECONSTRUCTION OF THE BUILDING STOCK

The existing building stock is 28.7 million m² of private building stock and 6.5 million m² of public buildings. In order to meet the EU recommendation for an annual reconstruction of 3% of the private building stock and 5% of the public buildings, there has to be an annual reconstruction of 1,153,000 m² (828,000 m²/year of the private building stock and 325,000 m²/year of the public buildings).

Such reconstruction asks for a 100 to 150 million euro annual investment, which is double the planned investment with the National Strategy for Energy Efficiency.

QUALIFICATION REQUIREMENTS

The measures (work of the directly employed workers in construction) that are to be implemented in EE and RES reconstruction refer to three areas:

- *Building envelope*: roof, façade; and windows and doors; for reduced energy losses
- *Energy supply*: interior walls and floors, electricity, heating, air-conditioning and ventilation, replacement of the equipment in order to decrease energy consumption and introduction of EE systems
- *Energy sources*: geothermal systems, biomass, solar heating, photovoltaic systems, wind turbines, and combined heat and power facilities as well as introduction of new renewable energy sources.

The primary occupations related to the Roadmap refer to:

- Energy Efficiency: bricklayer, plasterer, carpenters, roofers, thermal insulation workers, installers, electricians, electrical fitters
- Renewable energy sources: installers of solar thermal systems, installers of biomass boilers and stoves, solar photovoltaic and thermal systems and installers of shallow geothermal systems and heat pumps.

REQUIRED NUMBER OF WORKERS

The need for skilled workers is a minimum of 9,600 and maximum of 16,200 skilled workers.

The required number of skilled workers in energy efficiency is:

- Bricklayers – construction work and use of new materials with a small heat transfer coefficient – minimum of 2,200 and a maximum of 3,500 workers
- Plasterers – External wall insulation – a minimum of 1,200 and a maximum of 1,500 workers
- Carpenters (roofers) – roof insulation – a minimum of 600 and a maximum of 1,000 workers
- Joiners – Glaziers – replacement of the existing windows with the new ones replacement of the existing windows with the same or new ones - a minimum of 1,200 and a maximum of 2,000 workers
- Thermal insulation workers – insulation of walls, floors and perimeter - a minimum of 800 and a maximum of 1,600 workers
- Installers, electricians, (installers of electrical systems), electrical equipment (fitters, ne e sodvetno), specialists for energy management systems, installers for reconstruction of the heating system - a minimum of 3,600 and a maximum of 7,000 workers

Renewable energy sources:

- ◆ Solar thermal installers, installers of biomass boilers and stoves, solar photovoltaic and thermal systems, shallow geothermal systems and heat pumps – a minimum of 2,000 and a maximum of 3,000 workers

STRATEGIC APPROACH for securing the required number of skilled workers

The strategic approach is based on the development of training schemes for the construction vocations of the V-th qualification degree (highly qualified craftsmen). The training will encompass the construction vocations of the V-th (b) and IV-th and III-rd qualification degree for workers with a minimum of 3-year working experience. With this approach by 2016 the delivery of these qualifications will be carried out through the informal education institutions, while after 2016 the already developed curricula will be incorporated into the formal secondary vocational education system.

With this approach by 2016 there will be around 4,800 building workers trained from six priority occupations.

PRIORITY MEASURES

The measures for the provision of the required number of skilled building workers can be divided into four priorities.

Priority 1: Upgrade of the national education system within the construction occupations for the provision of EE and RES qualifications

1. 1. Upgrade of the adult education system for EE and RES qualifications in the following occupations:
 - Bricklayers – construction work – use of new materials with a small heat transfer coefficient
 - Façade installer -External wall insulation
 - Carpenters - (roofers) – roof insulation
 - Joiners (Glaziers)– replacement of the existing windows with the same or new ones
 - Thermal insulation workers – insulation of walls, floors and perimeter

- Installers, electricians, electrical fitters, installation of energy management systems, reconstruction of the heating system

1.2. System for accreditation and certification of qualifications acquired through the informal education system (development of procedures, trainer criteria)

1.3. Established monitoring system of the verified institutions, the quality of the programmes and the number of trained building workers

Priority 2:Following and transfer of the European experiences on the design of EE and RES programmes for the application of certification schemes

2.1. Development of curricula for the training of 10 construction vocations (bricklayer, plasterer, carpenters/ assembly of building envelope, joiners, thermal insulation workers, wall insulation, floor and perimeter, installers, electricians, electrical mechanics and fitters)

2.2. Verification of 3 institutions for the training of trainers

2.3. Implementation of training for 300 trainers and securing the required number of trainers

Priority3:Building capacity of the education institutions for the delivery of trainings in line with the needs of the skilled workers

3.1. Verification of 20 institutions for the training of building workers

3.2. Verification of 10 construction companies for the implementation of partial training (practical work)

3.3. Training of 4,500 building workersfor the 10 priority vocations

Priority4:Identification and overcoming barriers for the implementation of the defined goals

4.1. Development of programmes for the support of the training of 500 unemployed, 300 building workers with lower qualification level and 300 workers from other sectors

4.2. Training programmes for 500 graduated high school students from the construction vocations

4.3. Informative campaign on the meaning of construction of low-energy buildings

ACTION PLAN

The action plan for the implementation of the measures for the four priorities has been developed for the period of 2013-2016. It entails training for 4,800 workers, directly involved in construction, i.e. in construction companies, 500 unemployed, 300 building workers with low qualifications, 300 workers from other sectors and 300 graduated high school students. More precisely, the action plan refers to the provision of 7,200 qualified workers for the application of EE and RES measures.

The total budget for the implementation of the action plan is€ 1,785,000 and will be provided by: Build Up Skills, Pillar 2 – € 275,000, IPA's forth component - € 1,470,000 and with financial participation of the participants in the amount of € 40,000.

ROADMAP ADOPTION

The document has been supported by ministries, institutions and companies, members of the National Qualifications Platform.

2. Introduction

The *Build Up Skills Roadmap for Energy Efficiency and Renewable Energy Sources in the Macedonian Building Sector* was developed in the context of the Analysis of the National Status-Quo for the application of energy efficiency and renewable energy source measures.

The main considerations in the analysis refers to the condition of the building sector, the national policies and the vocational adult education system as well as data on the existing number of building workers, current energy consumption, national energy targets and the share of the building sector, the number of workers in need of training and the required skills for the workers directly involved in construction. The end of analysis identifies the barriers for meeting the 2020 energy targets.

2.1. Building sector

The rate of the GDP in construction is higher than the average GDP rate and for the past 3 years it's been 3.4%. The building sector has significant contribution to the national economy: with 6 - 7.9% in the creation of the added value in the GDP (480 million euro) and with 34.7% in the total investments into fixed assets.

In 2011, the participation of the micro and small-sized companies rose and the one of the medium-sized companies went down, further deepening the fragmentation of the building sector.

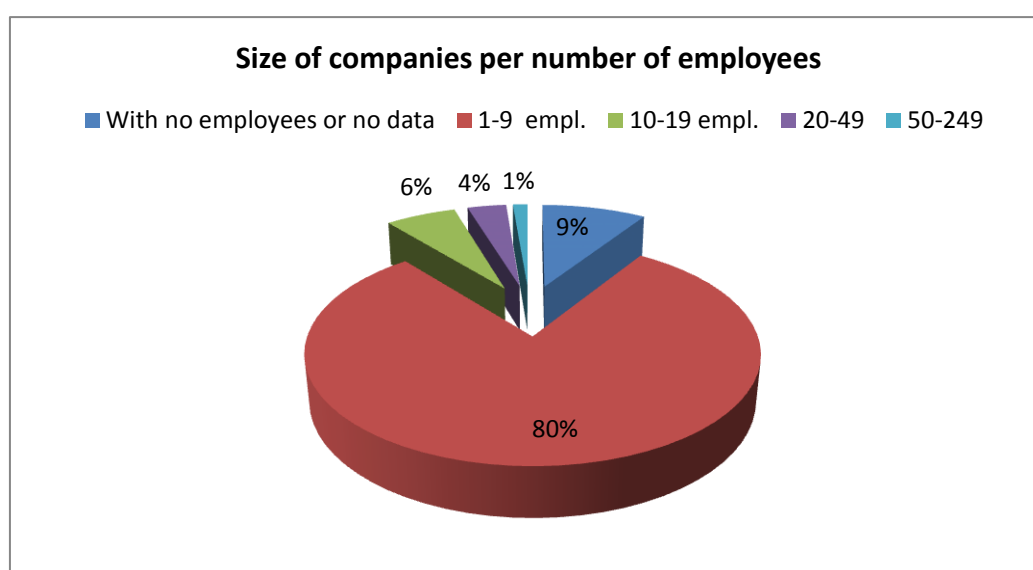


Figure 1 Structure of the building sector enterprises according to the number of employees in 2011

The number of employees in construction has been quite variable in the last 4 years and is 6.5 - 7 % from the total number of employees in the Republic of Macedonia.

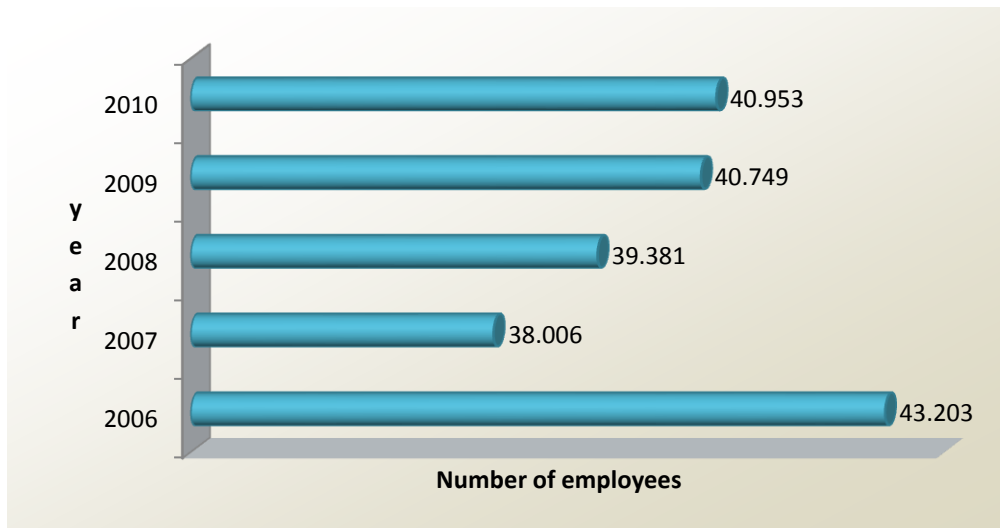


Figure2Employees in construction in the period from 2006-2011

2.1.1. Building stock

Republic of Macedonia has 564,296 households and 698,143 apartments, with 1.2 apartments per household. In the last 10 years, there have been between 5,000 and 5,500 apartments built each year with the exception of 2006 when there were 6,493 apartments built.

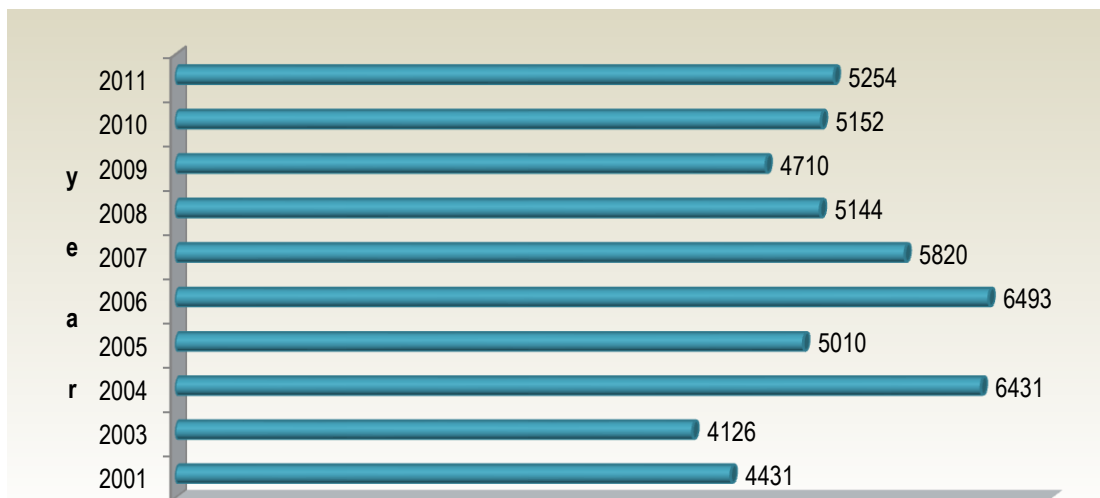


Figure3Apartments built in 2001 - 2011

Today's building stock consists of 28.7 million m² of individual dwellings and residential buildings with several apartments (construction units). The public building stock (public administration and under the ownership of the municipalities) is 2.6 million m² with a note that this figure refers only to those public buildings for which there exists recorded data (cadastre data). The total building stock (private and public) is 31.3 million m².

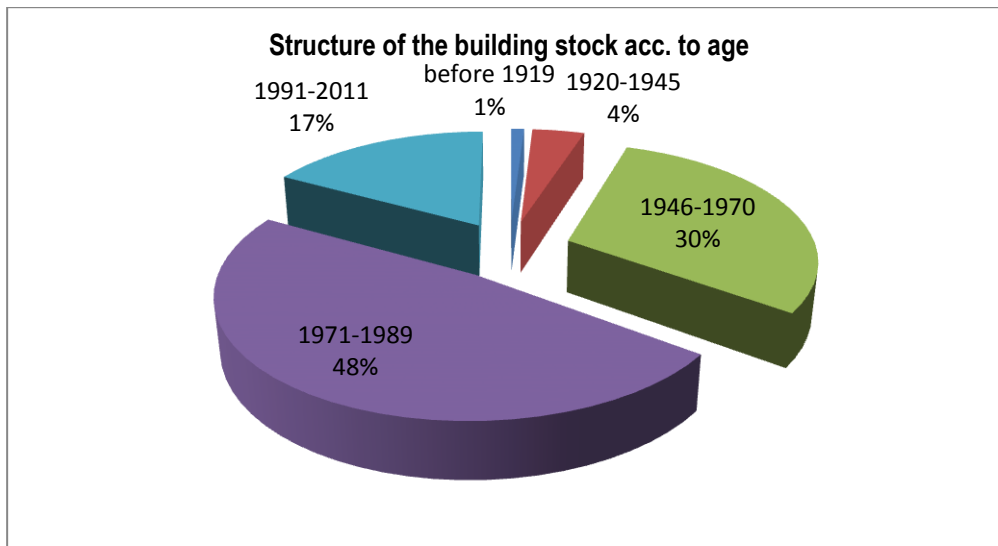


Figure4 Structure of the building stock according to age

2.1.2. National energy targets

The national energy targets in relation to the EU strategy 20/20/20 are:

- 1) to ensure 9% of savings by 2018 and to reach 14.5% of energy savings by 2020 compared to the average consumption in the period from 2002-2006; or 237.31 ktoe
- 2) reduction of CO₂ emissions from 2010 to 2020 by 5,792 ktCO₂
- 3) participation of 21% of the renewable energy sources in the consumption of final energy by 2020

Current consumption: The households have highest energy consumption in electricity with an increasing growth rate as well as in biomass, but with a decreasing growth rate in the last two years.

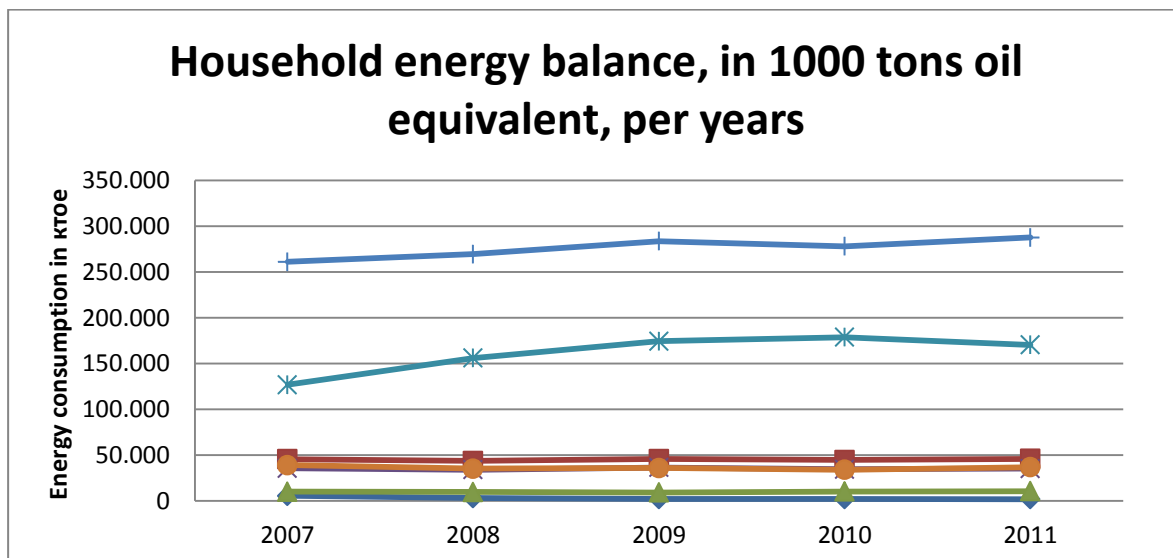


Figure 5 Household energy balance in thousand tones oil equivalent per years

The average specific energy consumption in public buildings is 214 kWh/m² while the average energy costs amount to €18.7 per 1m². The potential of savings has been estimated at 33% and €95.2 million are required for

its implementation. The implementation of the EE measures will save €14 million per year making the investment return period of 6.8 years.

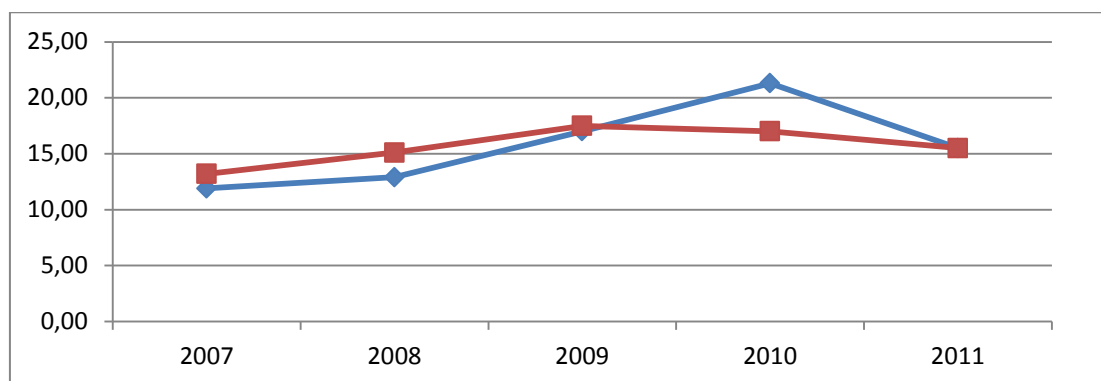


Figure 5 Participation of the RES in the final energy consumption, 2007-2011

The building sector contribution planned is 36.13 % of which 24.08 % in households (57.14 ktoe) and 12.05% in the commercial and service sector (28.6 ktoe from the total savings planned by 2020 at 237.31 ktoe).

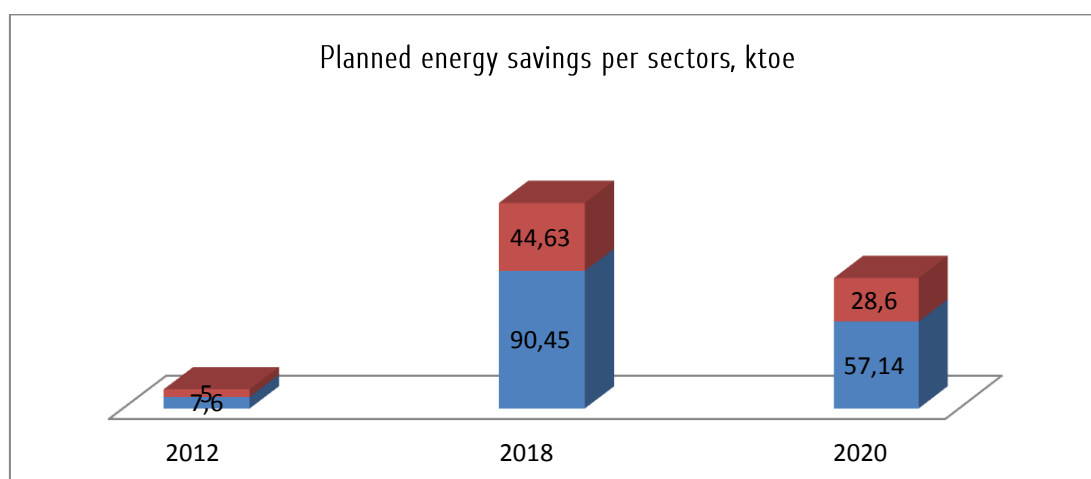


Figure 6 Energy savings planned per sectors, ktoe

Table 1. Investments needed for meeting the EE National Strategy targets by 2020 (in million euros)

Building Sector	Total Investment	Macedonian Government	Municipality	Foreign Donors	Private Sector
Private apartments	279.56	4.0	0.7	44.9	229.9
Commercial and administrative buildings	114.1	27.4	14.4	18.8	53.5
Total in the building sector	393.70	31.4	15.1	63.7	283.4

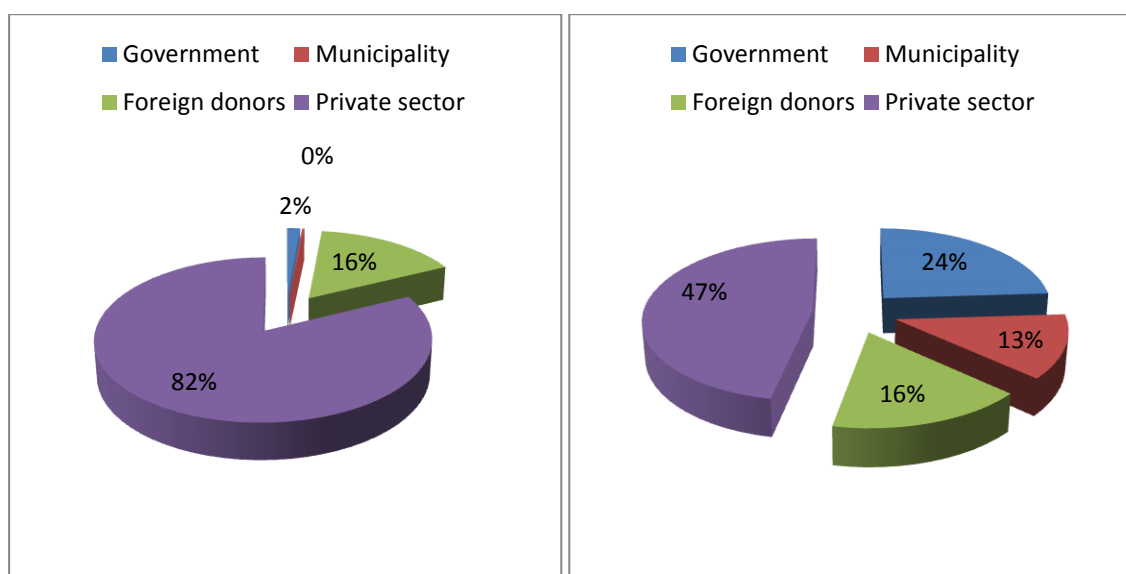


Figure 7 Structure of the investment sources for the private apartments and the commercial sector

2.2. National education policies and the existing system of secondary vocational education

Republic of Macedonia has a national education system that consists of formal and informal education and has developed functional procedures for the verification of programmes and institutions for the provision of adult education. However, implementation is in its initial stages and capacity building of the institutions for verification of programmes and institutions is ongoing as well as setting up a monitoring system for the delivery of education services.

Informal adult education is mostly carried out in line with the provisions of the Law on Adult Education in the Republic of Macedonia. Service providers of adult education can be both public and private adult education institutions, training centers, employers and social partners, citizens associations or individual trainers that meet the conditions prescribed by law.

All resources for funding and development of adult education are provisioned from the budget of the Republic of Macedonia, the budgets of the units of the local self-government and from the participants in the adult education process and other sources.

2.2.1. National Qualifications Framework and capacity of the national institutions for EE and RES

The National Qualifications Framework has been harmonized with the European Qualifications Framework for the V (a), VI (a and b) and VII (a and b) degrees. The harmonization procedure for degrees V (b) and IV, III, II and I is ongoing.

The qualification sectors related to EE and RES are civil engineering (02), electrical engineering (05) and mechanical engineering (09). The qualification degrees for these sectors, which need to be taken into

consideration with the Build Up Skills Roadmap for EE and RES, are the following: V (b – post-secondary education – (specialist education and skilled workman examination)) and IV (four-year technical education and informal education for acquiring full or partial qualification) and III (vocational education for vocations (in the duration of three years and informal education for acquiring full or partial qualification)).

EE and RES programmes need to be developed for these qualification degrees with the following development approach:

Development of EE and RES programmes by 2016 for the V (b -) degree for employees in the construction sector with a degree from V (b) and IV, III who have had at least 3 years of experience in the construction industry. The delivery of these qualifications is to be carried out through verified institutions for informal education.

EE and RES programmes are to be developed for all degrees by 2018 and then incorporated into the system for secondary formal vocational education.

The capacity of the institutions for verification of programmes and institutions for informal education is 10 programmes and 5 to 7 institutions per year.

For the implementation of the short-term goals within the BuildUp Skills MK project, all institutions need to develop a simpler verification system for EE and RES programmes.

2.2.2. Training providers for EE and RES

The current informal education training is carried out through the following institutions:

- 15 (fifteen) secondary vocational schools for seven verified programmes for building workers directly involved in construction (electrical installer and electrical fitter for residential buildings in Skopje, Bitola, Kumanovo, Kochani and Shtip; electrical installer and electrical fitter for industrial facilities in Skopje, Strumica, Kumanovo, Prilep and Shtip; installer and fitter of water and gas supply installation in Skopje; plasterer fitter in Tetovo and Skopje; ironmonger in Skopje, Kochani, Kumanovo, Bitola, Shtip, Gostivar; maker and fitter of joinery in Skopje, Kavadarci, Strumica. Each of these institutions can take on 200 participants a year
- 9 (nine) verified institutions for adult education for 3 construction vocations (maker and fitter of joinery in Strumica, Bitola; plasterer fitter in Prilep, Ohrid, Kumanovo and Skopje); plasterer (Prilep, Ohrid, Skopje). Each of these institutions can take on 50 participants a year
- 26 institutions for adult training delivering courses in the construction of KSINTI facades, energy sanitation of existing buildings, energy efficiency in new construction building, solar thermal energy, photovoltaic systems, EE in buildings
- 56 private companies that give advice on the reconstruction of buildings and training for the use of materials in EE buildings

The programmes of the verified adult education institutions for the construction vocations do not entail topics for EE and the use of RES.

There are also no programmes on training of trainers, i.e. trainers that will help create qualified trainers for EE and RES programmes.

2.2.3. Certification schemes for building workers

The certification schemes for the building workers are carried out on four levels:

- ◆ First, through the verified institutions for adult education by earning a **graduation degree** in some of the construction vocations. Courses are conducted in a set number of classes, which consist of $\frac{3}{4}$ theory classes, $\frac{1}{4}$ practice and an exam section
- ◆ The second level is by taking exams for skilled workmen for construction vocations directly involved in construction. Courses consist of $\frac{2}{3}$ theory classes, $\frac{1}{3}$ practice, taking a final exam for skilled workman and getting the corresponding **certificate**
- ◆ The third level is through courses and seminars of adult education institutions and private companies for the application of construction materials for EE or systems for the use of RES depending on the qualifications needed for a certain construction vocation(**Certificate for having attended the given course**)
- ◆ The fourth level is through work in construction companies where training is conducted within the company itself by employees of that same company(**Certificate for working experience**)

Therefore, the certification schemes will be developed on short term and long term. On short term, the qualifications are to be verified on several levels:

1. Certified occupations(certificates for EE and RES qualifications delivered by verified institutions according to the national system on adult education) and
2. Qualification verification schemes (certificates for acquired skills, which will be issued by the construction companies, based on previously trained trainers – employees at the company).

2.3. Workforce

The total number of employees in the building sector has fallen in the last 3 years.

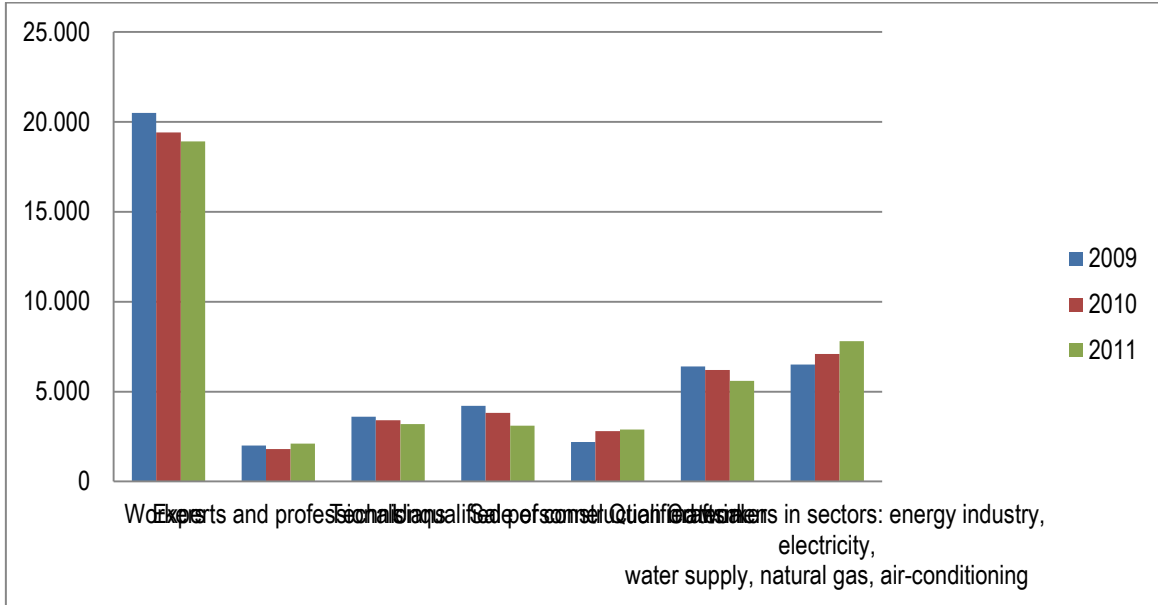


Figure 8 Employees in the building sector in 2009-2011

Workers directly employed in construction take up 74% from the total number of employees in the building sector

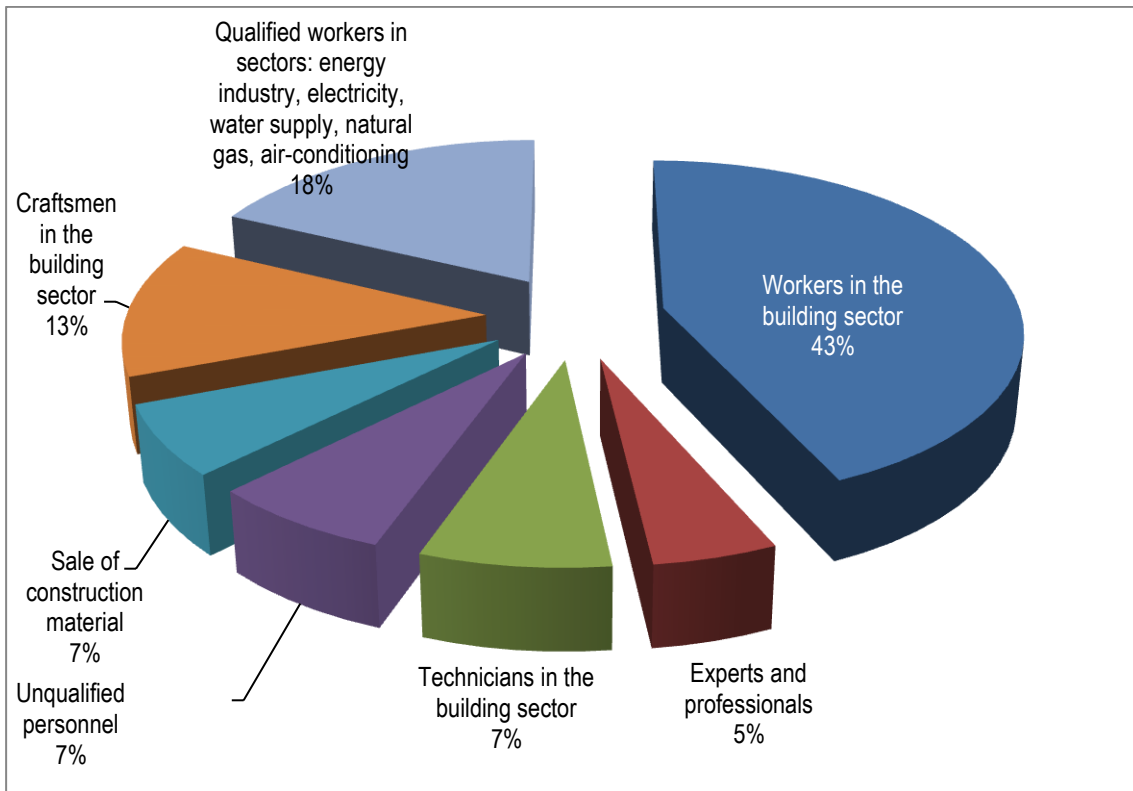


Figure 9 Employee structure in the building sector in 2011

3.3.1. Number of qualified building workers per occupations for meeting the 2020 targets

The measures (work carried out by the direct employees in construction) that are to be implemented in reconstruction refer to three areas:

- *Building envelope*: roof; facade; and windows and external doors; for reduction of the energy loss
- *Energy supply*: interior walls and floors; electricity; heating; air-conditioning and ventilation, replacement of the equipment in order to decrease energy consumption and introduction of EE systems
- *Energy sources*: geothermal systems; biomass; solar heating; photovoltaic systems; wind turbines; combined heat and power facilities (introduction of new renewable sources)

All of the occupation standards are defined in line with the Standard Methodology.

From the 52 occupation standards, 3 refer to construction (plasterer fitter, dry construction fitter, wall decorator, technician designer for interior architecture). The development time of a new standard related to the implementation of EE and RES measures is 2 weeks (according to the given procedure and committee). The proposal of the committee is then approved and verified by the Ministry of Education (but this is still not law effective)

Table 2. Priority occupations for meeting EE and RES national targets

Occupation	Annual need for workers
7111 - Construction operatives-semi-qualified workers	200
7112 - Bricklayers and related construction occupations	1200
9313 - Blue collars in building construction	300
7115 –Carpenters and joiners	550
7121 -Roofers	1100
7123 – Plasterers- façade workers	500
7124 - Insulation workers	400
7125 - Glaziers	500
7124.1 – Thermal insulation workers	1.100
3113.1 - Electrical trades for installation and equipment	1.000
7133 - Heating and air-conditioning installers	900
7412 - Electric mechanics and fitters	300
7412.4 - Electrical fitter of power machines and devices	200
7412.8 - Electrical mechanic for electrical energy, specialized	300
7412.9 - Electrical fitter	500
7412.9 - Electrical mechanic	100
7412.10 - O&M (Operation & Maintenance) of electrical appliances and equipment	150
TOTAL	9.600

Priority occupations

- *Energy Efficiency*: bricklayer, plasterer, carpenters, roofers, thermal insulation workers, installers, electricians, electrical fitters

- Renewable energy sources: solar thermal installers, installers of biomass boilers and stoves, solar photovoltaic and thermal systems, shallow geothermal systems and heat pumps.

3.3.2. Need for qualifications, courses and qualification schemes, number of trainers, accreditation and training structure for the delivery of training courses

3.3.2.1. Need for qualifications

The need for qualified workers is a minimum of 9,600 and maximum of 16,200 qualified workers.

Energy efficiency:

- Bricklayers – construction work – use of new materials with a small heat transfer coefficient – minimum of 2,200 and a maximum of 3,500 workers
- Plasterers (Façade workers) – External wall insulation – a minimum of 1,200 and a maximum of 1,500 workers
- Carpenters (roofers) – roof insulation – a minimum of 600 and a maximum of 1,000 workers
- Joiners – replacement of the existing windows with the same or new ones, a minimum of 1,200 and a maximum of 2,000 workers
- Thermal insulation workers – insulation of walls, floors and perimeter, a minimum of 800 and a maximum of 1,600 workers
- Installers, electricians, electrical fitters, installation of energy management systems, reconstruction of the heating system - a minimum of 3,600 and a maximum of 7,000 workers

Renewable energy sources:

- ◆ Solar thermal installers, installers of biomass boilers and stoves, solar photovoltaic and thermal systems, shallow geothermal systems and heat pumps – a minimum of 2,000 and a maximum of 3,000 workers

The table with the needed qualifications per occupations and EE and RES topics has been given in Annex 1.

3.3.2.2. Courses and qualification schemes

The qualification schemes needed have been grouped in two levels:

1. Formal education qualifications – these qualifications can be acquired through degrees earned from secondary vocational schools for the existing occupations and for the new occupations for RES. This is a long-term measure, which is supposed to be implemented after 2016 (the occupations have been given in Annex 2). This qualification scheme will be developed in line with the given occupation standards and the National Qualifications Framework while the funding for this qualification scheme will be provided from the budget of the Republic of Macedonia.
2. Qualifications through informal adult education – these qualifications will be acquired through certificates awarded by verified institutions on adult education. This is a short-term measure that will start to be implemented in 2014-2016 (the occupations have been given in Annex 1). The funding for this qualification scheme comes from: IPA funds, EU Intelligent Energy Programme, construction companies and employees.

The qualification scheme on informal education will consist of:

Table 3 Qualification scheme on informal education for EE and RES construction occupations

1. Training and qualification verification (acquiring knowledge)		
1.1. General knowledge of EE and RES (meaning, uses, systems for the provision of EE, standards established with the national regulations) Training content: theory with examples of best practices		
1.2. Specialization for acquiring the degree of skilled workman (occupation from 3.3.1) for workers with three-year working experience		
1.2.1. Construction occupations for building exterior	1.2.2. Construction occupations for building interior and energy infrastructure	1.2.3. Occupations for the use of RES installation
Training content for item 2: two thirds theoretical training and one third classes		
1.3. Final exam (taking a theoretical exam and practical work for assessment)		
2. Qualification verification		
2.1 Verified institutions for adult education on EE and RES (certificate for final exam 1.3)		
2.2 Verified construction companies (specialization certificate for 1.2.)		
3. Accreditation of the programmes and institutions and monitoring of the Roadmap implementation		
3.1. Verification	3.2. Monitoring	
<ul style="list-style-type: none"> ◆ Programmes and institutions ◆ Construction companies 	<ul style="list-style-type: none"> ◆ Programme implementation ◆ Quality and number of training courses 	

Required number of trainers and institutions

1. **300 trainers** for training and verification of qualifications (acquiring knowledge)
 - 1.1. General knowledge of EE and RES (meaning, uses, systems for the provision of EE, standards established with the national regulations) - **60 trainers**
 - 1.2. Specialization for acquiring the degree of skilled workman (occupations from 3.3.1) for workers with three-year experience
 - 1.2.1. Construction occupations for building exterior - **80 trainers**
 - 1.2.2. Construction occupations for building interior and energy infrastructure - **80 trainers**
 - 1.2.3. Occupations for the use of RES installation - **80 trainers**
 - 1.3. Final exam (taking a theoretical exam and practical work for assessment) - **100 assessors**
2. Qualification verification
 - 1.1 **30 verified institutions for adult education on EE and RES** (final exam certificate 1.3)
 - 1.2 **20 verified construction companies** (specialization certificate for 1.2.)

3.3.2.3. Accreditation and training structure for the delivery of training courses

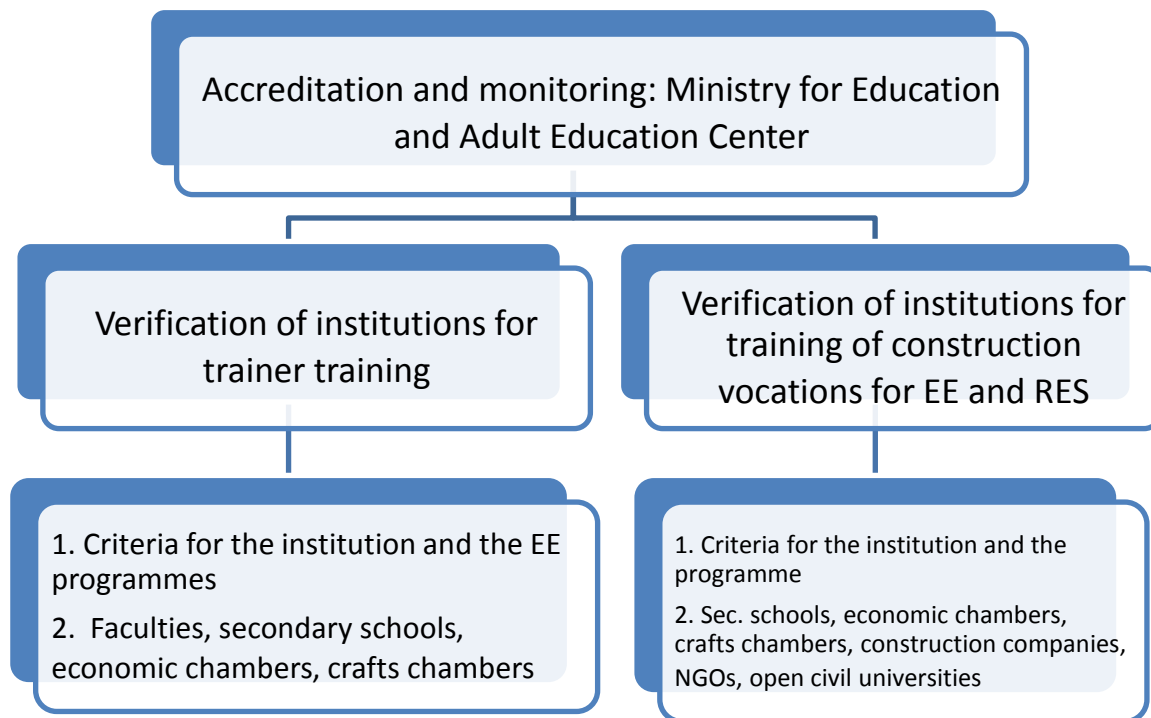


Figure10 Accreditation and training structure

3.4. Identified barriers for meeting the 2020 targets

The barriers were identified by consulting the corresponding legislation, strategic documents, holding meetings with the relevant institutions and conducting research which included construction companies and institutions for informal education.

General conditions: Lack of capacities for long-term planning, while in areas where this exists, the capacity building is only for the development of strategies; Fragmentation of the EE activities; Lack of statistical data unification; Financial risks and orientation towards help and support through programmes; There is no specific law for mandatory application of EE and RES in the new buildings and the refurbished ones; Lack of by-laws, rulebooks and guidelines on the construction method; Lack of stimulation policy based on numerical parameters for the EE degree; Lack of compliance to the KSINTI standard due to not having a rulebook or control for appropriate implementation of the given standard; Lack of the presentation of EE through figures and clear numeric indicators; Lack of guidelines for solar thermal energy; Insufficient information; High initial investment

Building sector: Sector fragmentation; Low EE and RES demand on the market; Weaknesses in the social partnership system; Poor interest for employee training

Formal education: Decrease in the number of students for the construction occupation; High dependence of projects development for EU programmes; Lack of funding to cover costs for new skill development; Old syllabi and methods of learning; Unsatisfying level of cooperation with the employers; Inadequate teacher reward system; Fragmentation of the vocational education and training sector; Lack of “soft skills”

Informal training:Lack of competent trainers for trainers; Fragmentation of the informal education sector; Small number of potential participants in the trainer training; Educators are oftentimes unaware of the situation in practice; Limited access to trainings for participants from small and medium-sized enterprises; Bad reputation of the sector.

3. General strategyforcreating qualified building workers

3.1. Strategic approach and priorities

The strategic approach in creating qualified building workers focuses on mobilizing the relevant institutions to apply the EE and RES measures in order to secure capacities for meeting the energy targets in households and the commercial and service sector.

The strategic approach for the development of the Roadmap consists of the following steps:

a) Development of a draft version of the Roadmap by the projectteam based on the analysis of the condition in the building sector and the needs for qualified staff

b) Discussions with the relevant institutions on EE and RES, such as:

- Construction sector: associations of construction companies and RES association (round tables on topics such as Legislation on the Construction of EE Buildings, EE Programme on Public Buildings, EE and RES training of workers, Paritaren training fund)
- Craftsman's Chamber of Skopje (direct meeting: training courses for craftsmen; organizing exams for the priority occupations; training funding; existing training courses on EE and RES)
- Social partners: Union of Building workers; Employer Federation of Macedonia (work groups: Training courses for building workers on EE and RES, certification, training payment)
- Educational institutions: (FEIT, Faculty of Civil Engineering and Faculty of Architecture, secondary vocational schools, development of training curricula and training forms, training of trainers, existing trainings on EE and RES)
- Institutions for adult education (work groups: development of training curricula and training forms, trainers, existing trainings on EE and RES)
- Government institutions for adult education: Macedonian Energy Agency, Ministry of Education, Adult Education Center, Secondary Vocational Education Center (round table on certification systems, training courses for the unemployed, graduated students from high school, training courses for the employed, funding by IPA and Build Up Skills, monitoring and implementation system)

c) The National Qualifications Platform will adopt the draft version of the Roadmap, which will be subject of discussion in the institutions inthe building sector, the energy sector and the education institutions, which in turn will show their support by sending a written approval of the Roadmap.

d) The Steering Committee of the project will run the approval process with the Government and the Macedonian Parliament

The strategic approach for the implementation of the adopted Build Up Skills Roadmap is the involvement of the relevant institutions and the National Qualifications Platform for EE and RES in meeting these four strategic priorities:

1. Upgrade of the national education system within the construction occupations for the provision of EE and RES qualifications
2. Following and transfer of European experiences on the design of EE and RES programmes for the application of certification schemes
3. Capacity building of education institutions for the delivery of trainings in line with the needs for qualified workers
4. Identifying and overcoming barriers for the implementation of the set goals

3.2. Long-term and short-term goals

There are long-term and short-terms goals set for each priority:

Priority 1 Upgrade of the national education system within the construction occupations for the provision of EE and RES qualifications

Long-term goals by2020:

- ◆ Incorporation of the EE and RES programmes into formal education for all qualification degrees;
- ◆ Training of the teaching staff for the implementation of the training courses for all qualification degrees;
- ◆ Developed system for verification of programmes and institutions for informal adult education for all construction occupations;

Short-term goals by2016:

- ⊕ Upgrade of the adult education system for 10 priority construction occupations with EE and RES programmes
- ⊕ System for accreditation and certification of qualifications acquired through the informal education system
- ⊕ Implemented monitoring system of the verified institutions, the quality of the programmes and the number of trained building workers

Priority 2:Following and transfer of European experiences on the design of EE and RES programmes for the application of certification schemes

Long-term goals by 2020:

- ◆ Introduction of programmes for the construction of passive energy buildings
- ◆ Introduction of an early warning system for qualification upgrade of building workers
- ◆ Compliance of the Macedonian Qualifications Framework with the European one

Short-term goals by 2016:

- ⊕ Development of curricula for the training of 10 construction occupations for EE and RES;
- ⊕ Verification of 3 institutions for the training of trainers;

- ⊕ Implementation of training courses for trainers and securing the required number of trainers.

Priority 3:Building capacity of the education institutions for the delivery of trainings in line with the needs of the qualified workers

Long-term goals by 2020:

- ◆ Upgrade of the formal education programmes with topics on EE and RES
- ◆ Introduction of new occupations for EE and RES in the national nomenclature of occupations

Short-term goals by 2016:

- ⊕ Verification of 20 institutions for training of building workers
- ⊕ Training of 4,500 building workers for the 10 priority occupations

Priority 4:Identification and overcoming barriers for the implementation of the defined goals

Long-term goals by 2020:

- ◆ Setting up a promotion system for the EE and RES occupations;
- ◆ Developed funding system for formal education for EE and RES.

Short-term goals by 2016:

- ⊕ Development of programmes for supporting the training of the unemployed, building workers with low qualifications and workers from other sectors;
- ⊕ Training programmes for graduated students from civil engineering highschoools;
- ⊕ Informative campaign on the meaning of construction of low-energy buildings.

4. Identification and prioritizing of measures for meeting the short-term goals

The measures for implementation of the short-term and long-term goals have been presented for each priority, while the development according to responsible institutions, timeframe and budget is in the action plan for their implementation.

Priority 1 Upgrade of the national education system for the construction occupations in terms of providing EE and RES qualifications

Identified measures

1. 1. Upgrade of the adult education system with procedures, contents and forms of training for the following occupations:

- Bricklayers – construction work – use of new materials with a small heat transfer coefficient;

- Plasterers – External wall insulation;
- Carpenters (roofers) – roof insulation
- Joiners – replacement of the existing windows with the same or new ones;
- Thermal insulation workers – insulation of walls, floors and perimeter;
- Installers, electricians, electrical fitters, installation of energy management systems, reconstruction of the heating system.

1.2. System for accreditation and certification of qualifications acquired through the informal education system (development of procedures, trainer criteria)

1.3. Established monitoring system of the verified institutions, the quality of the programmes and the number of trained building workers

Priority 2:Following and transfer of the European experiences on the design of EE and RES programmes for the application of certification schemes

Identified measures

2.1. Development of curricula for 10 construction occupations for EE and RES (bricklayer, plasterer, carpenters, joiners, thermal insulation workers, wall insulation, floor and perimeter, installers, electricians and electrical fitters)

2.2. Verification of 3 institutions for the training of trainers

2.3. Implementation of training for 300 trainers and providing the required number of trainers

Priority 3:Building capacity of the education institutions for the delivery of trainings in line with the needs of the qualified workers

Identified measures

3.1. Verification of 20 institutions for the training of building workersfor EE and RES

3.2. Verification of 10 construction companies for the implementation of partial training (practical work) for EE and RES of building workers directly involved in construction

3.2. Training of 4,500 building workerswithin the 10 priority vocationsfor the application of EE and RES measures

Priority 4:Identification and overcoming barriers for the implementation of the defined goals

Identified measures

4.1. Development of programmes for the support of the training of 500 unemployed, 300building workers with low qualifications and 300 workers from other sectors

4.2. Training programmes for 500 graduated high school students from the construction vocations

4.3. Informative campaign on the meaning of construction of low-energy buildings

5. Action plan

Priority 1 Upgrade of the national education system for the construction occupations in terms of providing EE and RES qualifications							
No.	Measure	Motivation	Goal	Timeframe	Responsible institutions	Costs (Euro)	Funding
1.1.	Upgrade of the adult education system for:	National Qualifications Framework	Informal education system	2014	Medu, AEC, VET center		Budget and Build UP
1.1.1.	Use of new materials with a small heat transfer coefficient	Upgrade				2.000	
1.1.2.	External wall insulation					2.000	
1.1.3.	Roof insulation					2.000	
1.1.4.	Replacement of windows with old or new ones					2.000	
1.1.5.	Installation of energy management systems					2.000	
1.1.6.	Reconstruction of the heating system					3.000	
1.1.7.	Solar thermal installers					3.000	
1.1.8.	Installers of biomass boilers and stoves					2.000	
1.1.9.	Solar photovoltaic and thermal systems					2.000	
1.1.10.	Shallow geothermal systems and heat pumps					3.000	
1.2.	System for accreditation and certification of qualifications acquired through the informal education system	EE and RES education	Certification	2014	Medu, AEC, VET Center	5.000	Budget and Build UP
1.3.	Monitoring system of EE			2014	AEC	5.000	
Total Priority 1						33.000	

Priority 2: Following and transfer of the European experiences on the design of EE and RES programmes for the application of certification schemes

No.	Measure	Motivation	Goal	Timeframe	Responsible institutions	Costs (Euro)	Funding
2.1.	Development of curricula for 10 construction occupations	EE and RES strategy	10 priority occupations	2013-2014	Faculties, professors	40.000	Build UP
2.2.	Verification of 3 institutions for the training of trainers	Informal adult education	10 institutions	2014	AEC and Medu	6.000	Private institutions
2.3.	Implementation of training for trainers		300 trainers	2014	IE institutions	150.000	Build UP
Total Priority 2						196.000	

Priority 4: Identification and overcoming barriers for the implementation of the defined goals

No.	Measure	Motivation	Goal	Timeframe	Responsible institutions	Costs (Euro)	Funding
4.1.	Development of training support programmes	Employment	500 unemployed, 500 con. workers, 5000 from other sectors	2014-2015	AEC and Medu	20.000	Build UP
4.2.	Training programmes for graduated high school students from the construction vocations		5000 graduated participants	2015-106	SVS	10.000	Build UP
4.3.	Informative campaign on the meaning of construction of low-energy buildings			2014	AEC and EERM	30.000	Build UP
Total Priority 4						60.000	

Priority 3: Building capacity of the education institutions for the delivery of trainings in line with the needs of the qualified workers

No.	Measure	Motivation	Goal	Timeframe	Responsible institutions	Costs (Euro)	Funding
3.1.	Verification of institutions for the training of building workers	EE and RES strategy	20 institutions	2014	SVS, NGO	20.000	Build UP
3.2.	Implementation of partial training (practical work)	Informal adult education	10 construction companies	2014	AEC and Medu	6.000	Private institutions
3.3.	Training of 4,800 building workers				Verified institutions		Build UP
3.3.1.	Bricklayers		1100	2015-2016		330.000	IPA 4 and companies
3.3.2.	Plasterers (Façade installer)		600	2015-2017		180.000	IPA 4 and const. companies
3.3.3.	Carpenters (roofers)		400	2015-2018		120.000	IPA 4 and const. companies
3.3.4.	Joiners (Glazier)		600	2015-2019		180.000	IPA 4 and const. companies
3.3.5.	Thermal insulation workers		500	2015-2020		150.000	IPA 4 and const. companies
3.3.6.	Installers		400	2015-2021		120.000	IPA 4 and const. companies
3.3.7.	Solar thermal installers		400	2015-2022		120.000	IPA 4 and const. companies
3.3.8.	Installers of biomass boilers and stoves;		300	2015-2023		90.000	IPA 4 and const. companies
3.3.9.	Solar photovoltaic and thermal systems		300	2015-2024		90.000	IPA 4 and const. companies
3.3.10.	Shallow geothermal systems and heat pumps		300	2015-2025		90.000	IPA 4 and const. companies
Total Priority 3						1.496.000	

6. Conclusions

1. The Build Up Skills Roadmap for Energy Efficiency and Renewable Energy Sources defines the path that needs to be followed in the next seven years for the upgrade of skills and qualifications of the building workers in the practical application of EE and RES measures.
2. The National Education System for EE and RES is in its initial stages and this is why all relevant institutions need to be involved in its upgrade, i.e. to provide the necessary number of building workers for meeting the national energy targets by 2020. The National Qualifications Platform is to be used as protection to all of the relevant institutions for EE and RES in order to support the Government in the upgrade of the formal and informal education systems with corresponding curricula and forms of education providing the necessary EE and RES skills and qualifications.
3. In terms of the Republic of Macedonia and the lack of education content on EE and RES, emphasis is to be given on measures which will directly offer training for the defined priority occupations through informal education so that more building workers gain the needed qualifications from the selected 10 occupations. The incorporation of EE and RES education content into formal education is to be priority after 2016. Hence, within Build Up Skills, Pillar 2, priority is to be given to the development of training curricula and forms for acquiring skills that can be implemented by the building workers in reconstructing the existing building stock and in applying EE and RES measures in new building construction.
4. The action plan consists of measures for the implementation of four priorities which will enable training of 4,800 building workers on EE and RES measures by 2016 so that they could contribute in meeting the national targets for the 2020 energy savings.
5. The implementation of the strategic approach of the Roadmap is closely related to the continued work of the National Qualifications Platform, which will greatly contribute to the development of the formal and informal education systems in the Republic of Macedonia.

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9. Annexes

Annex1 : National Roadmap for EE-RES Training of the Direct Labour Force in the Building industry (construction sector)

T1. Employed persons in the building sector with EE-RES relevant occupations

Training needs relevant for EE-RES occupations based on Gap analysis

Occupation-skill needs relevant for EE-RES relevant occupations in Building industry (construction sector)	Employed persons 2020 High scenario	Current labour force 2013	Workers recruited from unemployed 2013-2020	Young workers Recruited from VET-high schools 2013-2020	Name and the content (indicative) of the training. <u>Note.</u> The Training package shall be adjusted for each category of direct workers: 1. Current labour force 2013, 2. Workers recruited from unemployed people in the period 2013-2020 and 3. Young workers Recruited from VET-high schools 2013-2020
Based on High demand scenario					
Architectural design					
Architectural Technician	300	50	50	200	<ol style="list-style-type: none"> 1. The architecture, EE and RES 2. Basic concepts of EE-RES architecture 3. Passive house design 4. Daylight and transparent elements in EE buildings 5. High performance windows 6. Ventilated facades 7. Occupants behavior in "classical" buildings and modern Green buildings (Zero-Energy Buildings, Passive houses, , Low-energy, EE Buildings, etc)
AutoCAD Designers of Green buildings (ZEB, Passive houses, EE bgs)	300	0	0	300	<ol style="list-style-type: none"> 1. Basics of AutoCAD 2. Green buildings (Zero-Energy Buildings, Passive houses, EE buildings) 3. PHI (Passive House Institute) criteria-design 4. ZEB and NZEB (Nearly-zero Energy Buildings) – EU Directives 5. Best practice for design and construction of Green buildings (Zero-Energy Buildings, Passive houses, EE Buildings, etc)
Construction					
Construction design-classic	600	400	100	100	<ol style="list-style-type: none"> 1. Design factor of buildings 2. Classical Techniques in buildings 3. Thermal bridges 4. Optimization of classical buildings 5. Cost-factors
Construction and innovative design	600	100	200	300	<ol style="list-style-type: none"> 1. New technologies in building construction 2. New modular design for Green buildings (Zero-Energy Buildings, Passive houses, EE Buildings, etc) 3. Thermal bridges 4. Optimization of classical buildings 5. Cost-factors

Building envelope direct workers	Employed persons 2020 High scenario	Current labour force 2013	Workers recruited from unemployed 2013-2020	Young workers Recruited from VET-high schools 2013-2020	Name and the content (indicative) of the training. <u>Note.</u> The Training package shall be adjusted for each category of direct workers: 1. Current labour force 2013, 2. Workers recruited from unemployed people in the period 2013-2020 and 3. Young workers Recruited from VET-high schools 2013-2020
Masonry and brick-layers	100	0	100	0	<ol style="list-style-type: none"> 1. Principles of heat conduction and thermal

					comfort 2. Classical external walls 3. Best practice in performing external walls 4. Combined Techniques for insulation 5. New materials and technologies
Plasterer external and internal walls	40	40	0	0	1. Principles of heat conduction and thermal comfort 2. Classical internal walls 3. Best practice in performing internal walls 4. Dry-walls. 5. New materials and technologies for internal walls.
Windows installers (Glazier)	400	100	100	200	1. High performance windows 2. Daylight and transparent elements in EE buildings 3. Low-emission glazing 4. Windows and how to eliminate thermal bridges 5. Skylights
Insulation external walls	600	200	200	200	1. Principles of heat conduction and thermal comfort 2. Insulation for external walls 3. Best practice in performing external walls 4. Combined Techniques for insulation 5. New materials and technologies
Roof construction	600	200	300	400	1. Types of roof construction 2. Integrated roof construction
Green roofs design and installation	50				
Roof insulation installers	100	50	50	0	
Dome and Skylight installers	50	0	0	50	
Installers of daylight equipment	50	0	0	50	
Double-skin façade	50	0	0	50	
Façade ventilation-cladding system	50	10	10	30	
Mechanical technicians (HVAC)	Employed persons 2020 High scenario	Current labour force 2013	Workers recruited from unemployed 2013-2020	Young workers Recruited from VET-high schools 2013-2020	Name and the content (indicative) of the training. <i>Note.</i> The Training package shall be adjusted for each category of direct workers: 1. Current labour force 2013, 2. Workers recruited from unemployed people in the period 2013-2020 and 3. Young workers Recruited from VET-high schools 2013-2020
Radiator heating installer	650	300	150	200	1. Basic heating systems. Hydronic systems. 2. Piping connections for hydraulic radiators. Single and 2-pipe. 3. Piping connections for Fan-coil units-2 pipe and 4-pipe system 4. DHS (District Heating System) - Proper connections in sub-station. 5. Role of de-aeration and circulation pump
Installer for under-floor heating system	50	20	20	10	1. Basic heating systems. 2. Comparison Radiant heating vs Hydronic systems 3. Piping loops in under-floor systems 4. Combination of low temperature solar heating with floor heating. 5. Tips and tricks in installation of floor system.

Installer for air conditioning and ventilation system	150	40	10	100	<ol style="list-style-type: none"> 1. Basic of thermal comfort and air conditioning 2. Types of air conditioning systems: all-air, water based, 3 . The centralized and decentralized AC systems 4. Duct sizing and ADE (Air Distribution Equipment) 5. Fans and air-ventilation system
Installer for Heat pumps air-to-air	150	40	10	100	<ol style="list-style-type: none"> 1. The building characteristics for heat pumps 2. Centralized vs de-centralized ait-to-air heat pump 3. The characteristics of Heat pump air-to-water systems 4. High efficiency air heat pumps VRV (Variable Refrigerant Volume) 5. O&M (Operation & Maintenance) of heat pumps
Installer for GSHP (Geothermal HPs)	80	20	10	50	<ol style="list-style-type: none"> 1. Potential for Geothermal energy 2. Drilling techniques in for Earth Heat exchangers. Drilling equipment. 3. Configuration of Earth Heat exchanger . 4. GSHP (Geothermal and Ground Source Heat Pumps) 5. Water sourced heat pups
Central heating boiler-oil and gas	100				<ol style="list-style-type: none"> 1. Basic types of hot water boilers (oil, gas, biomass) 2. Improvement of combustion process. 3. Condensing boilers 4. O&M (Operation & Maintenance) of boilers 5. Regulation of Boiler plant
Installer for Biomass heating	100	20	30	50	<ol style="list-style-type: none"> 1. Basic types of biomass boilers (biomass, pellets, briquettes) 2. Installation of biomass boilers. 3. Installation of small biomass stoves 4. O&M (Operation & Maintenance) of biomass boilers 5. Economics of Biomass for Heating and CHP
Installer of ammonia water chillers	50	0	0	50	<ol style="list-style-type: none"> 1. Basics of Refrigeration ammonia systems 2. The characteristics of ammonia water chillers (with ecological working fluid (ammonia) and air or water condensers . 3. Installation of ammonia water chillers 4. O&M (Operation & Maintenance) of ammonia chillers 5. Safety and environmental issues
Installer of Centrifugal Water chillers	10	0	0	10	<ol style="list-style-type: none"> 1. Basics of Refrigeration systems 2. The characteristics of Freon chillers (with ecological working fluid (R-410) and air or water condensers . 3. Installation of Freon water chillers 4. O&M (Operation & Maintenance) of water chillers 5. Safety and environmental issues
Installer of small-medium W. chillers	30	10	0	20	<ol style="list-style-type: none"> 1. Basics of Refrigeration systems 2. The characteristics of Freon chillers (with ecological working fluid (R-410) and air or water condensers . 3. Installation of Freon water chillers 4. O&M (Operation & Maintenance) of water chillers

					5. Safety and environmental issues
Installer of Absorption Water chillers	10	10	0	0	1. Basics of Refrigeration systems 2. The characteristics of absorption chillers (working fluid LBr or water-ammonia) with air or water condensers . 3. Installation of absorption water chillers 4. O&M (Operation & Maintenance) of absorption water chillers 5. Safety and environmental issues
Installer for CHP (Combined Heat and Power) Facility	20	0	0	20	1. Basics of CHP (Combined Heat and Power) Facility systems 2. The characteristics of CHP . 3. Installation of various CHP plants 4. O&M (Operation & Maintenance) of CHP 5. Safety and environmental issues
Installer for Sanitary hot water system	600	200	200	200	1. Basic types of Sanitary hot water system 2. Sanitary hot water system with solar energy 3. Sanitary hot water system with waste heat 4. O&M (Operation & Maintenance) 5. Regulation, Safety and Environmental issues

RES (Renewable E) direct labour	Employed persons 2020 High scenario	Current labour force 2013	Workers recruited from unemployed 2013-2020	Young workers Recruited from VET-high schools 2013-2020	Name and the content (indicative) of the training. <i>Note.</i> The Training package shall be adjusted for each category of direct workers: 1. Current labour force 2013, 2. Workers recruited from unemployed people in the period 2013-2020 and 3. Young workers Recruited from VET-high schools 2013-2020
Installer for SEC (Solar thermal)	250	100	100	50	1. Basics of Solar Energy thermal systems 2. Types of SEC (Solar Energy Thermal Collectors) 3. Installation of Solar Energy collectors 4. O&M (Operation & Maintenance) of Solar Energy systems 5. Economics of Solar Energy
PV (Photovoltaic) system. Installers of PV modules and equipment	300	50	50	200	1. Basics of Solar Energy PV systems 2. Types of Solar Energy PV modules 3. Installation of Solar Energy PV elements 4. O&M (Operation & Maintenance) of Solar PV systems 5. Economics of Solar PV system
Installer for wind turbines - small	10	0	0	10	1. Basics of wind energy 2. The characteristics of wind energy turbines 3. Installation of wind energy turbines 4. O&M (Operation & Maintenance) 5. Safety and environmental issues
Installer for wind turbine – small-medium	20	0	0	20	1. Basics of wind energy 2. The characteristics of wind energy turbines 3. Installation of wind energy turbines 4. O&M (Operation & Maintenance) 5. Safety and environmental issues
Installer for wind energy turbines -large	10	0	0	10	1. Basics of wind energy 2. The characteristics of wind energy turbines 3. Installation of wind energy turbines 4. O&M (Operation & Maintenance) 5. Safety and environmental issues
Installer for combined	160	100	100	60	1. Basics of combined biomass systems

biomass systems					<ol style="list-style-type: none"> 2. The characteristics of biomass systems . 3. Installation of various biomass systems 4. O&M (Operation & Maintenance) of biomass systems 5. Safety and environmental issues
Installer for micro CHP (SOFC- Solid Oxide Fuel Cell technology)	10	0	0	10	<ol style="list-style-type: none"> 1. Basics of CHP and Fuel cell systems 2. The characteristics of micro SOFC- Solid Oxide Fuel Cell technology . 3. Installation of various Fuel cell system 4. O&M (Operation & Maintenance) of Fuel cells 5. Safety and environmental issues
Installers for Micro CHP (Combined Heat and Power) Facility	50	0	0	50	<ol style="list-style-type: none"> 1. Basics of CHP (Combined Heat and Power) Facility systems 2. The characteristics of CHP . 3. Installation of various CHP plants 4. O&M (Operation & Maintenance) of CHP 5. Safety and environmental issues
Electrical installers –direct labour	Employed persons 2020 High scenario	Current labour force 2013	Workers recruited from unemployed 2013-2020	Young workers Recruited from VET-high schools 2013-2020	<p>Name and the content (indicative) of the training.</p> <p><i>Note.</i> The Training package shall be adjusted for each category of direct workers: 1. Current labour force 2013, 2. Workers recruited from unemployed people in the period 2013-2020 and 3. Young workers Recruited from VET-high schools 2013-2020</p>
O&M (Operation & Maintenance)	500	300	0	200	<ol style="list-style-type: none"> 1. Types of maintenance (preventive, predictive) 2. Basics of NDT (Non-destructive testing) 3. Role of Energy audit in buildings 4. Organization of O&M (Operation & Maintenance) 5. Safety and environmental issues
Electrical lighting installer	600	250	100	250	<ol style="list-style-type: none"> 1. Basics of electrical lighting systems 2. The characteristics of lighting bulbs . 3. Installation of lighting equipment 4. O&M (Operation & Maintenance) of CHP 5. Safety and environmental issues
Wiring of electrical equipment	300	150	0	150	<ol style="list-style-type: none"> 1. Basics of electrical wiring 2. The characteristics of cables . 3. Wiring of equipment 4. O&M (Operation & Maintenance) 5. Safety and environmental issues
Installer of Radiant panel systems	50	50	0	0	<ol style="list-style-type: none"> 1. Basics of Radiant electric systems 2. The characteristics of Radiant bulbs . 3. Installation of Radiant panel equipment 4. O&M (Operation & Maintenance) of Radiant equipment 5. Economics of Radiant panels
Installer for generators power systems	50	50	50	0	<ol style="list-style-type: none"> 1. Basics of Electric generators systems 2. The characteristics of generators . 3. Installation of generators 4. O&M (Operation & Maintenance) 5. Safety and environmental issues
PV equipment : PV modules, inverters, BoS (Balance of System) etc	200	50	0	150	<ol style="list-style-type: none"> 1. Basics of Balance of system 2. The characteristics of BoS . 3. Installation of various BoS 4. O&M (Operation & Maintenance) 5. Safety and environmental issues

Annex2

Vocational subjects in the secondary vocational education

Vocation	Profile	Subjects in I year	Subjects in II year	Subjects in III year	Subjects in IV year	
Electrical engineering	Electric technician – energy technician	Electrotechnical materials and elements	Electric measurements	Automation	Automation	
		Electrical Engineering	Electronics	Electrical appliances and devices	Electrical appliances and devices	
		Electrical drawing	Electrical Engineering	Electric machines and drives	Electric machines and drives	
			<u>Lighting and installations</u>	Electric networks	Danger from power surge and power surge protection	
				Electronics	Electric machine service	
				Electrical appliances and devices		
	Electric technician for electronics and telecommunication			Analogue electronics	Digital electronics and microprocessors	Digital electronics and microprocessors - elective
				Digital electronics and microprocessors	Electronic assemblies and devices	Electronic assemblies and devices
				Fundamentals of measurement and electric circuits	Telecommunication assemblies and devices	Telecommunication assemblies and devices
				Telecommunication		
	computer system engineering		Automation	Automation	Automation- elective	

			Electronics	Digital systems	Digital systems
			Fundamentals of measurement and logic circuits	Programming	Process management
			Programming		Programming
Construction-geodesy	Technical designer for interior architecture	Descriptive geometry	Materials and structures		
		Fundamentals of Construction and Geodesy	Exterior and furniture design		
		Technical drawing with computer communication			
	Architectural technician		Building structures	Building structures	Reinforced concrete
			Construction materials	Management planning	Building structures - elective
			Descriptive geometry	Urban design	Installations
			Urban design	Technical mechanics	Management planning
			Architecture Development		Urban design
	Geodetic technician		Geodetic measurements	Photogrammetry	Geodetic measurements

		Geodesy and geodetic layouts	Geodetic measurements	Geodesy and geodetic layouts
			Geodesy and geodetic layouts	Engineering geodesy
			Engineering geodesy	Cadastre
			Cadastre	
Construction technician		Building materials and structures	Reinforced concrete structures	Reinforced concrete structures
		Fundamentals of geotechnical and hydrotechnical engineering	Hydrotechnical structures	Steel structures
		Technical mechanics	Strength of materials	Hydrotechnical structures
		Concrete technology	Management planning	Management planning
			Roads	Roads

Subject topics in secondary vocational education and proposal for new topics in relation to EE

Voc.	Profile	Subject	Year	Topics	Proposed topic (EE)
Electrical Engineering	Electric technician – energy technician	Lighting and installations	II	Electric installation material	EE electric installations
				Types of electric installations	
				Light sources, lights and quality lighting	EE light sources
				Low voltage installation	
				Electric installation design	Application of new technologies in lighting (electrochromic materials, smart windows)
		Electrical appliances and devices	III	Heat transfer	
				Electric heaters	EE heating systems (including hot water systems)
				Electrothermic domestic appliances and devices and automation	
			IV	Impact of cooling agents on the ozon layer	
				Cooling techniques	EE cooling systems

				Cooling devices	
				Electric air-conditioning equipment and automatic control	EE air-conditioning equipment and automatic control
	Electric technician for electronics and telecommunication	no corresponding topic			
	Electric technician for computer system engineering and automation	Automation	II и III	Systems for automatic operation and regulation	Systems for automatic operation and regulation in relation to energy efficiency
					Automatic lighting control
				Automatic air-conditioning control (cooling/heating)	
Construction - geodesy	Technician designer for interior architecture	Materials and structures	II	General on types of materials	
	Architectural technician	Building structures	II	Walls (internal and external)	Types of materials and blocks in relation to achieving EE buildings

				Proper connection and arrangement of blocks in EE buildings
			Horizontal and vertical humidity insulation	Types of insulation materials and their application in EE buildings
	Building materials	II	General on types of materials (with special emphasis on insulation) *	
	Design and urbanism	II	General on design without approach to EE	EE design aspects
	Building structures	III	Types of walls	EE openings in walls
			Mortaring and façade finish	Proper mortaring and EE facade finish
				Special (new) types of EE facades
			Chimneys and ventilation	
			Roofs and roofing work	EE roofs
			Whitesmith work	
			Joinery	Types of building envelope assembly with special emphasis on energy efficiency
				Proper building envelope assembly in EE buildings
	Painting and varnishing work	Wall and floor finish in relation to EE		
Installations	IV	Heating	EE heating systems (including hot water systems)*	

			Airing and air-conditioning	EE cooling systems*
			Electric installations	
Geodetic technician	no corresponding topic			
Construction technician	Building materials and structures	II	General on types of materials and structures (with special emphasis on insulation) *	Construction materials in relation to EE
				Use of new materials in relation to energy efficiency