BUILD UP Skills – Greece

Analysis of the national status quo

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Further information

More details on BUILD UP Skills can be found at www.build-up.ec.europa.eu

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TABLE of CONTENTS

0. Executive summary

The Analysis of the Status Quo for Greece was conducted as part of the work package WP3 (Analysis of the National Status Quo) for the project BUS-REGRoUP, having as initial objective to gather all relevant information regarding the current situation in the building sector in Greece concerning energy efficiency and its contribution to the energy and climate goals by 2030, as adopted/incorporated in the existing National Energy and Climate Plan (NECP). Secondly, the study aims to clarify the status of the Continuous education and training schemes.

The Analysis of the National Status Quo includes all professions related to the building sector and covers all Renewable Energy Sources (RES) and Energy Efficiency (EE) technologies and systems, including those recently introduced to the labour market. Given the "Renovation Wave" of the EU, the integration of the "Nearly Zero Energy Buildings" (NZEB) and the inclusion issues related with resource efficiency which are priorities of the EU in its path towards complete decarbonization by 2050 (but also within the framework of the NECPs for 2030 - under review in order to include the considerations of the "Fit for 55 Package" and the REPowerEU plan), these priorities require the availability of an all-levels workforce with appropriate skills for their implementation. Within this framework, an expansion of the target group was made, to ensure that the new required skills (digital technologies, smart buildings, e-mobility, circularity) will offer new possibilities

Furthermore, a series of challenges were identified, including barriers, the need of training and training-providers, as well as quantitative data on the needs of "blue-collar" and "white-collar" professionals and the skill- gaps between the current situation and the anticipated needs by 2030.

Finally, key stakeholders from Greece (members of the National Qualification Platform) were invited to participate in this specific work, to review and provide to the project partners comments/ opinions/ estimations and suggestions on the completeness and integrity of the results.

The essential information regarding the most significant conclusions of the analysis made in the framework of this project is presented in the following box:

- **The existing workforce of the construction sector in numbers**

In 2019, approximately 150,000 employees were employed in the construction sector (building constructions, civil engineering works, specialized constructions), and 127,000 more workers in other relevant sectors of the construction industry (extraction, industrial sectors, architectural services). Thus, the total employment in the construction sector reached around 274,000 workers in that year (according to the 3-digit classification of the Statistical Classification of Professions (STEP), the Construction sector includes 46 occupational categories, while the broader Construction sector includes 86 occupational categories, encompassing hundreds of individual professions). Despite the massive decline in the construction activity after 2007, the sector still maintains a significant share in the Greek economy.

The majority of the employed in the Construction sector are engaged in specialized construction activities, with 78,000 people in 2019, representing a 64.7% decrease compared to 2008. In building construction, where employment also experienced a significant drop (-73.1%) during the same period, 42,000 people were employed in 2019. In civil engineering works, mainly focusing on infrastructure investments, employment reached 28,000 people in 2019, showing a positive trend since 2016. A significant share is noticed in the industrial sectors of the broader Construction sector, where 62,000 workers were employed in 2019, having however a decline from 109,000 employees in 2008, while the in Services of the Construction sector 56,000 people were employed in 2019 (79,000 in 2008).

In conclusion, in 2008 the construction sector employed a total of 595,000 individuals, while in 2019, this number barely reached 150,000. In 2020, based on IOBE's research citing Eurostat data, the

construction sector in Greece had 61,511 companies, of which 4,830 specialized in building construction. Respectively, in 2009, the number of companies in the sector was 112,952, with 17,372 specialized in building construction. The overwhelming majority of construction companies in the country (96.8% in 2019) are very small enterprises (individual businesses, self-employed individuals, businesses with less than 10 employees). Nevertheless, these businesses contribute to the 36.4% of the production value in the construction sector. Only 15 companies employ more than 250 workers and represent the 1/4 of the production value in construction. In the other sectors of the Infrastructure and Construction Industry, there were more than 85,000 companies - primarily in the Services sector, which mainly includes architectural and design activities - employing 127,000 workers.

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

According to the energy balance for 2017, the energy consumption associated with buildings in Greece amounts to 6.605 ktoe, which corresponds to 42% of the total final energy consumption in the country. In the tertiary sector, public assembly buildings are the most energy-intensive (with an average annual primary energy consumption of 778.24 kWh/m^2), followed by correctional facilities (with an average annual primary energy consumption of 622.67 kWh/m^2) in almost all climatic zones. During the period 2005-2015 there was an increase in final energy consumption from 737 ktoe (in 2005) to 1,613 Ktoe (in 2015) in the tertiary sector, reflecting the rapid development of related industries in this decade. The largest share of final energy consumption is taken up by space heating, the use of electrical appliances and lighting, followed by air-conditioning and hot water production. Electricity predominates, covering 73% of the energy consumption needs of buildings in the tertiary sector. It is followed by oil, which experienced a significant decline during the peak of the economic crisis but partially recovered in 2015, while natural gas covers a relatively small share

Among residential buildings, detached houses are the most energy-intensive, while apartment buildings have an average annual primary energy consumption of 257.08 kWh/m^2. According to the energy balances of Eurostat for 2015, the energy consumption of Greek households amounted to 4,401 Ktoe, while 4,615 Ktoe in 2010 and 5,510 Ktoe in 2005. The economic recession in previous years greatly affected the energy consumption of households, as it was combined with an increase in fuel prices. During the 2005-2015 decade, there was a significant decrease in the share of oil (from 57% to 33%) and a notable increase in the share of natural gas and a smaller increase in electricity. Moving on to more recent years, specifically 2020, each household in the country consumed an average of 11,792 kWh annually to cover its total energy needs.

It is worth noting that the "Axis 1.2 - Energy upgrading of the country's buildings and spatial planning reform" of the "Green Transition" Package of the National Recovery and Resilience Plan describes and analyzes a series of investments and reforms that include an extensive program of energy upgrades for residences, building infrastructure of businesses, and public buildings and infrastructure.

- **Energy targets for 2030 for the country and expected contribution of the building sector**

At the end of 2019, with the No. 4/23.12.2019 Decision of the Governmental Council for Economic Policy (GG B'4893), the National Energy and Climate Plan (NECP) was ratified. The NECP constitutes a Strategic Plan for Climate and Energy matters for the Greek Government and presents a detailed roadmap for achieving specific Energy and Climate Goals by the year 2030. The NECP presents and analyzes Priorities and Policy Measures across a wide range of developmental and economic activities for the benefit of Greek society, making it a reference document for the next decade.

In addition to the NECP, a Long-Term Strategy for the year 2050 has been developed, which serves as a roadmap for Climate and Energy issues within the framework of the country's participation in the collective European objective of achieving a successful and sustainable transition to a climate-neutral economy by the year 2050 at the European Union level. The Long-Term Strategy takes the year 2030 as a reference point and presupposes the achievement of the relevant goals set by the NECP.

According to the NECP, the national target for the share of Renewable Energy Sources (RES) in gross final energy consumption is set at a minimum of 35%. It should be noted that the use of heat pumps to meet cooling needs in a more energy-efficient manner is not counted as part of the RES share. Furthermore, there are specific targets set to increase the share of RES in different sectors of energy consumption by at least 60% in gross final electricity consumption, the share of RES for heating and cooling needs should exceed 40% while the share of RES in the transport sector should surpass 14%, based on the relevant calculation methodology of the European Union. Additionally, there is a target to promote RES systems in buildings and distributed generation systems through self-consumption and energy aggregation schemes. More precisely, it is projected that by the year 2030, such RES-based electricity generation systems with a total capacity of 1 GW will be installed, capable of covering the average electricity consumption of at least 330,000 Greek households.

- **Number of workers in the construction sector who will be trained in each subsector/ profession and at each skill level to achieve the energy goals of 2030.**

In this specific chapter, the obstacles related to the professional specialization of workers in the construction industry are identified and analysed, which may hinder the achievement of the country's goals for 2030 in the construction sector. Through collaboration with members of the National Skills Platform created within the framework of the BUS-REGRoUP project, it was observed that there is an increased need for education and training for both technicians and engineers involved in the construction sector. Both categories face the need to acquire new skills to implement measures for improving energy efficiency and integrating renewable energy sources in buildings. The main obstacles for professionals in the construction sector (technicians and engineers) to access suitable training for acquiring the necessary new skills to achieve the energy goals set for 2030 are the lack of appropriate educational programs, time constraints, cost, and inadequate institutional framework.

- **Qualification Needs**

Chapter 7 discusses the skills gaps identified between the current status and the needs for 2030 in the construction sector. It examines the evolution of the workforce in the construction industry with a focus on two distinct stages. Stage A includes estimations of the necessary personnel for interventions in the existing building stock of the country to increase its energy efficiency. Stage B pertains to the reconstruction of new buildings. Both analyses reveal a significant shortage of tens of thousands of job positions in the sector in order to achieve the desired goals. Furthermore, this chapter identifies and highlights the skills gaps faced by the construction industry between the current situation and that envisaged for 2030, while the National Skills Platform indicates that the majority of technicians and engineers consider it essential to acquire skills for implementing measures to improve energy efficiency and to integrate renewable energy sources in buildings.

1. Introduction

Buildings, in the European level, represent one of the largest energy "consumers". Enhancing energy efficiency in the building sector will contribute to reducing emissions, addressing energy poverty, empowering people against energy prices, while will also support economic recovery and job creation. The "Renovation Wave" strategy (October 2020) sets out a series of measures aiming to double the rate of energy renovations by 2030. The revision of the Directive on the Energy Performance of Buildings (EPBD) is a fundamental element of this strategy. It upgrades the existing regulatory framework to take into account higher ambitions and more urgent needs concerning climate and social action, while, in parallel, provides the necessary flexibility for Member States to consider the differences in the building stock throughout Europe.

The revised directive defines the way Europe can gain a building stock with zero emissions and fully decarbonized by 2050. The proposed measures will increase the rate of renovations, especially for buildings with the worst performances, in each member state. The revised directive will modernize the building stock, making it more resilient and accessible, supporting air quality improvement, digitizing energy systems for buildings, and installing sustainable mobility infrastructures. Of crucial importance is the fact that the revised directive facilitates more targeted financing of investments in the construction sector, complementing other EU instruments that support vulnerable consumers and tackle energy poverty.

According to the analysis of the EU's climate targets, the rapid reduction of emissions from both new and existing buildings is of particular importance for the achievement of the decarbonization goals which have been set by the EU for the 2030 and the 2050 timeframe. To achieve this reduction, regulation is required to ensure that buildings use the smallest feasible amount of energy, that the cost of carbon is reflected in the energy mix, and that financial support is provided for investments in renovations. This is the aim of the revision, along with the new Emissions Trading System (ETS) for buildings and road transportation, as well as the Climate Social Fund envisioned in the "Fit for 55" package. Furthermore, according to the revised EPBD, in all new buildings, where technically feasible, 100% of the on-site energy consumption must be covered by renewable energy sources (RES) from 2030, and for public buildings, this requirement must be in place by 2027. Member states are required to develop policies and measures for the complete phasing out of the use of fossil fuels in buildings by 2040. The EPBD revision also foresees greater emphasis on the integration of RES in Energy Performance Certificates (EPCs).

Taking into account all of the above, in the BUS-REGRoUP project, the Analysis of the Current Situation and the National Roadmap, which were developed for 2020 in the first phase of the BUILD UP Skills initiative (under the BUS-GR project), will be revisited. The focus of the previous phase was on workers and technicians (blue-collar professionals). The BUS-REGRoUP project, which is part of the European BUILD UP Skills Initiative - "*Strategies and educational interventions enabling a building stock free from carbon emissions*," co-financed by the LIFE2027 Program, is being implemented by a consortium consisting of research organizations, educational institutions, representatives of social partners, and professional chambers. More specifically, the partners of the Greek consortium of the BUS-REGRoUP project are:

- Centre of Renewable Energy Sources and Savings (CRES) - Project coordinator of BUS-REGRoUP.
- National Technical University of Athens (NTUA) - Decision Systems and Management Laboratory, School of Electrical and Computer Engineering.
- Institute of Small Enterprises of the Hellenic General Confederation of Professionals, Craftsmen and Merchants (IME GSEVEE).
- Labour Institute of the General Confederation of Greek Workers (INE-GSEE).
- Technical Chamber of Greece (TEE).

Beside the partners of BUS-REGRoUP, there is a large number of involved stakeholders who closely monitor the consortium's ongoing efforts to ensure their active supportive role in the project. These stakeholders include the relevant Ministries responsible for energy & environment and lifelong learning issues in Greece, experts in sustainable buildings, associations/companies related to renewable energy sources (RES) and energy efficient building products, research institutes/organizations related to the building industry, federations / unions of technicians (“blue collar” professionals), as well as associations of the so called “white collar” professionals (i.e. architects, designers, engineers, product manufacturers, building energy managers, etc.) working in the construction and building sectors, certification and accreditation bodies, as well as the social partners.

During the proposal’s submission phase for this specific project, a total of 26 Letters of Support (LoSs) were gathered from such stakeholders, demonstrating their supportive and empowering nature. As the project commenced and following a structured communication process aiming at securing the participation of all key stakeholders in the National Qualifications Platform (NQP), many more organizations expressed interest in participating in the joint effort for Greece. This time, the interested parties included professional associations and federations, professional chambers, certification bodies, as well as collective bodies/representatives of Continuing Vocational Training Providers in Greece.

The main objective of each project accepted for funding under the framework of the BUILD UP Skills initiative "Strategies and educational interventions enabling a building stock with reduced carbon emissions," in all 14 European countries participating in the initiative, including Greece, is, firstly, the reactivation of the National Qualifications Platform (NQP) which has been created in the first phase of the BUILD UP Skills initiative (BUS-GR) and the expansion of its scope by involving new stakeholders. The second main objective is to update the "Analysis of the Current Situation" and the "National Roadmap," which are the two fundamental position papers developed in the first phase of the BUILD UP Skills initiative (in this case, for Greece, within the framework of the BUS-GR project), focusing on workers and technicians (blue-collar professionals). These position papers are intended to be updated for these professionals and enriched with new content that will map the skill needs of white-collar professions (e.g., architects, designers, engineers, product manufacturers, building managers, etc.), thus reflecting the reality and needs of the entire building value chain.

In the current updated "Analysis of the Status Quo," all necessary information has been gathered regarding the current state of the building/construction sector of the country concerning the ongoing education and training, energy efficiency, and its contribution to the 2030 climate and energy targets, as well as existing obstacles and gaps. Similarly, the updated National Roadmap, which will be developed in a later phase, will explain how the identified skill gaps and obstacles in various professions will be overcome to achieve the 2030 targets. Specifically, it will provide a set of priority measures for different professions, an action plan for the defined measures until 2030, critical success factors, and the required resources to promote implementation, as well as monitoring measures for tracking the progress of the proposed activities. The National Qualifications Platform (NQP) plays a pivotal role in the updating process of both the Analysis of the Status Quo and the National Roadmap throughout the project duration.

In this way, a crucial step in the overall process is the identification and quantification of the need for a specialized labour force in Greece in order to describe the current situation. This activity, as an initial but significant step towards the development of the “National (Qualifications) Roadmap” for 2030, aims to determine a list of challenges for the future, including obstacles and training needs, training providers, and quantitative data regarding the needs of skilled workers until the 2030. After an extensive analysis of the current situation concerning the existing qualification and training schemes, as well as the current and planned policies and strategies in Greece, the work carried out under WP3 "Analysis of the national Status Quo" of the BUS-REGRoUP project has been completed and is presented in the following chapters.

This report is structured into 9 distinct chapters (in addition to the Executive Summary presented as Chapter 0, the Authors/Contributors listed in Chapter 10, the References in Chapter 11, and the relevant

Glossary), following the guidelines provided within the framework of the implementation of the project and the template for the report communicated by CINEA (common for all participating countries).

In the first chapter, the goal of the BUILD UP Skills Initiative and the respective BUS-REGRoUP project implemented in Greece are presented, along with the structure of the report. The second chapter presents the purpose and specific objectives of the report, as well as the approaches and methodology used for data collection and analysis.

In the third Chapter, the national policies and strategies that will contribute to the EU and the country's energy and climate goals for 2030 are analysed, with a particular focus on buildings. More specifically, this includes the energy policies for the building sector and the national policy and strategy related to green skills and professions. Additionally, the implementation of the European Qualifications Framework (EQF) and other education and training policies in Greece, when applied to the building sector, is presented.

The 4th Chapter presents extensive statistical data from the building/construction sector in combination with the energy performance of the building stock in Greece, while it includes data and analyses regarding the employment in the construction industry. Then, Chapter 5 presents the current situation regarding the initial and continuing professional education and training for technicians and other on-site workers in construction and building systems installers, as well as for the “white collar” professionals employed in the buildings construction sector. This also includes a listing of the mandatory requirements and obligations and how the existing schemes are implemented in practice.

In Chapter 6, a concise presentation (in tabular form) is made of the key projects carried out in Greece and their main characteristics, either with EU or national financing, which are relevant to the subject of skills in the construction sector. Particular emphasis is given to the actions of the “EU Construction Blueprint” project in Greece, (where Greek partners were involved). Chapter 7 provides an in-depth analysis of the skill gaps observed between the current situation and the needs for 2030. The evolution of the workforce in the construction industry until 2030 is examined, divided into distinct stages: Stage A, which includes estimations of the required personnel for interventions in the existing building stock of the country in order to increase its energy efficiency, and Stage B, for the construction of new buildings.

In the following chapter (Chapter 8), the potential obstacles related to the professional specialization of professionals working in the building construction sector are identified and analysed, as these obstacles may hinder the achievement of the country's goals for 2030 in the building sector. Finally, the Status Quo report is completed with the main conclusions derived from the assessment of all these findings, which are presented in Chapter 9.

2. Objectives and methodology

2.1 Purpose of the Status Quo Analysis report for Greece

The objective of the work carried out in the frame of WP3: “Analysis of the national Status Quo” of the BUILDSKILLS BUS–REGRoUP (*REbooting the GReek National Platform and Updating*) project is compiling all existing information about the current situation of the building and construction sector in Greece regarding energy performance and its contribution to the 2030 energy and climate targets adopted by the National Energy and Climate Plan (NECP), as well as the enlightenment of the scene regarding existing continuing education and training. More specifically, the identification and quantification of the needs for skilled workers in the construction sector in Greece until 2030 and the analysis of the status regarding the existing professional qualifications of the workforce and the training programs available are attempted in the present report. Furthermore, the documentation of the current and planned policies and strategies in the fields of both energy and vocational education and training that shall contribute to the achievement of both national and EU targets for energy and climate in the buildings sector for the time horizon until 2030 is also performed.

The “National Status Quo Analysis” includes all professions involved in the building sector, including those having recently entered the market, while it covers all RES and EE technologies and systems. More specifically, the following 'categories' of "blue collar" and "white collar" professionals are included:

- ✓ Tradesmen: bricklayers, carpenters, plumbers, electricians, roofers, plasterers, glaziers, concrete workers, etc.;
- ✓ Supervisors/contractors, working on site and more specifically on groundwork, walls, roof, windows, doors, chimneys, heating / cooling systems, air handling, lighting, other services, etc.;
- ✓ Renewable energy system installers;
- ✓ Specialists who select/size/check/inspect installations for gas boilers, oil boilers, solid fuel burners, under-floor heating, radiators, air handling units, cooling / air conditioning plant, etc.
- ✓ Specialists (engineers, designers) working on digital technologies and smart buildings including e-mobility;
- ✓ Specialists (engineers, designers, building managers) working on resource efficiency, industrialized deep renovation and Life Cycle Carbon Assessments.

This activity, as a first/concrete step towards the National Roadmap’s elaboration (next major task in the frame of the project), identified a list of challenges for the future, including barriers and needs for training, training providers and quantified data for the need of skilled “blue collar” and “white collar” professionals for the time horizon till 2030. In order to identify all the above, the main stakeholders - members of the National Qualifications Platform (NQP) - actively participated in the work carried out for this purpose, through reviewing and commenting on the results but also by feeding the project partnership with their views and assessments. For the achievement of the described tasks, a well-structured approach was used, consisted of various levels, as analysed in the following paragraphs.

2.2 Approach and methods used to collect and analyse relevant data and information

2.2.1 Mapping of the current situation of continuing education and building sectors

In this report, the current situation in Greece regarding continuing vocational education and training (CVET) and in the building sector was depicted, updating the previous report "Analysis of the National Status Quo", which was developed in the framework of the project "BUS-GR" about ten years ago, towards 2020 and concerned exclusively "blue collar" professionals. For this purpose, it was divided in two sections, as follows:

Mapping of the vocational education and training sector concerns the depiction of the current situation about the following:

- National System for Vocational Education and Training in the building/construction sector (legal and normative framework including NQF development status, existing qualifications, recognition models, procedures for validating training courses, trainers and training providers, involved institutions, and the extent to which the current system already addresses necessary skills for high quality application/ installation of RES and EE measures in buildings;
- Existing training courses and certification schemes on RES and EE implementation in buildings which are not (yet) part of the National System for Vocational Education and Training (crafts / knowledge and skills areas covered, training providers, number of courses/year, workers attending/year, training approach, trainees' assessment procedures, certification, etc.).

Data gathering was based among others on the National System for Vocational Education and Training and the existing training courses and certification schemes (either acknowledged by the State or supported by professional associations or chambers). The current situation was compiled taking into account desk research findings, evaluating existing initiatives and data from interviewing relevant organizations and national bodies.

Mapping of the building sector is focused on the identification of the current status in the building stock, its energy consumption, the level of RES penetration in buildings, various supporting programs/ schemes, etc., including current statistics on EE and RES in buildings (energy consumption, RES contribution), as well as quantified data on the current workforce in the sector, considering both "blue collar" and "white collar" professionals. The appropriate stakeholders will be also identified and recorded.

As regards the building sector, the necessary statistical data were drawn by published reports from various statistical organizations (e.g. the Hellenic Statistical Authority - EL.STAT., the Foundation for Economic & Industrial Research - IOBE, Eurostat, UNESCO's Institute for Statistics, Organization for Economic Cooperation and Development – OECD, etc.). The relevant stakeholders were inquired, mainly in the frame of the very successful Consultation Meetings of the NQP (already 2 of them have taken place online). In addition, assistance was requested from involved stakeholders (such as the General Directorate of the Ministry of Environment and Energy – YPEN, as well as the relevant bodies of the Technical Chamber of Greece - TCG, GSEE, GSEVEE, the Hellenic Federation of Enterprises – SEV, the associations of Technical Companies etc.), mainly for the collection, evaluation and processing of primary unpublished data (i.e. data not included in published reports).

2.2.2 Mapping of the current status regarding national policies and strategies

In the frame of this work an extensive mapping of current and planned policies and strategies in the energy field on the one hand, and in the field of green skills and jobs, on the other was carried out. This work was further divided into two separate subtasks, and more specifically the mapping of the current status regarding:

The energy national policies and strategies aiming at the achievement of the national energy and climate targets, yet focusing on those addressing especially the building sector of the country, including:

- The National policy and strategy to meet the 2030 targets and the envisaged contribution of the building sector, within the framework of the NECP;
- The national policy and strategy in the framework of the National Energy Efficiency Action Plan (NEEAP);
- The National Plan to increase the number of nearly zero-energy buildings (Article 9, Directive 2010/31/EU on the Energy Performance of Buildings);
- The National Long-Term Strategy (LTS) for 2050;
- The Long-Term Building Renovation Strategy to 2050;

- National/regional plans to implement the EPBD recast in order to deliver high energy performing renovations and new, nearly zero energy buildings;
- The National Recovery and Resilience Plan – Greece 2.0.
- The **workforce national policies and strategies** that address the treating of the workforce vocational education and training issues, paying emphasis on the national strategy regarding green skills and jobs.

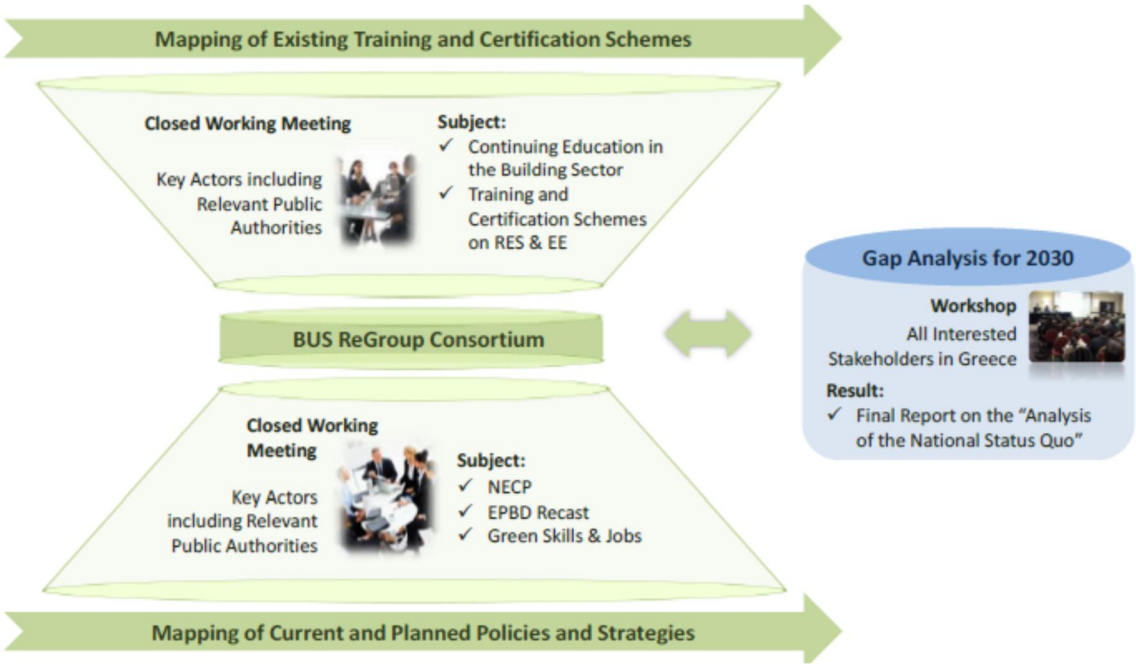


Figure 2.1: Engaging the stakeholders in the mapping of training and certification schemes and relevant national policies and strategies

The stakeholders consulted during data collection were mainly key representatives from the competent Ministries as well as the supervised bodies. More specifically, during the development of this report, the contribution of the General Secretariat for Vocational Education, Training, Lifelong Learning & Youth of the Ministry of Education & Religious Affairs was significant, as they provided updated data, regarding mostly the legislative-regulatory framework governing vocational training but also the most recent reforms concerning Vocational Education, Training & Lifelong Learning. Other supervised bodies such as the National Organization for the Certification of Qualifications and Vocational Guidance (EOPPEP), provided crucial information mainly on the Strategic Plan for Vocational Education, Training, Lifelong Learning and Youth 2022-2024, including important elements on the green and digital transition.

At last, it is worth mentioning that CRES (being the coordinator of the BUS-REGRoUP project), as the National Energy Agency in the fields of RES and EE, is the body that primarily possesses an in-depth knowledge of the relevant policies and strategies, especially in the field of energy, while it actively participates in their formulation at national level.

2.2.3 Needs analysis for 2030

The needs analysis process for the year 2030 aims at the identification of barriers and gaps between the current situation and the projected needs for the achievement of the 2030 targets, as they emerge from the cross-analysis of the results of previous actions (in the context of the same work package, i.e. WP3). Within the framework of this task, the consortium (mainly the involved working group of the partner NTUA, which is mainly responsible for this action) quantified the following **needs and gaps regarding the skills** of the construction sector workers:

- the new skills that will emerge, as well as the number of workers to be trained in each sub-sector/ specialty/profession and skill level (NQF level), based on the NACE and ISCO classifications;
- the needs in terms of structures for carrying out the training;
- the numbers of highly skilled “white collar” professionals in order to address the additional needs emerging in the building sector (a significant percentage of the “white-collar” professionals will be covered by women possessing the required expertise);
- the needs for the update of the existing academic courses programmes or post graduate courses of these “white collar” professionals, in order to provide the relevant expertise.

For the estimation of the so-called **labour force gap**, the methodology followed is described in detail in Chapter 7 of this report.

The stakeholders engaged in the procedure were representatives from the relevant national authorities, technical chambers, the social partners, technicians/worker’s associations, etc., according to the needs encountered. The basic tools used towards the efficient and quick compilation of the information received were the following:

- Implementation of unofficial work meetings (face-to-face or through the use of ICT means) with the key stakeholders, depending on the needs;
- Identification of each partner’s distinct role in the communication with the key stakeholders;
- Engagement of senior experts among partners in the discussions with the key stakeholders.

2.2.4 Compilation of the National Status Quo Analysis report

All the aforementioned processes (collection of information, analysis, processing of results) led to the development and synthesis of a draft of the Status Quo Analysis report. This version of the report (developed in Greek) was sent to the most competent of the stakeholders involved, mainly the national authorities and the main federations of employers/employees, and (other) members of the National Qualifications Platform (NQP), in order for them to provide the partnership with their valuable requested feedback.

In particular, representatives of the competent national authorities, the social partners, the employers' associations (enterprises active in the construction sector, suppliers of materials and/or equipment, etc.), the federations of technicians, representatives of VET providers, representatives of bodies operating certification of persons, etc. (i.e. representatives of all members of the NQP) were invited to review and comment the results as well as to provide the consortium with their views and new ideas. This procedure was deeply enhanced through the implementation of the first two Consultation Meetings of the NQP, which, as foreseen, treated the topic of the draft Status Quo Analysis (SQA) report.

These meetings were implemented online in order to guarantee the highest possible participation of NQP members (this was also a key recommendation of the NQP members, as it was clearly expressed in the NQP’s KoM Meeting), yet leading to a very fruitful and effective interaction and exchange of valuable comments among the participants and the provision of very useful feedback and data.

More specifically, during the 1st Consultation Meeting on the 9th of May 2023, the structure and main contents of the draft SQA were analytically presented to the NQP members, while their contribution to specific “missing” data as well as to specific topics of the SQA (e.g. identification of training needs, barriers, etc.) was also asked. The 2nd Consultation Meeting was held on the 18th of July 2023 and the main topic of discussion was the elaborated draft SQA, while the focus was made on the produced quantitative results of the needs analysis. All the relevant comments made by the participants were very useful and welcome, while the draft SQA was uploaded in the elaborated online Consultation Platform for further comments to be taken into account during the development of the present final Status Quo Analysis Report.

Based on the above, the initial draft of the report was thoroughly reviewed taking into account all comments and views provided by relevant stakeholders, and in month 9 of the project (July 2023) the final version of the analysis was completed (D3.2 - Final Report on the National Status Quo Analysis).

3. National policies and strategies to contribute to the EU 2030 energy and climate targets in buildings

3.1 National policies and strategies in the field of energy

3.1.1 National energy policy and strategy to meet the 2030 targets (with the envisaged contribution of the building sector)

National strategies and policies for achieving EU energy and climate targets are incorporated in the National Energy and Climate Plan (NECP), which constitutes for the Greek Government the central Strategic Plan on Climate and Energy issues, while it also includes a detailed roadmap for achieving specific energy and climate targets by the year 2030. It should be noted though at this point that the reference is made here to the NECP which was submitted to the EU in December 2019 (taking into consideration that the NECP is currently submitted to a revision process, as is the case in all EU Member States, in order to take into account the requirements of the EU plan for the green transition, i.e. the "Fit for 55" package), as well as those of the REPowerEU plan, which aims at making Europe independent of the fossil fuels inserted from Russia, well before the year 2030).

Based on the current (in power) NECP, specific policy measures in the energy and climate sectors are implemented, while in the frame of the NECP the Priorities and Policy Measures across a wide range of development and economic activities are presented and analysed. The NECP highlights Greece's priorities and growth potential on the energy issues and the tackling of climate change, while the Greek government intends to use the NECP as the key tool for ***developing its national Energy and Climate policy for the following decade***, taking into account the Commission's recommendations and the UN Sustainable Development Goals.

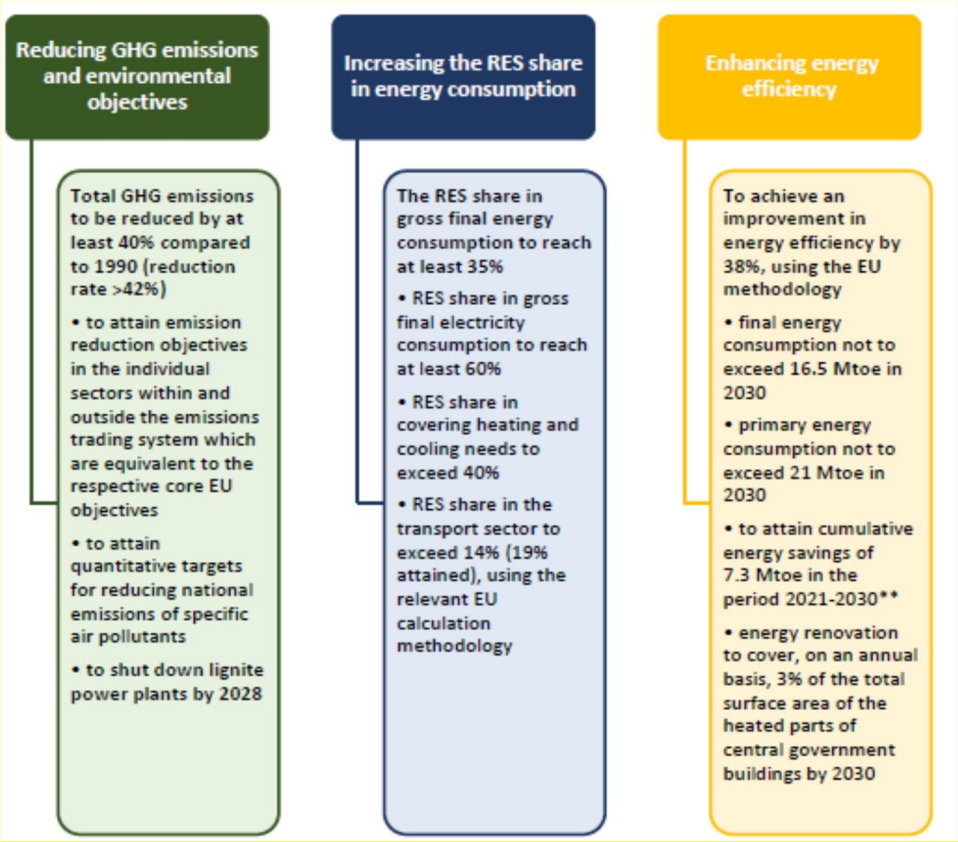
The definition of policy measures on ***climate change***, for ***reducing GHG emissions and gaseous pollutants*** in particular, as envisaged in the context of the National Emissions Ceilings (NEC) Directive (2016/2284/EU), in the period 2021-2030 aims to cover eight different policy priorities (PP1.1-PP1.10). The first policy priority "PP1.1 Attaining a climate neutral economy, through lignite phase-out, promoting RES in Greece's energy mix and interconnecting the autonomous island systems" focuses on making the economy independent of lignite, being a polluting fuel by 2028. The transition to a "lignite-free" era is feasible and can be supported thanks to Greece's strong RES potential, which will consist the fundamental national energy resource in the energy mix of the future, through the implementation of a set of measures addressing the penetration RES in electricity production, heating and transport.

In addition, given that natural gas, although being a fossil fuel, is characterized by lower greenhouse gas (GHG) emissions than conventional fuels, the substitution of oil and lignite use by natural gas is an intermediate policy step towards a path to reduce GHG emissions. A key priority is also the promotion of natural gas in specific final consumption sectors to replace the use of petroleum products. The schematic diagram below (Figure 3.1) shows the individual quantitative targets in the context of attaining the national energy and environmental objectives for 2030.

The objective for the ***RES share*** in gross final energy consumption by 2030 is set to at least 35% by 2030 (this target is more ambitious than the corresponding core EU objective of 32%). In particular, as regards the power generation sector, RES are expected to be the major domestic source of power as early as in the middle of the following decade, with a share exceeding 65% of the domestic power generation by 2030 and 60% of the gross final electricity consumption, by utilizing in the most cost-effective manner Greece's high potential especially for wind and photovoltaic plants.

Some basic tools in this direction are the full functioning of the new electricity market model, the simplification and speeding up of the licensing procedure, the digitization of the energy system and the enhancement and expansion of energy infrastructures to allow for maximum RES penetration in power

generation, focusing on storage systems. Another priority is the promotion of electromobility, which will now rely heavily on RES power generation, while at the same time ensuring considerable energy savings through improved energy efficiency. The NECP and the strategic plan for promoting electromobility, which is also an energy priority for the government, also fall in this context.



** Without taking into account the contribution of ambient heat*

*** The target has been calculated on the basis of the ex-post final energy consumption data for the period 2016-2017 and the temporary data for 2018*

Figure 3.1: National energy and environmental objectives for the period 2021-2030 in the context of EU policies, as described in the frame of the current NECP [Source: NECP, 2019]

According to the NECP, another objective with regard to promoting RES and increasing their share in final consumption is the gradual electrification and the highest and most efficient coupling of final consumption sectors, to allow for maximum RES share in final energy consumption. The electrification of different uses in final consumption is an essential component in achieving this aim. A typical example is heat pumps, which, together with the future greater use of energy storage systems and self-production schemes, will make a decisive contribution in this direction.

To sum up, the definition of policy measures for the promotion of RES in the period 2021-2030 aims to meet eleven different Policy Priorities (PP2.1-PP2.11), as shown in Figure 3.2, covering all sectors in which RES can be developed.

Specifically, targets are set for the share of RES in gross final energy consumption (35%), for the share of RES in final consumption for heating and cooling (42.5%), for the share of RES in gross electricity consumption (61%) and the corresponding share in transport (19%). In addition, a 'specific' objective is set for the promotion of RES systems in buildings and distributed generation systems, through self-production schemes and energy netting. In particular, the total operation of such RES power generation systems with an installed capacity of 1 GW is foreseen by 2030, capable of covering the average electricity consumption of at least 330,000 Greek households.

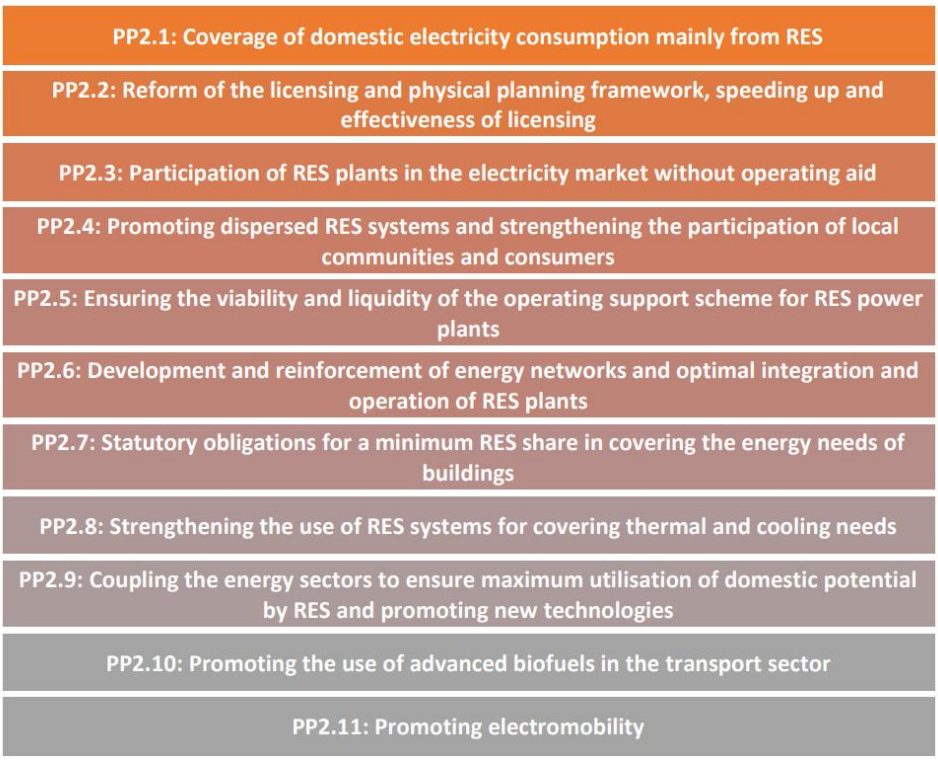


Figure 3.2: Policy priorities for policy measures to reduce greenhouse gas emissions in the period 2021-2030 [Source: NECP, 2019]

In the field of electricity generation from RES, the dominant applications for the next period that will contribute to the achievement of the targets are wind and photovoltaic farms, which are considered the most mature and competitive ones with market rules and economy in terms of their impact on aid issues. According to the NECP, almost 7 GW of wind power plants are planned to be installed, together with 7.7 GW of PV, 0.1 GW of concentrated solar power plants, 0.1 GW of geothermal energy plants, 0.3 GW of bioenergy plants (biomass and biogas), 3.9 GW of small hydropower plants and an additional production capacity of large hydropower plants and pumped storage facilities, to achieve 54% of electricity generation by 2030.

However, the development of the appropriate institutional framework for storage units and their participation in the electricity market as well as the development and operation of new categories of RES projects with technological innovation and/or local added value (e.g. installation and operation of small wind turbines in buildings) for power generation consist of a critical challenge for the following period. Finally, offshore wind farms are expected to pose a new challenge for the regulatory framework, as the timely and integrated development of such a framework is a necessary prerequisite for launching these projects in the following decade.

Regarding the use of RES for heating and cooling, the incomplete regulatory framework and the absence of an implementation monitoring mechanism are the main problems relating to the promotion of RES in nearly zero-energy buildings, while the need for the stakeholders to obtain education/training and to adapt to the technical requirements is also critical. An important parameter is that the use of RES systems for heating and cooling (mainly heat pumps and solar thermal systems) will be strengthened by combining different policy measures.

Finally, regarding RES in the transport sector, the projected penetration of bioenergy (final energy consumption) of 371 ktoe by 2030 should be achieved through a combination of actions such as the revision of the regulatory framework for the operation of the electromobility market and the development of the required infrastructure. Emphasis will also be placed on the domestic production of the required quantities of biodiesel, but also on the reinforcement of the fleet of public transport of all kinds, as well

as special public vehicles for specialized uses (municipal transport, municipal school buses, etc.). An additional challenge is to increase the use of electric micro-mobility vehicles, whether private or municipal available for rental, by utilising appropriate infrastructures and mechanisms for the use of such vehicles. Similar challenges are there with regard to vehicles used by businesses for supply and loading/unloading purposes.

Moving on to the very crucial and timeless issue of ***improving energy efficiency***, it is a fact that it is a key horizontal priority but also hierarchically the first axis on which all other policies are designed. The new target on final energy consumption is particularly ambitious compared to the European core target of 32.5% (corresponding to approximately 16.1-16.5 Mtoe). The definition of policy measures for energy efficiency improvement in the period 2021-2030 aims to cover twelve different policy priorities (PP3.1-PP3.12), which are presented in Figure 3.3.

Figure 3.3: Policy priorities to promote energy efficiency over the period 2021-2030 [Source: NCEP, 2019]

The objective in the frame of Article 7 of Directive 2012/27/EU will be achieved by combining the energy efficiency obligation scheme with the implementation of alternative policy measures. The scheme of the energy efficiency obligation scheme will continue to be implemented by energy providers, while its operation through a new regulatory framework will adjust the energy saving target undertaken by the obligated parties taking into account the achievable techno-economic potential of energy savings in the field of activity. In addition, the implementation of this scheme will be extended to the operators of both electricity and natural gas distribution networks, setting a specific target for improving energy efficiency and ensuring at the same time that the conditions of competition with the energy providers of the respective energy products will not be distorted.

Making a special reference to buildings, the **"Long-term Renovation Strategy for Building Stock"** foresees a specific set of policy measures for the improvement of the energy performance of both public and private buildings. This strategy was completed in March 2020, in accordance with the requirements of Directive 2018/844/EU. The purpose of this strategy is the techno-economic analysis and the

emergence of efficiently optimal measures to meet the high renovation rate of the building stock as this has been set.

The financing programmes for the renovation of buildings in both the residential and tertiary sectors under the new programming period will be implemented by adapting and improving the existing financing model, aiming at increasing existing leverage levels by beneficiaries. In the case of public buildings, the redesign of the financing model for energy upgrade actions has been completed, while in the case of other buildings in the tertiary sector, emphasis will be placed on the adoption of new-smart technologies and focus will be given both on the achievement of an optimal cost-effectiveness and on the protection of equal access for interested parties. At the same time, alternative financing mechanisms will be adopted, such as Energy Performance Contracting (EPC).

The new minimum energy performance requirements for buildings will be incorporated into the revised Energy Performance of Buildings Regulation, while emphasis will be placed on increasing nearly zero-energy buildings, in line with the requirements of Directive 2010/31/EU. The adoption of new regulatory measures (in the context of the revision of Directive 2010/31/EU with Directive 2018/844/EU) will aim both at creating the appropriate framework and at creating incentives to maximize the number of buildings that will exceed the minimum energy performance requirements.

Indicatively, the following regulatory provisions will be promoted:

- ✓ After 31st of December 2023, all buildings housing public authorities should be classified in energy class B and above, according to the Energy Performance Certificate (EPC).
- ✓ Every new lease or purchase of a building or building unit by central government bodies, from 01/01/2021 should be almost zero energy consumption (energy class A and above).
- ✓ For each building or building unit offered for sale or lease from 01/01/2021, the energy performance index of the energy performance certificate will be stated in all commercial advertisements.

Research and innovation activities to improve the energy performance of buildings are also foreseen in the NECP, and these focus basically on new materials and innovative applications of heating and cooling systems, with the main objective being to improve their reliability and automated operation, with special emphasis on heat pumps (HPs). Green public procurement will also play a very important role in the planned policies, measures and programmes to achieve the national energy efficiency target for 2030, through the inclusion of criteria for the promotion of energy-efficient technologies and services, while highlighting the exemplary role of the public sector.

A particular contribution as a policy for the promotion of energy services in the public sector will be made by “ELECTRA” program, the main purpose of which is to create attractive and sustainable energy upgrade investments in the building stock of public bodies (General Government bodies), by effectively leveraging funds from both the private and public sector. Through the adaptation of the regulatory framework, the mobilization of private capital in a sector with great potential is facilitated, which will contribute significantly to the ambitious goals of the National Plan for the energy upgrade of buildings.

Finally, it is worth mentioning the National **Long Term Strategy for 2050 (LTS)**, since it was developed as a complement to the NECP. This strategy, which was submitted in the beginning of 2020 by the Greek Government to the European Commission, sets the year 2030 as its reference point and assumes the achievement of the relevant objectives of the NECP. The LTS constitutes for the Greek Government a roadmap on Climate and Energy issues, in the context of the country's participation in the collective European goal of successful and sustainable transition to a climate-neutral economy by the year 2050. Its aim is to present the available technological solutions with the possibility of being implemented at national level, avoiding the unit selection of some of them, so that at the level of energy policy there is the possibility and flexibility to adapt the measures according to technological progress and the structure of final energy consumption in sectors of economic activity following the year 2030.

3.1.2 Relevant national buildings codes and regulations and RES obligations in buildings

Table 3.1 below lists the measures that led to building renovations with the corresponding resulting energy benefit, according to the Annual Report on the Achievement of National Energy Efficiency Targets dated 01.06.2020 (reference year 2018):

Table 3.1: Building renovation and energy saving policy measures
[Source: Annual Report on the Achievement of National Energy Efficiency Targets, 2018]

No	Policy measures to save energy from building renovation	Achieved final energy savings (ktoe) for the years 2014-2018
1	**Program "Energy Saving at Home"**	**37**
2	**Program «Saving» for Local Government Organizations**	**6.75**
3	**Program «Saving II» for Local Government Organizations**	**0.69**
4	**Energy upgrading of residential buildings**	**9.71**
5	**Issuance of EPC as a supporting measure**	**25.27**
6	**Offsetting of arbitrary fines with energy works**	**9.88**
7	**Energy managers in public and wider public sector buildings**	**4.81**

More specifically, the **"*Energy Saving at Home*"** Program was launched in 2011, aiming at promoting interventions to improve energy efficiency in the building envelope and heating systems of residential buildings. Especially for the building construction industry, which was in a prolonged period of recession due to the economic crisis, this program was a real boost for employment, as well as for the development of markets for building and other materials that contribute to energy saving, with an increased added value, as many of them are produced in Greece.

Furthermore, some of the several **legislative interventions** as well as **national specifications and regulations** that have been established for buildings in the last decade, with the aim of improving their energy performance, are:

- "***Approval of the Energy Performance of Buildings Regulation (KENAK)***" (Joint Ministerial Decision D6/B/οικ.5825/9.4.2010): The "Energy Performance of Buildings Regulation" (KENAK - EPBR) has been instituted in 2010 and was revised in 2017 with the aim of reducing conventional energy consumption for heating, cooling, air conditioning, lighting and domestic hot water production (DHW), while ensuring comfort conditions in the interior spaces of buildings.
- Article 24 of Law 4172/2013 (A' 167) (as amended by Government Gazette B' 5597/2018) provides for ***an increase in depreciation rates*** of the energy efficiency related in buildings cost items assets of the assets of enterprises.
- ***Increase of building density coefficient for buildings with high energy efficiency***: Law 4067/2012 (A' 79) "New Building Regulation" in article 25 provides incentives for the creation of buildings with minimum energy consumption. More specifically, if the building is classified, according to the Energy Performance Study (EPS), in the highest energy efficiency category of the Energy Performance of Buildings Regulation (EPBR), the floor area ratio is increased by 5%. In residential buildings with primary energy consumption of less than 16% of the EPBR "Reference Building", according to the EPS, the floor area ratio is increased by 10%. The same percentage increase of the floor area ratio applies to the remaining uses of buildings with primary energy consumption less than 16% of the Reference Building, which simultaneously presents excellent energy performance (i.e. performance equivalent to or better than LEED Gold, BREEAM Very Good or DGNB Silver).

- ***Offsetting of arbitrary fines with energy upgrade works***: This measure results from the implementation of the Article 20 of Law 4178/2013 (A' 174), which offers the possibility of offsetting the amounts paid for service fees, works and materials spent and/or used for the energy upgrade of buildings with the amounts of the special fine provided for and up to 50% of the provided special fine. The netting shall be carried out if the interventions result in an upgrade of the building by at least one energy class, or annual primary energy savings of more than 30% of the reference building consumption
- ***Energy manager in public sector buildings***: By the joint decision no. D6/B/14826/17.06.2008 (B'1122) of the Ministers of Internal Affairs, Economy and Finance and Development provides that for buildings used by the public and the wider public sector at least one energy manager is (or, should be) appointed
- ***Plan for the Increase of Nearly Zero Energy Buildings (NZEBs):*** The Ministerial Decision 85251/242/5.12.2018 (B' 5447) of the Minister of Environment and Energy approves the National Plan to increase the number of NZEBs.

The "**National Climate Law - Transition to climate neutrality and adaptation to climate change, urgent provisions to address the energy crisis and protect the environment**" (Law 4936/2022, GG A 105 - 27.05.2022), includes Article 14 (Measures to reduce emissions from buildings), according to which, starting from 2023, the installation of heating oil burners is prohibited where there is a sufficiently available natural gas network. In fact, with the decision of paragraph 7 of Article 28, which shall be reviewed at least once a year, the areas in which a sufficiently available natural gas system is available are specified. Furthermore, the installation of heating oil burners is prohibited since the beginning of 2025, while the use of heating oil burners is also prohibited from January 1st of 2030. In the context of the same article and with regard to building permits submitted from 1.1.2023, the special buildings of par. 21 of Article 2 of Law 4067/2012 (A' 79), with the exception of tourist accommodation and churches, having a coverage of more than 500 m^2, are obliged to install photovoltaic or solar thermal power generation systems at a percentage corresponding to at least 30% of the coverage.

One of the key priorities of the NECP is the energy upgrade of 12-15% of buildings and/or building units in the decade 2021-2030 through targeted policy measures. In this long-term time horizon and on the basis of the long-term strategy for the renovation of the public and private building stock, the development of a specific mechanism is foreseen to monitor, measure and evaluate the extent to which the objective has been achieved as well as the expected economic and social benefits for all policy actions in the field of energy efficiency.

In order to achieve the goal of renovating the building stock, both the maintenance of the measures that have been successfully implemented in the past, as well as the implementation of new ones deemed necessary, will be applied. The most important **regulatory and financial measures** in this direction are described below.

- ***EPBR revision:*** the new minimum requirements are incorporated with the aim of increasing the number of Nearly Zero Energy Buildings (nZEBs). At the same time, a reform of EPBR (KENAK) is being considered, passing from the reference building method to the method of actual operation of the building, as it is actually necessary to know the energy behaviour of a building, in order to approximate with the best possible accuracy the optimal mix of interventions during renovation.
- ***Upgrading the role of the Energy Manager of Public Buildings:*** the electronic platform for monitoring the energy performance of buildings is clearly a useful tool, which will become even more functional with a building energy management system, according to ISO 50001 (see below). The ultimate goal is the energy interconnection of all public sector buildings per use and per body/authority and the overall real-time monitoring capability.
- ***Implementation of energy management systems according to ISO 50001 in public buildings:*** the implementation of an EMS is examined and it is suggested that this is launched with the General Government buildings and then proceed to all public buildings. This measure will contribute to the energy monitoring of public buildings, but also to the planning of their renovation.

- ***Energy Poverty:*** in order to tackle energy poverty, the specification of energy upgrading measures to improve the building stock in energy-vulnerable households is included in the Energy Poverty Plan, which has already been elaborated.

For the time horizon of 2030, the successful funding programmes for the improvement of the energy performance of residential buildings will continue, while their operating framework will be appropriately modified by streamlining incentives to maximise energy benefits, while supporting financially vulnerable and energy-vulnerable households. More specifically, the **funding programs** that will be implemented with the necessary modifications are:

- ***"Energy Saving at Home" / "Energy Saving - Autonomy" program:*** the funding programs to improve the energy efficiency of residential buildings will continue, with the addition of a "smart" component to enhance the energy autonomy of homes such as RES systems, batteries, electric vehicle chargers and smart lighting.
- ***Program "Electra"***: this program, which concerns the financing of energy efficiency interventions in buildings of General Government and Legal Entities of Public Law (NPDD) with the participation in the implementation of interventions of Energy Service Companies (ESCOs) through Energy Performance Contracts (EPCs), enhances the energy upgrade of public buildings by financing part of the investments through investment loans, which will be repaid by the program.
- ***Competitive procedures for energy saving:*** this new measure of competitive procedures, during its pilot implementation, is expected to focus on final energy savings, contributing significantly to the achievement of the objective of Article 7 of the EED. The measure will provide financial support to technical interventions for energy saving in sectors with high potential, such as the industrial and tertiary sectors. The measure will apply to all sizes of enterprises and it is mandatory to carry out an energy audit on the results of which the design of energy saving interventions will be based.
- ***National Energy Efficiency Fund (ETEAP):*** this is expected to form the basis for the development of new financial instruments, aiming to finance programmes and other measures to improve energy efficiency and develop the energy services market.
- ***Innovative financial tools of mixed financing:*** innovative mixed/hybrid finance schemes will be designed in cooperation with the domestic financial sector, combining public and private funding on favourable terms, to support energy efficiency improvements in specific sectors with high potential, such as the tertiary, the residential and industry

Table 3.2: Financial measures for the renovation of the building stock and fields of application [Source: Annual report on the achievement of national energy efficiency targets 2018]

A/A	Financial measures for building renovation	Residential	Tertiary private	Tertiary public
1	"Energy Saving at Home" Program	✓		
2	Program "Electra"			✓
3	Competitive procedures for energy savings		✓	
4	Energy efficiency obligation schemes	✓	✓	✓
5	National Energy Efficiency Fund	✓	✓	✓
6	Innovative financial tools of mixed financing	✓	✓	✓

3.1.3 Reports on buildings within the "National Recovery and Resilience Plan – Greece 2.0"

The National Recovery and Resilience Plan includes a comprehensive and coherent set of reforms and investments structured in four (4) Packages of proposals that make up eighteen (18) individual Axes. Thus, in "Axis 1.2 - Energy upgrade of the country's building stock and spatial reform" of the "Green Transition" Package, a series of investments and reforms are described and analysed, including an

extensive program of energy upgrading of houses, tertiary sector buildings and public buildings and infrastructure.

Axis 1.2 includes reforms and investments that promote both the renovation and energy upgrading of buildings, the implementation of urban planning and the realization of strategic "green" regeneration. More specifically, by targeting buildings, the Axis includes investments aimed at renovating the existing building stock, including residential, commercial, industrial and public buildings, as well as social infrastructure, while promoting the new plan to tackle energy poverty. In particular, the "Exoikonomo" program, which is included in the Axis, will contribute to the achievement of up to 15% of the relevant target for the energy upgrade of houses (NECP). This Axis also includes the Action entitled "Energy saving in the public sector", with a total budget of € 200,000,000, which concerns the renovation and energy upgrade of infrastructure and buildings of the public and local government and the energy upgrade of street lighting, with the partnership of the private sector. The Axis will contribute directly and indirectly to the development of the national economy and the creation of new employment opportunities in many sectors. By providing incentives for energy upgrade, the Axis favours the attraction of sustainable private capital inflows, the creation of new jobs and the sustainable development of multiple sectors, while promoting the resilience of the Greek economy.

3.2 National policies and strategies in the field of continuing education & training

3.2.1 National policy and strategic approach regarding green skills and jobs

In Greece, the discussion on "green development," "green employment", and "green jobs/professions" began around 2009 during the period of economic recession. “Green development” has been prioritized as a new strategy to navigate the country out of the socio-economic crisis, aiming to reconstruct the country's productive base, to achieve balanced regional development, to create new job opportunities, and in the same time, to invest in education, knowledge, innovation, and new technologies. Vocational education and training shall play a crucial role in this transition, providing the necessary knowledge, skills, and competencies, i.e., comprehensive qualifications, whether through upskilling or reskilling, in order to meet the demands of the changing job landscape.

In the field of continuous vocational education and training (CVET), the "Strategic Plan for Vocational Education, Training, Lifelong Learning, and Youth 2022-2024" was formulated in January 2022 by the Central Council for Vocational Education and Training, the General Secretariat for CVET & Life Long Learning (LLL), and the Directorate of Planning & Development for CVET & LLL, within the framework of the Strategic Planning in the Education Sector. Furthermore, in addition to **Law 3879/2010**, which is partially still in effect, the policy priorities are mainly determined by the **Law 4763/2020** (GG 254A), aiming for the comprehensive restructuring and upgrading of this critical sector of education. This law initiates a holistic reform of VET and LLL in three (3) key areas:

1. Common planning of vocational education and training (VET) and lifelong learning (LLL);
2. Alignment of VET and LLL with the real needs of the labour market;
3. Upgrading of the existing VET.

More specifically, **Law 4763/2020** includes substantial and organizational regulations that cover the entire spectrum of VET and LLL for adults, addressing long-standing dysfunctions, such as overlaps between structures and educational pathways, lack of post-secondary educational structures, existence of outdated specialties and training curricula, the insufficient connection with the real needs of the labour market (including the absence of involvement of social partners in the designing of the VET), the lack of reliability in the certification of professional qualifications, as well as inefficiencies in the organization of continuous vocational training provided by Lifelong Learning Centres (KDVM / LLCs).

According to Article 79 of Law 4763/2020, the mission of the formed General Secretariat for Vocational Education, Training, Lifelong Learning, and Youth includes "*the design, coordination, supervision, and evaluation of policies, actions, and programs in the fields of vocational education, training, lifelong*

learning, and youth, without discrimination or exclusion, having as a main purpose to strengthen the country's human resources with modern qualifications tailored to the real needs of the labour market, to increase the employment in quality new job positions, to improve the organization and competitiveness of the Greek economy, to enhance personal development and to upgrade citizens' skills, as well as to ensure the rights and equal opportunities for all young people, including young people with disabilities and chronic illnesses, for their smooth integration into the educational, social, and economic life of the country." Additionally, in Chapter VII of the above-mentioned law are defined the services within the framework of non-formal learning provided to adults, having special arrangements concerning licensing, registry, operation, trainers, programs, validation of learning outcomes, and supervision.

Additionally to the significance attributed by this law to the connection between VET and the labour market, the reform highlights the need for regulations and investment in the pillar of Adult Learning (Education and Training) and the holistic approach of the formal VET and the non-formal learning. Now, the options for Adult Non-Formal Learning include the following:

1) continuous professional training;
2) reskilling;
3) upskilling;
4) general adult education, and
5) counselling and professional orientation.

Particular emphasis is placed on the development of mechanisms for quantitative and qualitative forecasting of skills in order to understand the impact of changes within sectors and occupations. The information gathered through such mechanisms is utilized for the readjustment of Curriculum/Training Guides/Training Programs and for the support of individuals in the processes of identifying, evaluating, and adopting learning and career choices. Furthermore, the VET, apart from its traditional role in initial training, now has an increased role in upskilling and reskilling the adult population (employed, unemployed, immigrants, refugees, and special population groups) in order to enable them to remain professionally active or to re-enter the labour market thoroughly prepared.

The objectives of the reformation described in **Law 4763/2020** are:

- establishing the National System of Vocational Education and Training (VET), which is developed at levels 3, 4 and 5 of the NQF, corresponding to those of the EQF;
- total reformation of VET programs of educational institutions, focusing on their more effective alignment with the labour market;
- direct linking of the VET and Lifelong Learning to the labour market, with substantial involvement of social partners in their design;
- strengthening the autonomy of individual VET units, with the active participation of representatives of the local government and the community;
- promoting excellence, research, and innovation in teaching within vocational education and training;
- promoting the permeability of students/learners/ trainees of the VET to other levels of education;
- upgrading and expanding the institution of internships and apprenticeships.

The strategic axes / actions of the *"Strategic Plan for Vocational Education, Training, Lifelong Learning, and Youth"*, will be funded both by national and European resources, including funds from the Recovery and Resilience Facility (RRF). Currently, there are various means for implementing the actions identified in the Strategic Plan, such as the Public Investment Program (PIP), which is divided into two sub-programs, the national PIP and the co-funded PIP, as well as the National Development Program established by Law 4635/2019 (GG A167) with the aim of adopting a comprehensive system for the design, management, monitoring, and auditing of interventions funded by national resources of the PIP. Actually, two of the five pillars that correspond to the equal number of the development goals of the NDP 2021-2025 are "smart development" and "green development".

One of the Policy Objectives of the Partnership Agreement for Regional Development (ESPA) 2021-2027 (PO4 - *A more social Europe through the implementation of the European Pillar of Social Rights*) aims to upgrade the quality and enhance the external orientation and relevance of Education at all levels and LLL with the labour market. In this context, emphasis is placed on improving the performance of students, particularly in modern knowledge and skills, harnessing new technologies, enhancing career guidance and counselling services, improving the curricula quality, and strengthening the effectiveness of VET. Improving performance and enhancing equal access are also at the forefront with a focus on vulnerable groups. The creation and upgrading of infrastructure and equipment, ensuring service quality through improved governance at all levels, and strengthening autonomy are also prioritized. The resources of the ESPA-PO4 are allocated to the 13 Regional Programs, in order to cover the infrastructure needs for education and LLL, and to the Sectoral Programs, mainly the new Program "Human Resource Development, Education and Lifelong Learning 2021-2027," for funding actions related to the improvement and development of education systems, training, and Lifelong Learning.

As previously mentioned, the National Recovery and Resilience Plan "Greece 2.0" is fully aligned with the EU's targets for a faster transition of the Greek economy towards a green and digital model. One of the four pillars is the (3) Employment, Skills, and Social Cohesion (health, education, social protection). Specifically, Axis 3.2 "Strengthening Education and Lifelong Learning and Modernizing Vocational Education and Training" of the NRRP includes reforms at all levels of education and the integration of new skills in vocational education and training, with the main goal of connecting the country's workforce with the modern needs of the labour market and the digital world. It also includes the introduction of new educational methodologies and the digitization of the educational process at all levels of education, as well as investments that enhance the autonomy and relevance/exposure of Higher Education to the local and international community and economy.

Notably, within this Axis, the Action "*Upgrading Vocational Education and Training*" has been incorporated by the Ministry of Education, aiming to accelerate the implementation of Law 4763/2020. The Sub-action 3 ("*Transformation of VET - Digitization of EOPPEP - VET Platform*") aims to digitize EOPPEP with the development of information systems (e-examination system, management system for certified educational providers, registry management system, etc.), to digitize the certification process for graduates of Professional Education at levels 3 and 5 of the NQF, and to develop an "examination questions pool" for this purpose. Additionally, an e-learning VET platform will be developed and existing educational materials will be transformed into digital training programs to enhance digital learning for students throughout Greece and upgrade the "train-the-trainers" program for educators and trainers.

Finally, Sub-action 4 ("*Development and certification of new professional profiles in the fields of energy, environment, and digital economy*") is of great importance, its goal being to develop and certify 200 professional profiles in all priority areas of the pillars of economic development, with a focus on the fields of energy, environment, and digital economy. The new professional profiles will be designed to ensure and promote the participation of women.

3.2.2 National and regional level implementation of the EQF and other EU education and training policies in the building sector

All relevant policies in the field of Lifelong Learning (LLL) are included in Law 4763/2020 (GG 254A), in reference to the National System of Vocational Education, Training and LLL, with substantial and organizational provisions covering the entire spectrum of Adult Vocational Education, Training, and Learning (Education and Training), as presented in the previous sub-chapter. Also, since May 8, 2006, with GG 566/Issue B', the certification of occupational profiles has been institutionalized.

The most significant step, however, is the establishment of a coherent national framework for the assessment and certification of all forms of training and general education for adults through the National Organization for the Certification of Qualifications (EOPPEP). EOPPEP is responsible for establishing a system of recognition and certification of qualifications, skills, and competencies in a way that ensures quality and mutual trust among social partners. It also serves as the efficient body of administration for

the National LLL Network. EOPPEP develops and implements a comprehensive national system for certifying non-formal education (initial and continuing vocational training and general adult education) and provides scientific support to the Vocational Guidance and Counselling services in the country.

Also, Law 4763/2020 establishes the **National Qualifications Framework (NQF)**, which has as a reference point the "*Recommendation of the European Parliament and the Council of 22 May 2017 on the establishment of the European Qualifications Framework (EQF) for LLL*" (2017/C189/03). The NQF provides the basis for the classification - in its levels - of all degrees awarded by the Greek education system and aligning them with the levels of the EQF. The goal of the NQF was to create a coherent and understandable classification system for qualifications, i.e. academic degrees at all levels of education in the country. In a subsequent stage, a system was developed to classify qualifications acquired through non-formal education and informal learning.

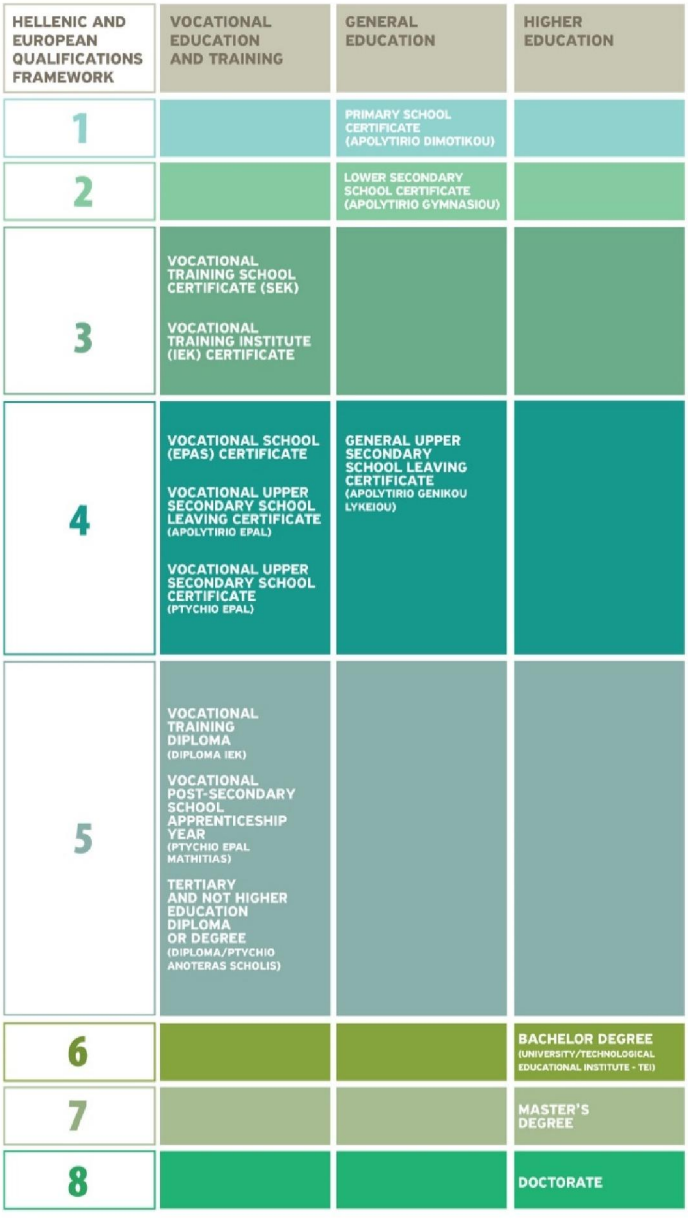


Figure 3.4: The 8 levels of the National Qualification Framework (NQF)
[Source: https://nqf.gov.gr/en/index.php/ta-8-epipeda]

The structure of the NQF, as shown in Figure 3.4, is characterized by the following features:

- ✓ **Levels**: the architecture of NQF is straightforward and includes levels covering the entire spectrum of qualifications, from compulsory education to higher education;
- ✓ **Learning Outcomes**: in the NQF, qualifications are expressed as learning outcomes categorized into knowledge / skills / competencies achieved by individuals upon completing a learning process;
- ✓ **Descriptor Indicators**: descriptors define the learning outcomes corresponding to qualifications at a specific level, and are formed by qualitative and quantitative distinctions in knowledge, skills, and competencies;
- ✓ **Types of Qualifications**: in addition to levels, the NQF adopts various Types of Qualifications. These types represent groups of titles with common characteristics. The use of qualification types facilitates the categorization of titles placed at the same level.

3.3 National policy and strategic approach on the digitalization of construction, smart buildings, circular construction and green public procurement

The European Strategy for Energy and the Environment promotes the European energy integration, i.e. the abolition of energy borders between the various national energy markets and the strengthening of the EU's energy security and independence. Another aspect approached by the overall Strategy in relation to the five dimensions of the Energy Union is **mobility**. Cities are at the heart of the transition to sustainable mobility. Through sustainable urban planning and addressing mobility and infrastructure demands, the cities have a key role to play. Urban areas need to move towards digitalization, automation and other innovative solutions, and they should adopt active and shared modes of transport, from more walking, use of bicycles and micromobility vehicles, and use of public transport, to car-sharing services and carpooling («sharing economy»). This is depicted in the **"Sustainable Urban Mobility Plans"** of the various cities / metropolitan areas that have been developed the last years.

In this context, and among all policies and measures outlined in the Greek NECP to achieve the national contribution to the binding EU-level target for 2030, the **digitalisation of the energy sector**, the pilot actions **promoting smart cities**, for the proper functioning of energy markets, as well as the promotion of **electromobility** consist of important measures and strategic policy priorities for Greece (also in the dimension of R&I). Moreover, one of the ten Policy Priorities (PP1.1-PP1.10) of the Greek NECP in the context of which the policy measures for climate change and in particular those for the reduction of GHG emissions and air pollutants foreseen under Directive NEC 2016/2284 in the period 2021-2030, is Policy Priority PP1.7: *Strategic Plans for the Circular Economy*.

The **Circular Economy** is a key element of the country's Development Strategy and its implementation includes, among others, a four-year strategic plan that permeates the entire spectrum of the value chain. Circular economy and bioeconomy are expected to be a catalyst for the productive reconstruction of the country, with a clear regional dimension. The transition to a circular economy is based on three pillars:

- ➢ Creating circular resource flows through reuse and recycling.
- ➢ Extending the use and recycling phases of materials through repair, renovation and remanufacturing.
- ➢ Reducing the use of natural resources and maximizing the efficiency of production processes.

The "National Strategy for the Circular Economy", which was approved on 17/4/2018, aims precisely at accelerating circular economy actions and unlocking growth potential, including a series of actions for the development of financial tools, the design and adoption of a regulatory framework and regulations in combination with the removal of bureaucratic obstacles, linking small and medium-sized entrepreneurship and the social economy with technological innovation, providing know-how and improving governance and networking, as well as accelerating applications. This strategic plan enhances circular consumption and entrepreneurship by providing incentives for initiatives such as eco-design and repair–renovation of structures using products that have a long life cycle.

The circular economy has a crucial role also in the construction sector. More specifically, the principles of circular economy in this sector are translated into the **"circular construction"**, as a strategy for the

construction sector in which energy consumption and recycling opportunities are crucial in the choice of materials and methods, while at the same time construction and demolition waste is used in conformity to the principles of circular economy. Reuse is incorporated as an element already before the materials are used for the first time. The objective of the strategy is to detach the desire for growth from the use of natural resources, thus reducing the overall climate and environmental impacts of society.

The transition to a circular economy is highly complex due to the crucial importance of the construction sector to the environment, economy, and social aspects of society. The world of construction, being a sector that has the first say in the production and consumption of a huge volume of building materials, has begun to raise environmental awareness and promote strategies that promote the circular economy. Circular construction entails major changes in the sector. All players in the value chain must be involved, and research, new thinking, and innovation are needed if the transition is really to make itself felt.

Green Public Procurement (GPP): Public authorities and entities, by using their purchasing power to choose environmentally friendly goods, services and works, they contribute locally, regionally and nationally to the achievement of national and international sustainability and environmental policy objectives, which relate to the rational use of resources through sustainable consumption and production of goods and the mitigation of climate change. Therefore, GPPs promote innovation by providing real incentives for the development of green products and services. In addition, when the life cycle cost of a good, service or work is taken into account, GPPs contribute to cost savings for the public sector.

Regarding GPPs at the regional and local level, notable actions are carried out by local authorities in cooperation with other bodies and within the framework of co-funded programs in the field of sustainable and green development (Interreg MED, LIFE, Covenant of Mayors, Green Fund, etc.). Applications of GPPs have preceded and are implemented in specific sectors (street lighting, energy savings) through various actions in local authorities, such as the collaboration of CRES with the Deposit and Loan Fund and the Jessica Program. At national level, thanks to a wide range of reforms, significant progress has been made towards a more transparent, cost-effective and business-friendly public procurement system. Law 4412/2016 and the mandatory implementation of the National System of Electronic Public Procurement for the supply of goods, the provision of services and public works led to a modernization and simplification of procedures. The implementation of centralized purchasing through the National Central Purchasing Authorities started in 2017 and is evolving systematically. The National Strategy for Public Procurement (2016) has set the roadmap and explicitly refers to actions for GPP.

Moreover, in February 2021, the “National Action Plan for the promotion of GPPs” for the years 2021 to 2023 was approved with the no. 14900/4-2-2021 Joint Decision of the Ministers of Development & Investment and Environment & Energy, with its general objectives being:

1) The establishment and implementation of an elementary level of adoption of green criteria in public procurement of products, services and works;
2) The gradual increase in the supply of green products and the provision of green services in certain sectors of goods, services and works;
3) The wider integration of products life cycle costing into public procurement;
4) The dissemination of environmental and economic benefits of GPP;
5) The active participation of those involved, such as contracting authorities and economic operators, in the GPP process;
6) Monitoring the achievement and updating the objectives of the Action Plan.

4. Key data on building and energy sectors

4.1 Introduction

The construction sector has always been one of the key sectors and drivers of growth of the Greek economy. Besides the potential of the construction industry in shaping the economy, its contribution to the general development of the country is equally important and has to do with its contribution to the implementation of investment projects in sectors such as tourism, industry, urban development and regeneration, etc. The projects designed and implemented contribute decisively to the enhancement of the productivity of the economy, the sustainable development and citizens' quality of life. The sector has experienced a rapid growth from the early 1990s until 2007, and - as a result - it led to the creation of modern technical companies, design offices/firms, specialized technical staff, know-how, and technical equipment. Undoubtedly, the recession in the construction sector, which began to be observed from 2007 onwards, cannot go unnoticed, while unfortunately it risks of taking on permanent characteristics.

Currently, the construction sector faces a variety of obstacles and distortions stemming from the economic and regulatory environment affecting construction activities. Over the past few years, the insufficient demand has been the main obstacle to the sector's growth. In addition, financing difficulties have a significant impact on construction activity in Greece. In general, Greece has a lower quality index in the infrastructure sector compared to other countries, lagging behind mainly in terms of planning, financing capacity and procurement procedures. Furthermore, important issues concerning public infrastructure projects, such as stagnation and declining number of public works, incomplete control and supervision mechanisms in public works (cost, technical excellence), the focus of tendered projects on construction costs rather than quality, as well as maintenance and management costs, late payments and lack of liquidity of businesses, are still noticed.

The cumulative decrease in the added value of the construction sector between 2008-2019 reached a percentage of 87.7%, while the corresponding percentage for the employment reached 61.8%, largely exceeding the decrease recorded in total and the other sectors of the Greek economy (see Figure 4.1).

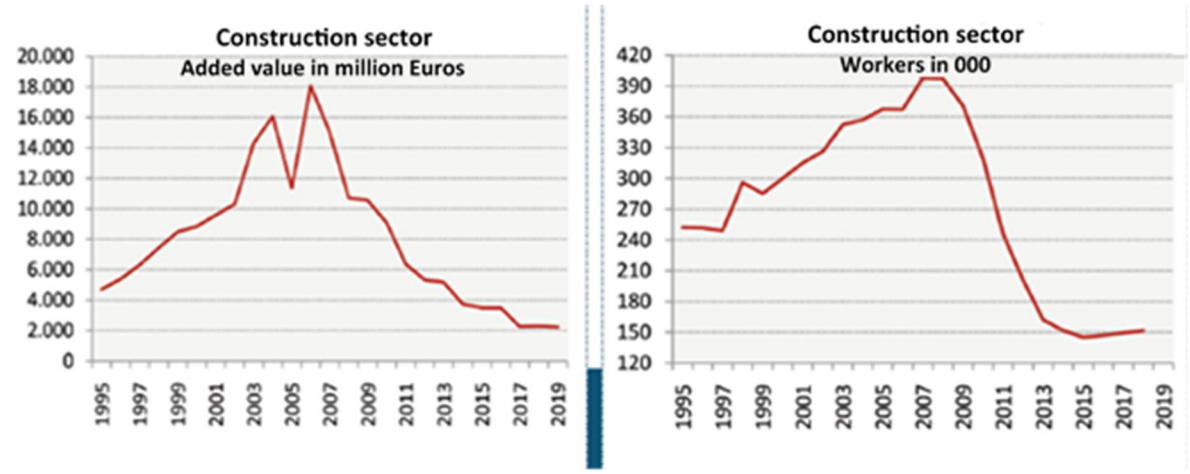


Figure 4.1: Added value and number of employees in the construction industry, for the time series 1995 – 2019 [Source: ELSTAT]

The significant reduction in the number of new projects has led to a fierce competition in project auctions and a significant increase in the percentage of discounts on submitted bids. The problems in the legislation addressing the public procurements have led to the reform of the regulatory framework with the aim of simplifying and clarifying the provisions, reducing bureaucracy and administrative burden for contracting authorities and economic operators, increasing public procurement procedures efficiency, extending the use of electronic tools (e-procurement), increasing transparency and addressing problems such as the issue of excessively low bids and excessive adherence to formality over the substance of tenders.

In this context, reforms recently introduced by Law 4782/2021, such as the strengthening of the design-build system, the addressing of abnormally low bids (ADRs) in projects, the enhancing of multiple award criteria, the private supervision of projects, the arbitration and conciliation used in dispute resolution, the modernization and digitalization of procedures, the unified system of technical specifications and pricing of technical projects and studies, are moving in the right direction.

4.2 Statistical data on the building stock

4.2.1 Characteristics of the building stock (age & type of buildings, building activity)

Approaching the building sector on a quantitative basis, and according to the latest published census of the Hellenic Statistical Authority (ELSTAT), carried out in 2021, the population of Greece amounted to 10,482,487. The Population & Housing Census of 2021 was conducted by ELSTAT during the period from October 2021 to December 2021, with reference date of the registered data being the 22nd of October 2021. The Preparatory Phase of the Population & Housing Census was the Building Census, the data for which were collected during the period from July 2021 to September 2021, with the reference defined as the 30th of June 2021. It is noted that the Building Census is carried out every ten years and it covers all existing buildings in the country regardless of their use, e.g. residential buildings (houses), shops, offices, factories, etc.

However, regarding the statistics on the number of households and buildings, still no published statistics from the completed census of 2021 exist yet, so based on the published data of the preceding census of 2011, the number of households amounted to 4.134.540, while the number of buildings in the country amounted to 4.105.637 buildings, of which the largest percentage even 19.1% (783.752 buildings), are located in the Attica Region. The age of buildings as derived from the implemented census of 2011 in Greece is presented in Table 4.1 and Figure 4.2.

Table 4.1: Buildings, by construction period[1]

Construction period	Number of buildings	Percentage over the total number
Before 1919	154,006	3.75%
1919-1945	324,701	7.91%
1946-1960	573,250	13.96%
1961-1970	639,475	15.58%
1971-1980	704,340	17.16%
1981-1985	402,368	9.80%
1986-1990	316,799	7.72%
1991-1995	259,394	6.32%
1996-2000	254,797	6.21%
2001-2005	237,460	5.78%
2006 and onwards	186,861	4.55%
Under construction	52,186	1.27%

It is also worth noting that – always based on the data provided by the 2011 census – the largest percentage of buildings (704,340 buildings) were constructed in the time period between 1971 and 1980 (17.2%) (Table 4.1). The next percentages are 15.6% (639,475 buildings) constructed in the period 1961-1970 and 14% (573,250 buildings) constructed in the period 1946-1960. There was no specific regulation as concerns the assessment of energy performance and certification of buildings before the law N.3661/2008, which consist the harmonization of the national legislation to the EPBD in Greece. As shown by the aforementioned data, about 47% of the buildings in Greece were constructed before the year 1980, when the Thermal Insulation Regulation begun to be in force, and this had resulted to those buildings lacking any kind of thermal insulation, while also being characterized by low energy efficiency and, at the same time, by old electro-mechanical installations.

1 ELSTAT, https://www.statistics.gr/el/census-buildings-2011

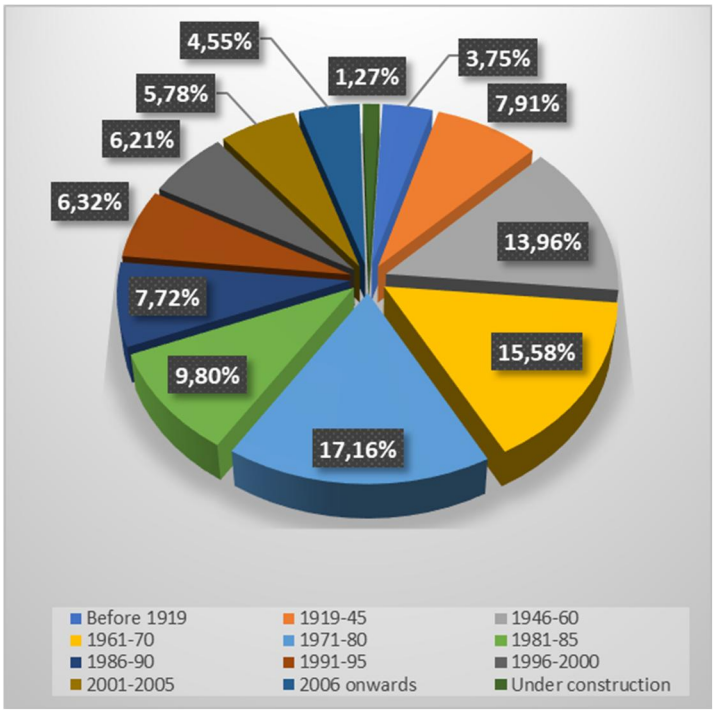


Figure 4.2: Buildings, by construction period [Source: ELSTAT, Building Census 2011]

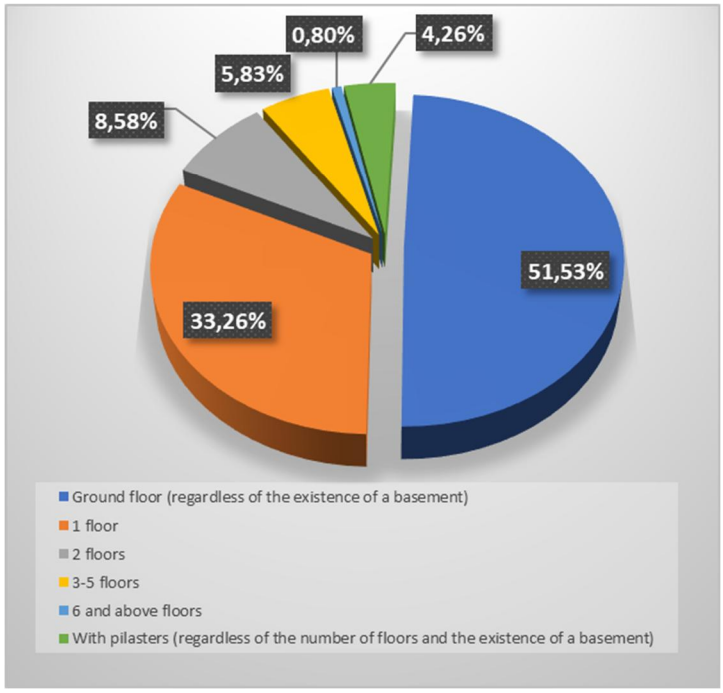


Figure 4.3: Distribution of buildings according to their height [Source: ELSTAT, Building Census 2011]

Of the total number of buildings recorded in the country, 51.53% of them are ground floor (regardless of the existence of a basement), while 33.26% have an additional floor. It is characteristic that less than 6% of buildings have between 3 and 5 floors, while only 0.80% of the total number of buildings are built with more than 6 floors (Figure 4.3). Out of the total number of buildings, the 92% of them (3,775,848) are characterized as “exclusive use” ones, while the 329,789 (8%) are of mixed-use. The distribution of buildings according to their exclusive use is presented in Table 4.2. A percentage higher than 79% (see Figure 4.4) of the registered buildings are characterized as residential ones, thus offering a strong incentive for the residential sector to consist of the main target of national energy saving policies.

Table 4.2: Number of buildings according to their exclusive type of use [2]

Residential buildings	Churches-monasteries	Hotels	Industrial buildings - Laboratories	School buildings	Offices Shops	Parking stations	Hospitals Clinics	Others
2.990.324	47.872	34.736	30.731	19.474	153.510	16.952	1.749	480.500

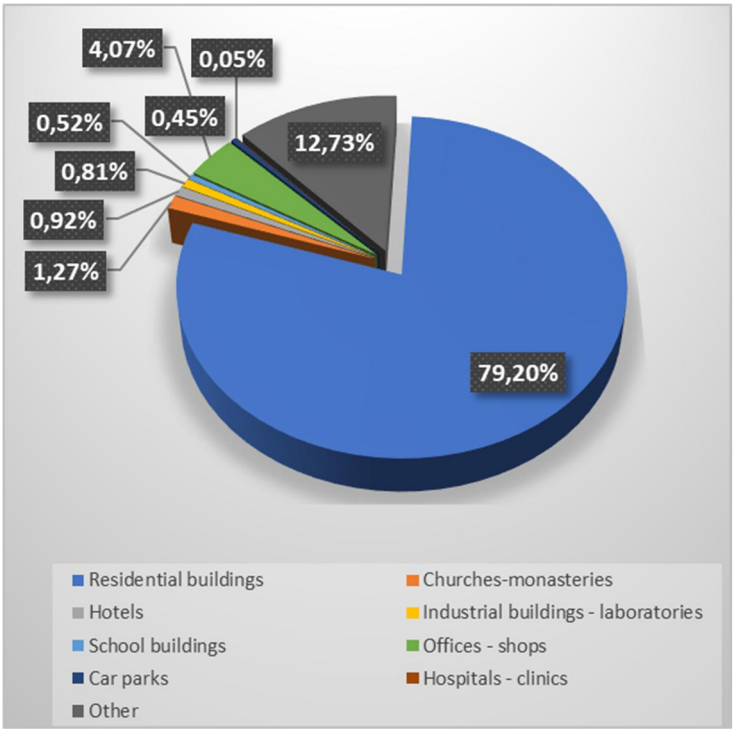


Figure 4.4: Uses of the existing building stock [Source: ELSTAT, Building Census 2011]

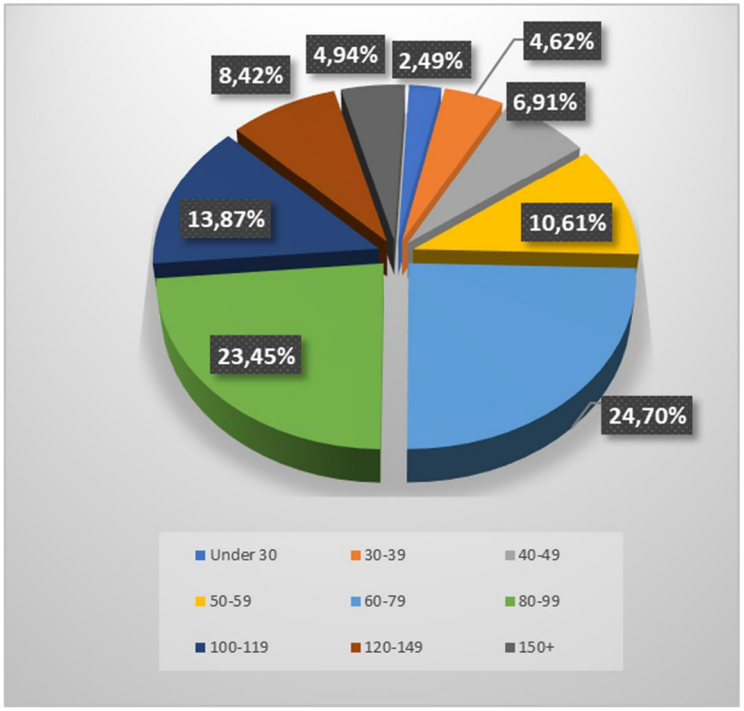


Figure 4.5: Size of dwellings [Source: ELSTAT, Building Census 2011]

2 ELSTAT, https://www.statistics.gr/census-buildings-2011

Regarding the size of the dwellings, an equal percentage of the total number is divided between the categories of "60 to 79" m^2 (24.70%) and 80-99 m^2 (23.45%), respectively, while 10.61% of the dwellings are characterized by areas between 50-99 m^2, about 11% cover areas smaller than 49 m^2, and about 27% of the dwellings are larger than 100 m^2.

Regarding the further characteristics of building materials that have been used for the construction of buildings, based on the 2011 census, the largest percentage of buildings, i.e., the 63.4% of them, with concrete as the basic construction material, have one (1) floor or more, while on the contrary the largest percentages of buildings with metal, wood, bricks/concrete blocks and stone being the main construction material only have a ground floor. More specifically, out of the total number of buildings having just one ground floor, in the 91.2% of them metal was used as the basic construction material, while 83.7% of them are made mainly by wood, 80.4% were built with bricks / concrete blocks and 58.6% of buildings with stone as the basic construction material.

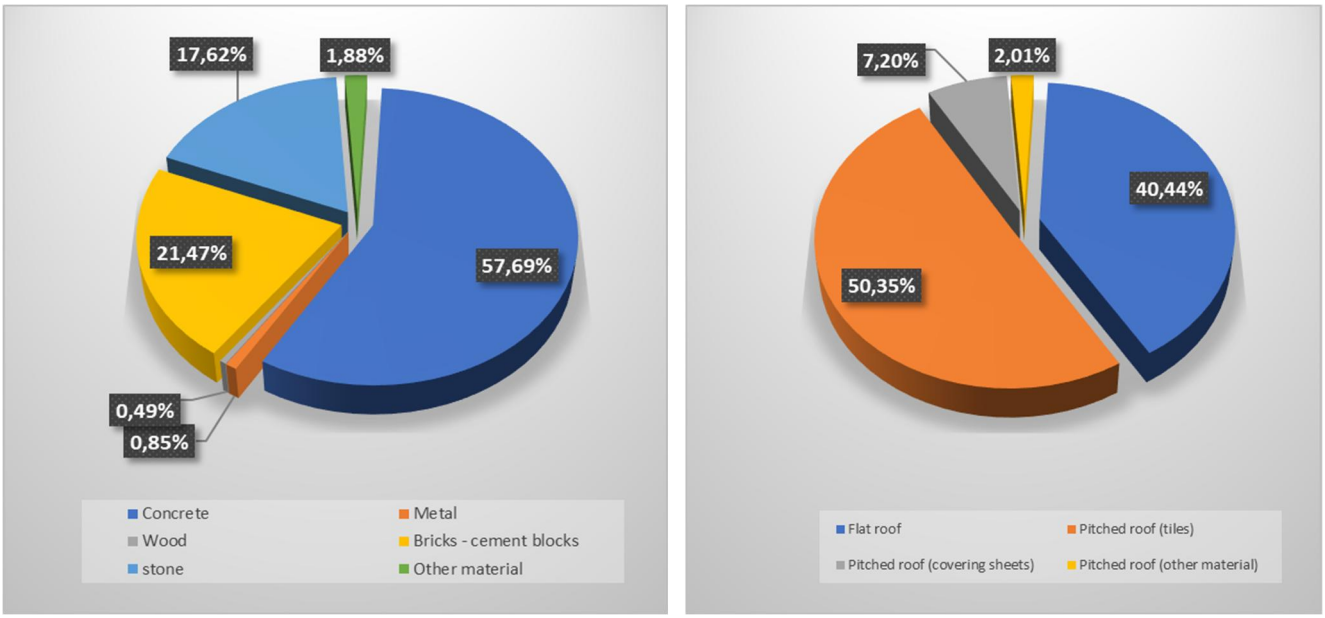


Figure 4.6: The basic building materials (construction materials) of the buildings (left) and the ways of covering them (right) [Source: ELSTAT, Building Census 2011]

Further studying the data concerning the basic construction material of "exclusively use" buildings, it emerges that the basic construction material of most residences (61.5%), hotels (83.8%), industrial buildings / laboratories (49.5%), school buildings (58.8%), shops / offices (65.9%) and hospitals / clinics (75.2%) is the concrete, while for the building of the largest percentage of churches / monasteries (57%), the stone has been mainly used as construction material. It is also noteworthy that, as regards the type of the roof of buildings, the majority of them (~60%) possess sloping roofs, with the predominant construction material being tiles, while the rest of the buildings only possess a simple roof (terrace).

Regarding the recovery observed in the building construction sector, especially during the last 1-2 years, it is worth quoting the (most recent) data of Building Activity in Greece as formulated by ELSTAT for March 2023[3]. Thus, during March 2023, the total building activity (private-public) in Greece, which is calculated on the basis of the number of issued building permits, amounted to 2,686. This figure corresponds to 647,555 m^2 of surface and 2,955,046 m^3 of volume, reflecting a 34.2% increase in the number of building permits, a 68.9% increase in surface and a 70.2% increase in volume, respectively compared to the corresponding month of 2022 (Table 4.3).

[3] *"Building Activity Survey: March 2023"* – ELSTAT, June 2023

Table 4.3: Total Building Activity by Region (NUTS II), March 2022 and 2023 [Source: "Building Activity Survey: March 2023" – ELSTAT, June 2023]

Region	Number of Building Permits			Surface (in m^2)			Volume (in m^3)		
	March		Change (%)	March		Change (%)	March		Change (%)
	2022	2023		2022	2023		2022	2023	
Anatoliki Makedonia, Thraki	105	121	15.2	25,320	44,022	73.9	109,233	276,214	152.9
Kentriki Makedonia	264	363	37.5	68,751	113,446	65.0	345,829	596,098	72.4
Dytiki Makedonia	28	29	3.6	4,209	3,448	-18.1	20,580	15,725	-23.6
Thessalia	127	158	24.4	15,483	29,548	90.8	56,193	129,095	129.7
Ipeiros	76	87	14.5	17,666	38,646	118.8	91,407	162,773	78.1
Ionia Nisia	143	178	24.5	18,145	33,469	84.5	59,906	109,102	82.1
Dytiki Ellada	127	136	7.1	16,804	30,357	80.7	80,224	144,893	80.6
Sterea Ellada	114	162	42.1	9,930	22,706	128.7	37,566	129,285	244.2
Peloponnisos	165	204	23.6	27,974	41,356	47.8	119,073	216,866	82.1
Attiki	447	617	38.0	117,303	136,761	16.6	595,821	576,066	-3.3
Voreio Aigaio	44	77	75.0	4,615	8,608	86.5	16,371	30,117	84.0
Notio Aigaio	227	340	49.8	37,487	97,499	160.1	127,282	372,430	192.6
Kriti	135	214	58.5	19,607	47,689	143.2	77,137	196,382	154.6
Greece, Total	2,002	2,686	34.2	383,294	647,555	68.9	1,736,622	2,955,046	70.2

The building permits for the Private Building Activity issued in Greece in March 2023 amounted to 2,671. This figure corresponds to 628,059 m^2 of surface and 2,873,242 m^3 of volume. In comparison to the respective month (March) of 2022 there is an increase of 34.2% in the number of building permits, 64.4% in surface and 65.9% in volume, are respectively noticed (Table 4.4).

Table 4.4: Private Building Activity by Region (NUTS II), March 2022 and 2023 [Source: "Building Activity Survey: March 2023" – ELSTAT, June 2023]

Region	Number of Building Permits			Surface (in m^2)			Volume (in m^3)		
	March		Change (%)	March		Change (%)	March		Change (%)
	2022	2023		2022	2023		2022	2023	
Anatoliki Makedonia, Thraki	104	120	15.4	25,320	43,133	70.4	109,233	271,573	148.6
Kentriki Makedonia	261	362	38.7	68,333	112,438	64.5	343,749	591,884	72.2
Dytiki Makedonia	27	28	3.7	3,777	3,448	-8.7	19,215	15,725	-18.2
Thessalia	127	158	24.4	15,483	29,548	90.8	56,193	129,095	129.7
Ipeiros	76	86	13.2	17,666	23,191	31.3	91,407	103,604	13.3
Ionia Nisia	142	178	25.4	18,145	33,469	84.5	59,906	109,102	82.1
Dytiki Ellada	127	134	5.5	16,804	29,799	77.3	80,224	142,815	78.0
Sterea Ellada	114	161	41.2	9,930	22,706	128.7	37,566	129,285	244.2
Peloponnisos	163	204	25.2	27,543	41,356	50.2	117,392	216,866	84.7
Attiki	444	611	37.6	117,303	136,761	16.6	595,821	576,066	-3.3
Voreio Aigaio	44	77	75.0	4,615	8,608	86.5	16,371	30,117	84.0
Notio Aigaio	227	340	49.8	37,487	97,499	160.1	127,282	372,430	192.6
Kriti	134	212	58.2	19,607	46,103	135.1	77,137	184,680	139.4
Greece, Total	1,990	2,671	34.2	382,013	628,059	64.4	1,731,496	2,873,242	65.9

Accordingly, during the last twelve months, from April 2022 until March 2023, the total building activity (private-public) in Greece, calculated on the basis of the number of issued building permits, amounted to 25,892. This figure corresponds to 5,831,367 m^2 of surface and 26,474,879 m^3 of volume. Compared to the corresponding period April 2021 - March 2022, an increase of 6,5% was observed in the number of building permits, a decrease of 4,2% in surface area and an increase of 2,0% in volume (see Table 4.5).

Table 4.5: Total Building Activity by Region (NUTS II), April 2021 - March 2022 and April 2022 - March 2023 [Source: "Building Activity Survey: March 2023" – ELSTAT, June 2023]

Region	Number of Building Permits			Surface (in m^2)			Volume (in m^3)		
	April - March		Change (%)	April - March		Change (%)	April - March		Change (%)
	2021-2022	2022-2023		2021-2022	2022-2023		2021-2022	2022-2023	
Anatoliki Makedonia, Thraki	1,307	1,296	-0.8	333,418	404,428	21.3	1,527,576	2,155,810	41.1
Kentriki Makedonia	3,319	3,573	7.7	881,575	889,587	0.9	4,326,952	4,397,959	1.6
Dytiki Makedonia	315	348	10.5	85,125	55,335	-35.0	396,234	275,620	-30.4
Thessalia	1,601	1,566	-2.2	394,183	341,230	-13.4	1,884,824	1,599,000	-15.2
Ipeiros	874	870	-0.5	238,457	244,876	2.7	1,045,391	1,034,858	-1.0
Ionia Nisia	1,557	1,648	5.8	320,267	281,587	-12.1	1,115,578	953,854	-14.5
Dytiki Ellada	1,626	1,569	-3.5	272,846	218,147	-20.0	1,111,968	951,149	-14.5
Sterea Ellada	1,432	1,500	4.7	311,249	280,277	-10.0	1,793,318	1,664,408	-7.2
Peloponnisos	1,914	2,057	7.5	354,429	306,802	-13.4	1,510,374	1,330,014	-11.9
Attiki	5,500	5,962	8.4	1,804,578	1,709,863	-5.2	7,126,212	8,026,266	12.6
Voreio Aigaio	616	699	13.5	86,580	90,628	4.7	314,827	320,473	1.8
Notio Aigaio	2,288	2,699	18.0	498,630	563,637	13.0	1,664,962	1,984,048	19.2
Kriti	1,958	2,105	7.5	505,760	444,970	-12.0	2,137,420	1,781,420	-16.7
Greece, Total	24,307	25,892	6.5	6,087,097	5,831,367	-4.2	25,955,636	26,474,879	2.0

During the same period of time, April 2022 - March 2023, the Private Building Activity in Greece recorded a 6.1% increase in the number of issued building permits, a 5.7% decrease in surface and a 0.4% increase in volume, compared to the corresponding period from April 2021 to March 2022 (see Table 4.6). During the same period, the Public Building Activity accounted for a 2.6% of the total building volume.

Table 4.6: Private Building Activity by Region (NUTS II), April 2021 - March 2022 and April 2022 - March 2023 [Source: "Building Activity Survey: March 2023" – ELSTAT, June 2023]

Region	Number of Building Permits			Surface (in m^2)			Volume (in m^3)		
	April - March		Change (%)	April - March		Change (%)	April - March		Change (%)
	2021-2022	2022-2023		2021-2022	2022-2023		2021-2022	2022-2023	
Anatoliki Makedonia, Thraki	1,301	1,282	-1.5	333,408	370,143	11.0	1,527,548	1,978,882	29.5
Kentriki Makedonia	3,296	3,529	7.1	877,588	871,923	-0.6	4,308,078	4,312,545	0.1
Dytiki Makedonia	305	342	12.1	83,900	43,987	-47.6	391,326	214,153	-45.3
Thessalia	1,592	1,554	-2.4	390,356	334,368	-14.3	1,850,434	1,549,236	-16.3
Ipeiros	870	861	-1.0	234,507	228,385	-2.6	1,020,793	971,238	-4.9
Ionia Nisia	1,556	1,638	5.3	320,267	281,587	-12.1	1,115,578	953,854	-14.5
Dytiki Ellada	1,618	1,552	-4.1	272,810	216,156	-20.8	1,111,608	941,143	-15.3
Sterea Ellada	1,423	1,482	4.1	309,301	277,975	-10.1	1,778,267	1,654,169	-7.0
Peloponnisos	1,896	2,042	7.7	345,274	301,419	-12.7	1,470,333	1,303,038	-11.4
Attiki	5,465	5,892	7.8	1,783,836	1,671,292	-6.3	7,043,035	7,866,323	11.7
Voreio Aigaio	613	688	12.2	85,636	89,765	4.8	310,499	316,219	1.8
Notio Aigaio	2,287	2,692	17.7	498,630	562,400	12.8	1,664,962	1,974,590	18.6
Kriti	1,937	2,076	7.2	494,147	439,157	-11.1	2,088,898	1,743,625	-16.5
Greece, Total	24,159	25,630	6.1	6,029,660	5,688,557	-5.7	25,681,359	25,779,015	0.4

Observing all the above Tables 4.3 to 4.6, it should be noted that the increase or decrease in the number of the issued building permits does not imply, necessarily, an increase or decrease in underlying surface or volume. This is due to individual building permits involving big surface or volume or to building permits that do not concern surface or volume.

4.2.2 Number of low energy consumption buildings, annual construction rate of new energy efficient buildings and renovations

According to Article 2 of the EU Directive 2010/31/EU: a "nearly zero-energy building" means a building that has a very high energy performance, and whose nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby. Nearly Zero Energy Buildings (nZEBs) are characterized by the following:

- ✓ building elements of high energy standards,
- ✓ E/M installations of particularly high energy efficiency, and
- ✓ a significant share of their energy consumption shall be covered by renewable energy sources at local level.

According to Article 9 of Law 4122/2013, as of 1.1.2021, all new buildings in Greece must be nearly zero energy buildings (NZEBs), while for new buildings of the public and wider public sector services, this obligation came into force on the 1st of January 2019. More specifically, this was legislated and was set in force since 1.1.2020, but the requirement for the classification of new buildings in energy class A and existing ones in B+ cannot be applied in practice. According to the document of the General Secretariat for Energy and Mineral Raw Materials on the "Amendment of the provisions of Law 4122/13 and Law 4342/15" (Government Gazette 5447B/18), it follows that the conditions for a new building to become "Nearly Zero Energy Consumption" is that it has to be classified in energy class A, in case it is a new building, and in category B+ in case it is an existing one.

Since, as mentioned above, the need to renovate the existing building stock is undeniable, as this will achieve significant energy and cost savings for citizens, while improving comfort, safety and health conditions when using these buildings, a central quantitative target for the renovation and replacement of residential buildings with new nearly zero energy consumption has been set in the NECP, i.e., a combined percentage that could reach 12-15% of total housing by the year 2030. More specifically, an annual target is foreseen to upgrade, or replace by new, more energy efficient ones, around 60,000 buildings or building units on average.

Also, within the framework of the "Exoikonomo-Autonomo" Program, it is planned to strengthen the process of renovations in residences but also with the very significant expansion in apartment buildings, residential complexes and urban complexes, while the contribution of the "Electra" Program will be very important, which aims at the energy upgrade of public sector buildings by promoting the exemplary role of the State in the field of energy efficiency of buildings, However, the actions within this framework have not yet started, so there are no quantitative data on the number of renovated buildings.

4.2.3 Enterprises active in the construction sector

According to a study by Foundation for Economic & Industrial Research (IOBE), approximately 60,000 enterprises were active in the construction sector in Greece in 2018 (Figure 4.7). Almost 2 out of 3 companies were active in the field of **specialized construction work**. A percentage of 26.4% of the enterprises had as their main object the **construction of buildings**. The number of companies carrying out **civil engineering works** is considerably smaller (4,894 companies or 8% of the total).

As can be seen from the same figure, between 2009 and 2018 the number of companies operating in the Construction sector decreased by approximately 53,000 (-47%). This decrease permeates all segments of the sector, but showed greater intensity in building construction (-58%). The vast majority of enterprises in the construction sector in Greece (96.8% in 2018) are very small enterprises (sole proprietorships / self-employed, businesses employing less than 10 people). Their small size is a major obstacle to continuing professional training of staff and the development of organisational and managerial skills, and may also be linked to less favourable conditions for access to finance. It is, however, an inherent feature of the construction industry, which faces the (often unpredictable)

fluctuation in demand for the construction of various projects of varying degrees of technical requirements in different regions of the country. In such an environment, business flexibility is particularly important – the main concern of businesses is to minimize fixed costs (e.g. remuneration of permanent staff), which is achieved (also) by contracting subcontracts with small businesses for specific construction works.

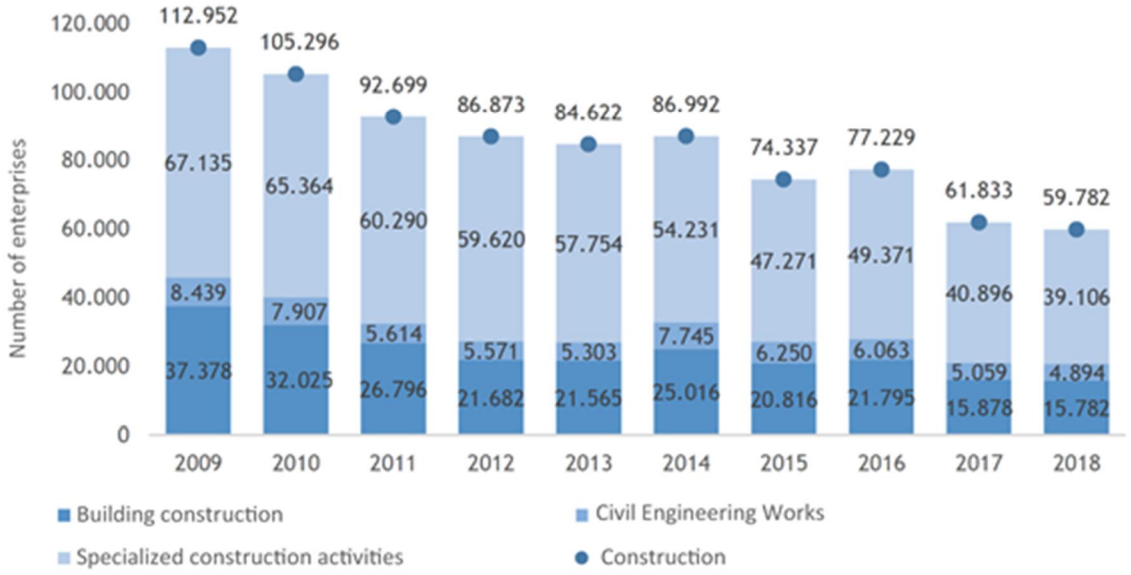


Figure 4.7: Number of enterprises in the construction sector by field (2009 – 2018) [Source: The role of the Infrastructure and Construction Industry in the next day of the Greek economy, IOBE – 2021]

In a broader context, more than 85,000 enterprises were active in activities closely related to construction in 2018, mainly in the "Services" sector, which mainly includes architectural and design activities, as shown in Figure 4.8. In the same year (2018), approximately 16,000 enterprises were active in the wholesale and retail trade of materials for construction, while in the mining and building materials industry, approximately 14,000 enterprises were registered.

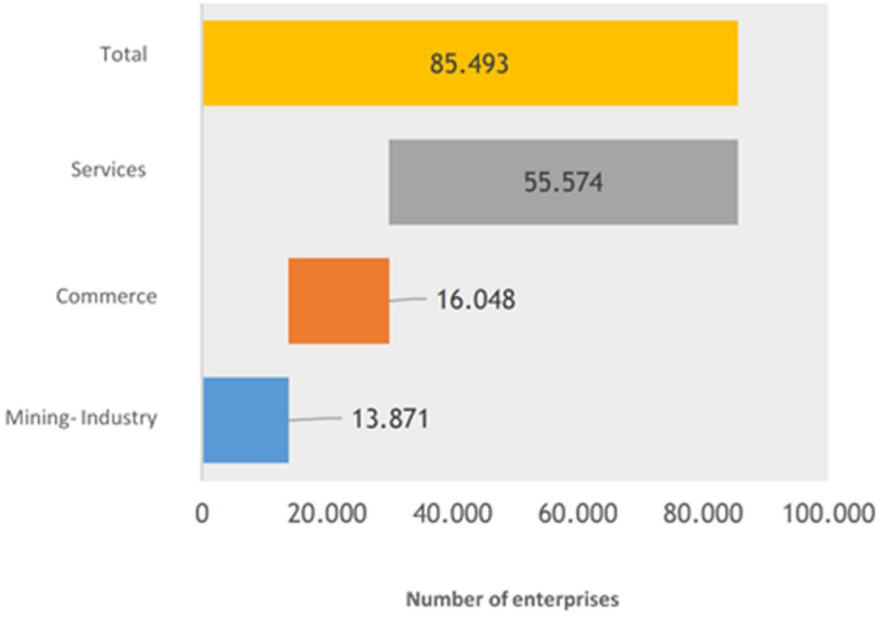


Figure 4.8: Number of enterprises in the wider construction sector (2018) [Source: The role of the Infrastructure and Construction Industry in the next day of the Greek economy, IOBE – 2021]

4.3 Statistics on the workforce in the construction sector

The situation regarding the adequacy of the workforce in the construction sector in Greece is currently not very promising. More specifically, and according to the Technical Chamber of Greece, a total of 100,000 workers are missing from buildings construction and 127,000 from construction in general. An additional 10,000 engineers and more than 50,000 craftsmen are needed. That this estimate is modest is vividly demonstrated by the depiction of the evolution of the workforce in construction.

It is worth noting that, as can be seen in both Figures 4.9 and 4.10, in 2008 the total employment in the construction sector approached 595 thousand. persons, while only in the Construction sector there were employed 397 thousand people. In 2019, the majority of employees in the construction sector are detected in “specialized construction activities”, with 78 thousand persons, and a decrease of 64.7% compared to 2008. Building construction, which also saw a significant decrease in employment during the same period (-73.1%), employed 42 thousand people in 2019 (from 155,000 in 2008). On the other hand, in civil engineering projects, which mainly concern investments in infrastructure, employment in 2019 reached 28 thousand individuals, even showing a trend of strengthening after 2016.

According to the following figures (that present the statistics of the construction sector in Greece as regards employability), in 2019 approximately 150 thousand people were employed in the Construction sector (see Figure 4.9) while in the other sectors of the Construction sector another 127 thousand workers (see Figure 4.10). Thus, the total employment in the wider construction sector approached 274 thousand of workers. The sector includes 46 categories of professions, based on the 3-digit classification of STEPs (Statistical Classification of Occupations), while in the broader sector of Construction, 86 categories of professions are identified, in which hundreds of individual professions are incorporated. The sector continues to have a significant presence in the Greek economy, despite the fact that construction activity declined rapidly after 2007.

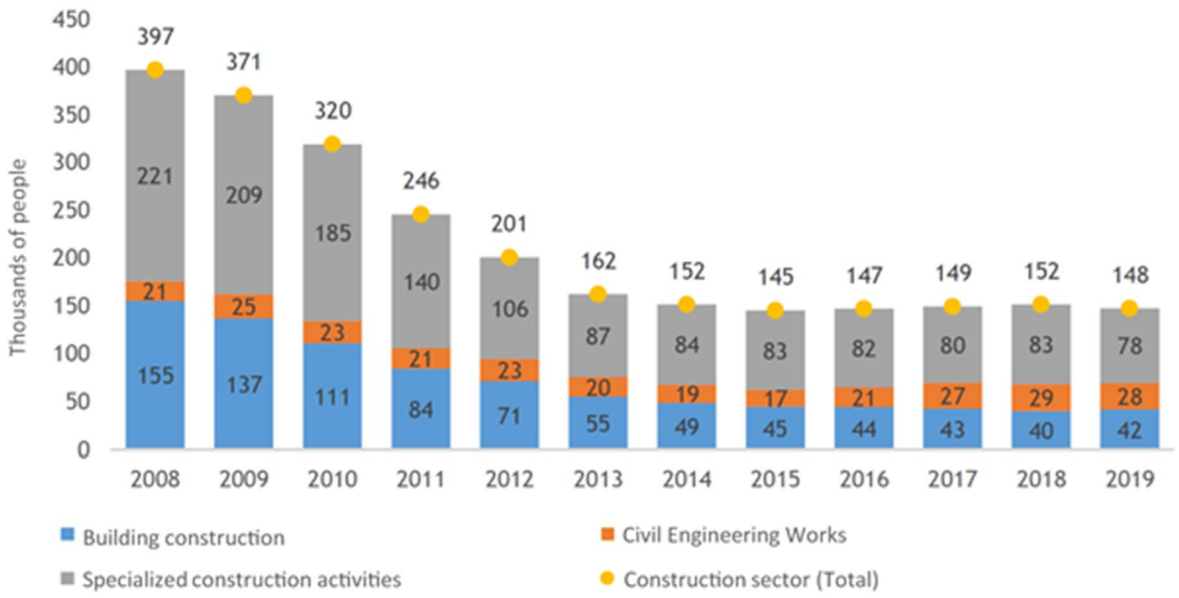


Figure 4.9: Employment in Construction by field, 2008 - 2019 [Source: The role of the Infrastructure and Construction Industry in the next day of the Greek economy, IOBE – 2021]

A significant footprint in terms of employment is recorded in the industrial sectors of the wider Construction sector, with 62 thousand employees in 2019, but a clear drop from 2008 (109 thousand), while the Services of the Construction sector employed 56 thousand persons in 2019 (compared to 79 thousand of persons in 2008) (see Figure 4.10).

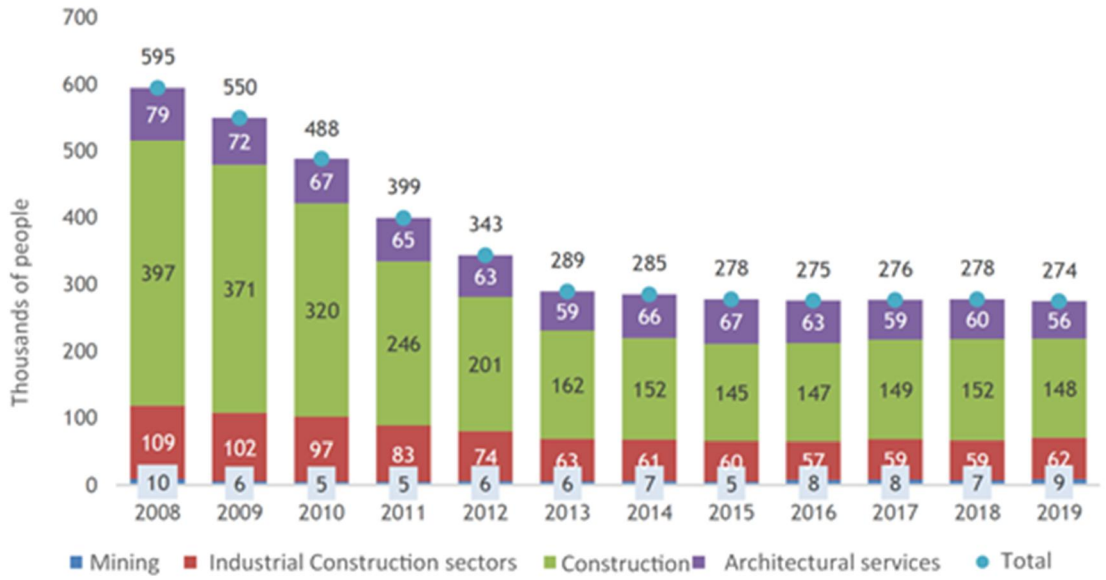


Figure 4.10: Employment in Construction, 2008 - 2019 [Source: The role of the Infrastructure and Construction Industry in the next day of the Greek economy, IOBE – 2021]

Table 4.7 below presents quantitative data on the number of employees in the construction industry during the years **2019 to 2022**. More specifically, the **average prices of the 4 "3-months" periods of each year** for each one of the years from 2019 to 2022 are recorded. These data are derived from ELSTAT's Labour Force Survey, where a categorization has been made by position in the profession (self-employed, employees and assistants in a family business).

Table 4.7: Number of employees in the construction sector for the 4-year period 2019-2022 (average values of the 4 "3-months" periods)
[Source: https://www.statistics.gr/el/statistics/-/publication/SJO01/-]

Construction sector		2019	2020	2021	2022
Total number of employed people		**147,6**	**140,8**	**141,8**	**148,6**
Employment relationship	*Self-employed with employees*	15,9	14,4	14,7	21,8
	Self-employed without employees	40,7	44,9	41,8	45,8
	Employees	89	80,4	84	79,4
	Assistants in a family business	2	1,1	1,3	1,7

4.4 Data related to the energy consumption and renewable energy sources in buildings

4.4.1 Energy consumption in buildings

The Greek building stock consists mainly of residential buildings and a number of buildings from the tertiary sector. Residential buildings account for 95.4% of the building stock, while from the tertiary sector commercial stores constitute 1.4%, offices and other buildings make up 1.1%, hospitals and clinics account for 0.8%, hotels and restaurants represent 0.5%, and schools and educational institutions, along with warehouses, account for 0.4% each. The overwhelming majority of residential buildings, as a percentage of the total buildings, highlights the particular importance placed on their energy upgrading.

BUILDING USE	NUMBER OF BUILDINGS
HOUSES - HOUSEHOLDS	
Houses	*4.631.528*
TERTIARY SECTOR	
Hotels and restaurants	*24,109*
Schools and educational institutions	*19,167*
Offices and other buildings	*53,064*
Hospitals and clinics	*38,664*
Commercial shops	*65,957*
Warehouses	*20,374*
Cold stores	*308*
Tertiary sector total	*221,643*
TOTAL	4.853.171

Figure 4.11: Total number of buildings and their use for the year 2015 [Source: Long-term Strategy for the Renovation of the Building Stock]

The upgrade of the energy efficiency of existing buildings poses the greatest challenge in achieving energy-saving targets in the building sector, as the energy performance of the current building stock will determine the future energy efficiency index of this sector. It should be noted that for buildings housing public services, considered particularly energy-intensive, there is insufficient data regarding their exact number in relation to their use and energy characteristics. The 2011 census estimates the buildings housing Central and Decentralized Administration, Municipalities, and Regional and Local Authorities' Legal Entities to be around 112,000, while their ownership status is reflected in the following table.

ENTITY USING THE BUILDING	TOTAL BUILDINGS	PROPERTY OPERATOR		
		PUBLIC	PRIVATE	BOTH
Central / Decentralized Administration	4,141	3,449	631	61
Local authorities and their bodies	31,167	28,791	2,111	265
Other legal persons governed by public law	57,959	55.838	1,876	245
Other legal persons governed by private law	18,789	4,772	12,958	1,059

***Source**: National Plan for Increasing the Number of Nearly Zero Energy Buildings (Ministry of Energy, 2017)*

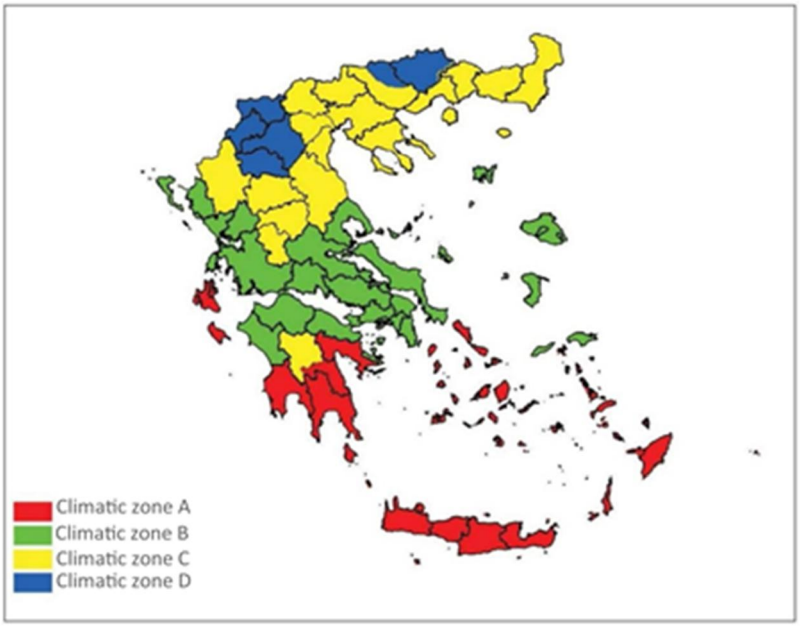
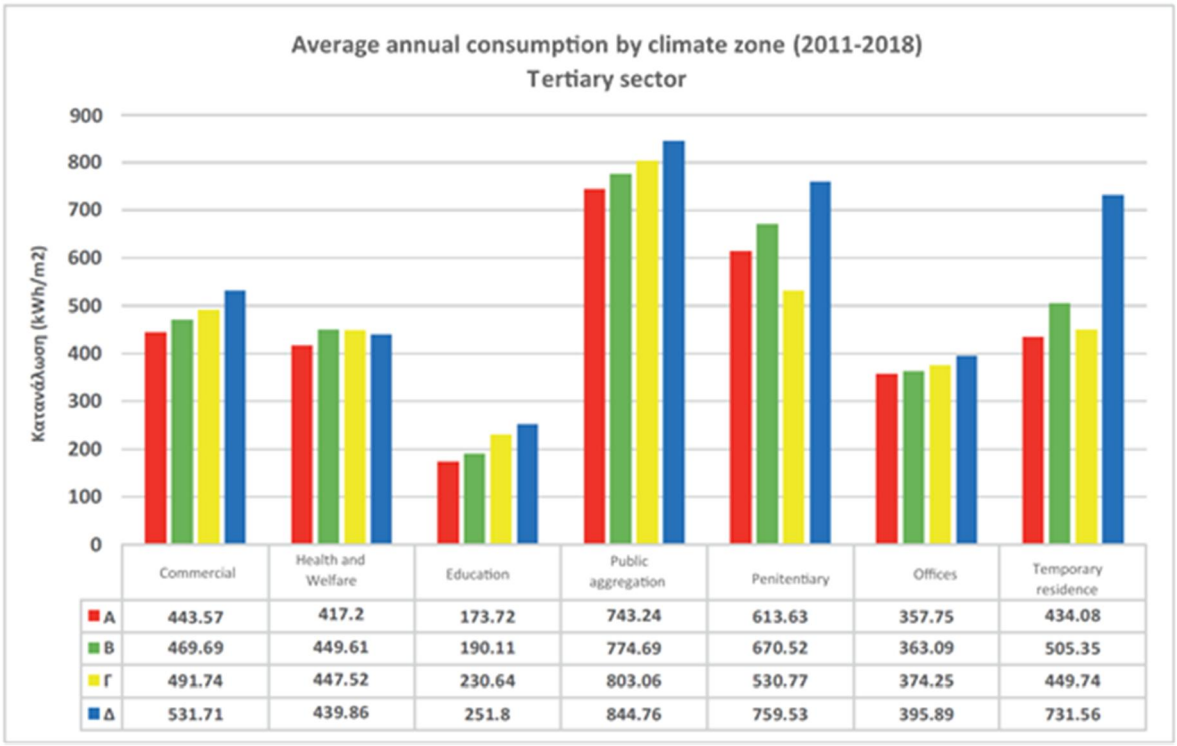


Figure 4.12: Climate zones in Greece [Source: Regulation of Energy Performance of Buildings (K.EN.A.K)]

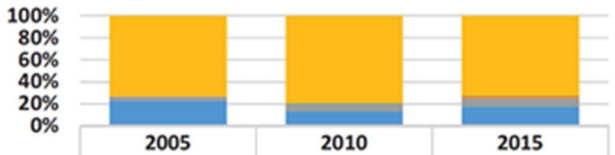
According to the energy balance of the year 2017, energy consumption related to buildings in Greece amounted to 660,522 ktoe, which corresponds to 42% of the country's total final energy consumption. By gathering information from the Energy Performance Certificates (EPCs) issued up to the present, different consumption patterns are observed for each building use in each climate zone (shown in Figure 4.12).



	Commercial	Health and Welfare	Education	Public aggregation	Penitentiary	Offices	Temporary residence
A	443.57	417.2	173.72	743.24	613.63	357.75	434.08
B	469.69	449.61	190.11	774.69	670.52	363.09	505.35
Γ	491.74	447.52	230.64	803.06	530.77	374.25	449.74
Δ	531.71	439.86	251.8	844.76	759.53	395.89	731.56

Figure 4.13: Average annual consumption of buildings in the tertiary sector, per climate zone (2011-2018) [Source: Long-term Strategy for the Renovation of the Building Stock].

In the tertiary sector, public assembly buildings are the most energy intensive (with an average annual primary energy consumption of 778.24 kWh/m^2), along with correctional facilities (with an average annual primary energy consumption of 622.67 kWh/m^2) in almost all climate zones. Energy consumption in educational buildings increases in colder zones, while in office and commercial buildings, it is not significantly affected by the climate zone. For healthcare and welfare buildings, energy consumption is higher in climate zone B (due to cooling needs).



	2005	2010	2015
Electricity	73%	79%	73%
Distributed heat	0%	0%	0%
RES	0%	0%	1%
Biomass	0%	0%	2%
Natural gas	4%	7%	8%
Petroleum and solid fossil fuels	23%	13%	17%

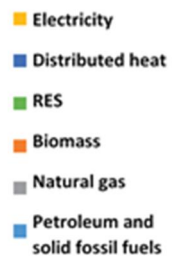


Figure 4.14: Shares of energy consumption in the tertiary sector (%) [Source: Long-term Strategy for the Renovation of the Building Stock]

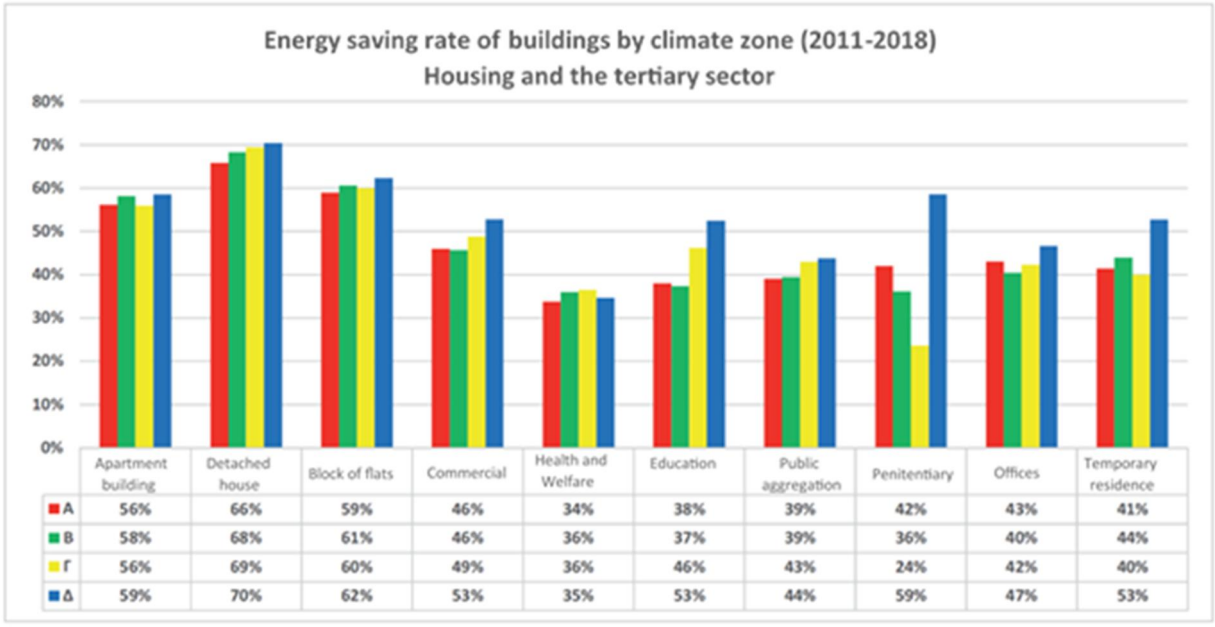
The final energy consumption in Greece decreased in all sectors, particularly in the industrial, residential, and tertiary sectors, during the period from 2008 to 2015, as these sectors were the first to experience the effects of the economic recession. However, since then, the final energy consumption has shown an increasing trend, as is evident in the energy balances for 2016 and 2017.

During the time period 2005-2015, there was an increase in the final energy consumption from 737 ktoe (2005) to 1613 ktoe (2015) in the tertiary sector, reflecting the rapid development of this sector during the decade. The largest shares of final energy consumption are attributed to space heating and the use of electrical appliances and lighting, followed by air-conditioning and hot water production. As can be seen in Figure 4.13, electricity dominates, covering 73% of the energy consumption needs of buildings in the tertiary sector in 2015. It is followed by petroleum, which experienced a significant decline during the peak of the economic crisis but partially recovered in 2015, while natural gas covers a relatively small share.

4.4.2 Residential energy use and consumption

Among residential buildings, detached houses are the most energy intensive, while houses in apartment complexes have an average annual primary energy consumption of 257.08 kWh/m^2. According to the data provided in the “Long-term Strategy for the Renovation of the Building Stock 2020”, and comparing the average annual primary energy consumption of residential buildings per climate zone, it is evident that detached houses in climate zones C and D are the most energy-intensive (500.68 kWh/m^2 and 555.67 kWh/m^2, respectively).

On the other hand, there are significant energy saving opportunities in those zones (especially C and D), as the energy consumption is double to triple compared to the reference building's consumption. Detached houses, in particular, demonstrate the highest percentage of energy savings across all climate zones (Figure 4.15).



	Apartment building	Detached house	Block of flats	Commercial	Health and Welfare	Education	Public aggregation	Penitentiary	Offices	Temporary residence
A	56%	66%	59%	46%	34%	38%	39%	42%	43%	41%
B	58%	68%	61%	46%	36%	37%	39%	36%	40%	44%
Γ	56%	69%	60%	49%	36%	46%	43%	24%	42%	40%
Δ	59%	70%	62%	53%	35%	53%	44%	59%	47%	53%

Figure 4.15: Energy savings percentage of buildings per climate zone (%) [Source: Long-term Strategy for the Renovation of the Building Stock]

By examining the data for the years 2010-2015, it can be inferred that approximately 50% of Greek households use oil-fired radiators as their main heating method. The remaining heating methods are depicted in Table 4.8. On the other hand, the vast majority of households (~88%) use an electric stove for cooking (Table 4.9).

Table 4.8: Percentage of the distribution of households by main heating method, 2010 - 2015

	2010	2011	2012	2013	2014(2)	2015(2)
Oil radiators	65.9	64.4	55.7	38.1	35.4	39.7
Natural Gas »	7.2	7.7	8.1	8.9	9.2	10.4
Oil stove	5.0	4.2	3.4	2.2	2.7	2.4
LPG »	1.4	1.5	2.0	2.3	2.2	1.4
Firewood »	5.4	6.7	7.9	11.6	11.1	9.9
Storage Heaters	2.6	2.3	1.7	1.9	2.2	1.9
Electrical appliances (Stove, air heater, radiator)	4.7	4.4	6.9	11.5	13.5	14.3
Air conditioning device	4.8	4.7	5.8	12.6	12.8	9.6
Electric heat pump	...	...	...	...	...	...
Geothermal heat pump	...	...	...	...	...	...
Other	2.3	3.8	7.8	9.5	9.2	9.9
Do not get heated	0.5	0.2	0.8	1.5	1.8	0.5

Table 4.9: Percentage of the distribution of households by main cooking means, 2010 - 2015

	2010	2011	2012	2013	2014[2]	2015[2]
Electric cooker	90.5	89.8	89.5	87.1	86.5	89.8
LNG appliance	8 2	8.7	8.8	9.6	9.8	7.9
Gas cooker	0.1	0.3	0.3	0.4	0.3	0.4
Firewood	0.4	0.5	0.4	1.1	1.6	0.6
Other	0.2	0.0	0.1	0.4	0.1	0.1
Do not cook	0.6	0.7	0.9	1.4	1.8	1.1

***Source**: Directorate of Population, Employment and Cost of Living Statistics ELSTAT.*

(1) The figures in the table come from the Household Budget Survey (EEA), which was carried out every four years until 2008 and has been carried out annually since 2009.

(2) The Household Budget Survey (EEA) data for the reference years 2014 and 2015 have been revised due to the recalculation of reduction factors by applying an appropriate trimming procedure

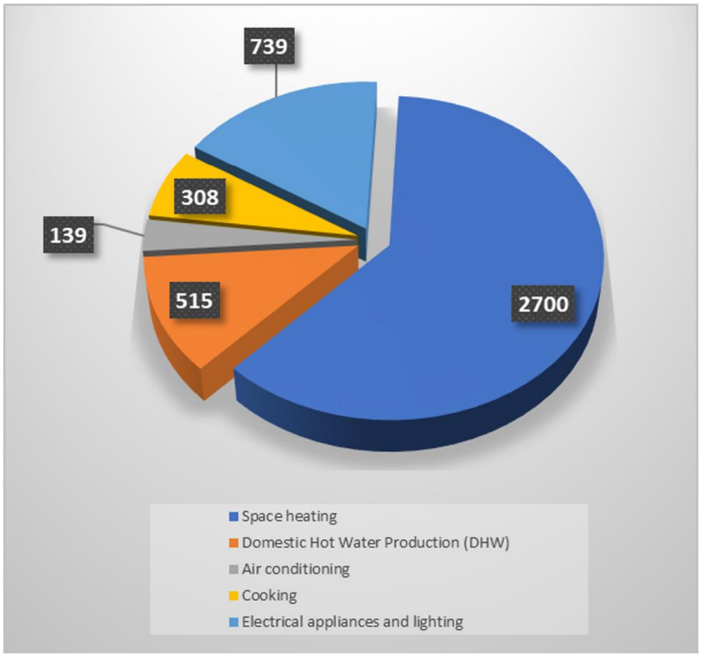
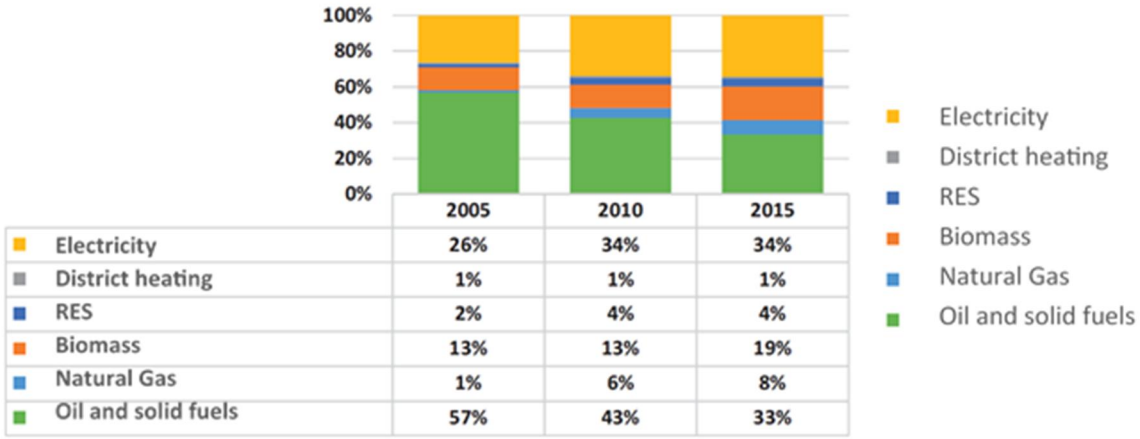


Figure 4.16: Final energy consumption per use in the residential sector (ktoe) (2015) [Source: Long-term Strategy for the Renovation of the Building Stock]

According to the energy balances of Eurostat for the year 2015, the energy consumption of Greek households amounted to 4401 ktoe, compared to 4615 ktoe in 2010 and 5510 ktoe in 2005. The economic recession in previous years significantly affected the energy consumption of households, as it was accompanied by a parallel increase in fuel prices. As is shown in Figure 4.17, during the period from 2005 to 2015, there was a significant reduction in the share of oil (from 57% to 33%) and a notable increase in the share of natural gas and electricity.



	2005	2010	2015
Electricity	26%	34%	34%
District heating	1%	1%	1%
RES	2%	4%	4%
Biomass	13%	13%	19%
Natural Gas	1%	6%	8%
Oil and solid fuels	57%	43%	33%

Figure 4.17: Share of energy consumption in the residential sector (%) (2015) [Source: Long-Term Strategy for the Renovation of the Building Stock

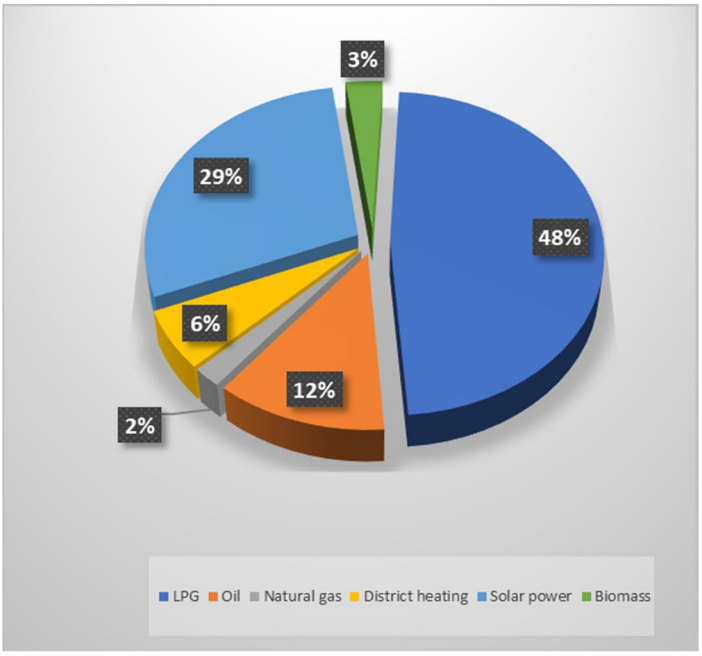


Figure 4.18: Final consumption of thermal energy in the residential sector (2015) [Source: Long-Term Strategy for the Renovation of the Building Stock]

It is notable that in 2015, the energy consumption for thermal uses amounted to 2892 ktoe, accounting for 66.62% of the total energy, while electrical energy accounted for 1449 ktoe, covering the remaining 33.38%. The most widely used fuel for meeting thermal needs was oil with a share of 48%, followed by biomass with 29% and natural gas with 12%. Solar energy, liquefied petroleum gas, and distributed heat follow with 6%, 3%, and 2%, respectively. In proportion, oil boilers are the most common heating system in residential buildings, while among those more commonly used are boilers for burning wood or wood pellets, solid and liquid fuel stoves, and gas boilers.

Moving to more recent years, and more specifically in 2020, each household in the country consumed an average of 11,792 kWh annually to meet its total energy needs (Figure 4.20).

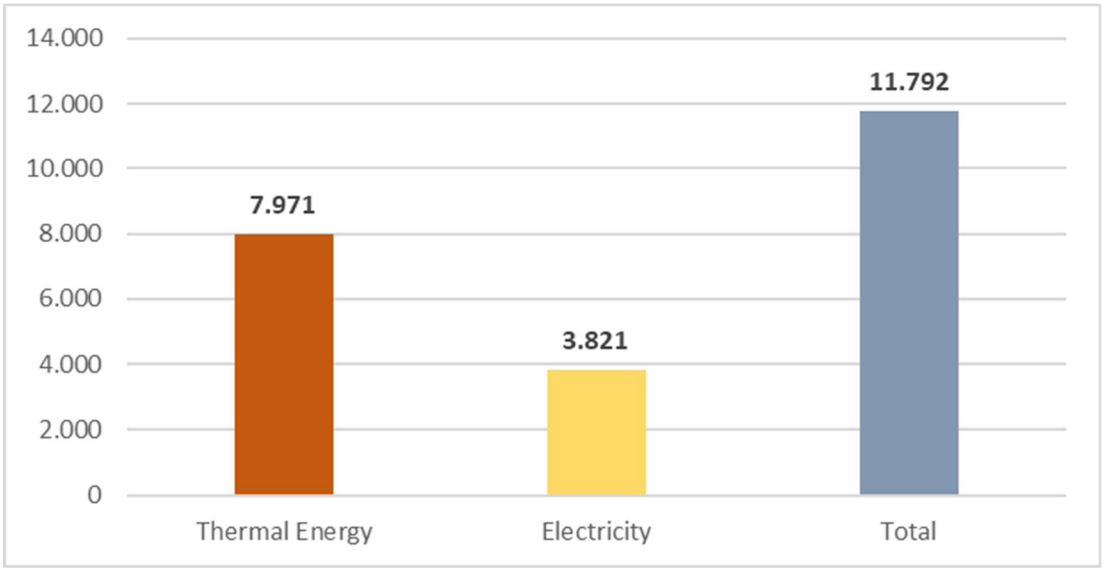


Figure 4.19: Average annual energy consumption (kWh) per household, for the year 2020 [Source: Report on the Annual Energy Consumption Distribution of Households for End Uses for Submission to EUROSTAT for the year 2020, CRES]

Out of the average annual energy consumption of 11,792 kWh per household in the country to meet its needs, thermal energy accounts for 67.6%, while the remaining 32.4% is consumed in electricity. Further, Figure 4.20 presents the percentage distribution of the total annual energy consumption by the type of fuel used and the type of use.

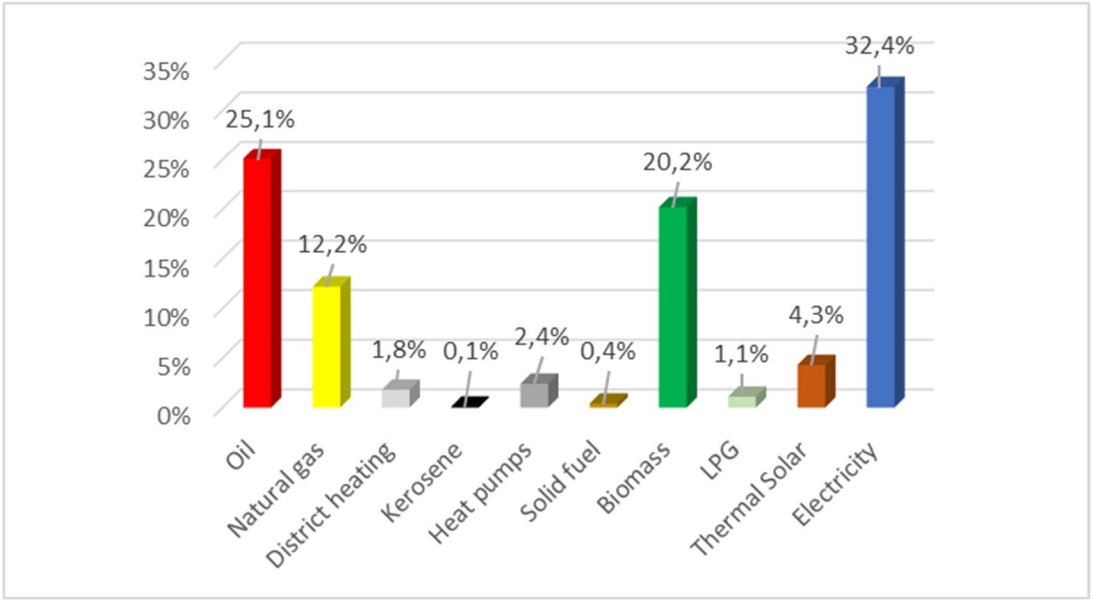


Figure 4.20: Percentage (%) of the distribution of total energy consumption by type of fuel used [Source: Report on the Annual Energy Consumption Distribution of Households for End Uses for Submission to EUROSTAT for the year 2020, CRES]

As is shown in Figure 4.21, regarding the energy needs of a household for space heating, cooking, and domestic hot water (DHW) preparation, these account for 81.1% of the household's total annual energy consumption, while the rest 18.9% is consumed for covering the rest of the annual energy needs related to cooling, appliances, and lighting.

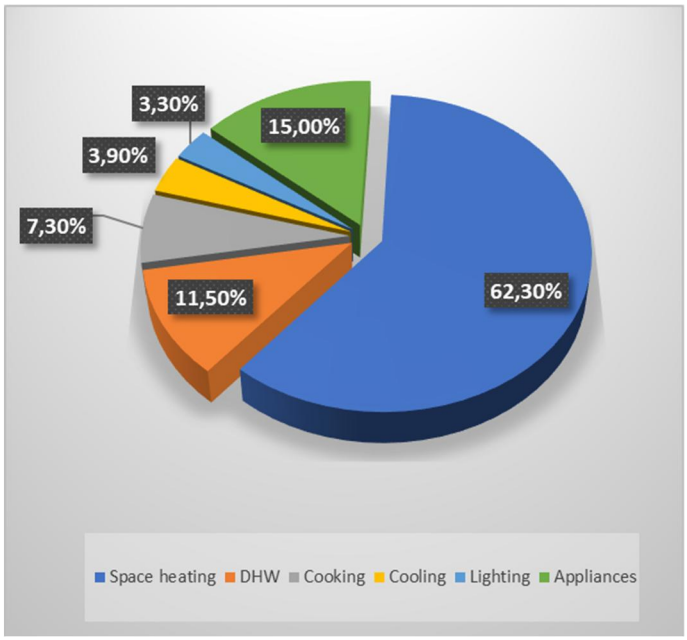


Figure 4.21: Percentage (%) of the distribution of total energy consumption per end use [Source: Report on Annual Energy Consumption Distribution for end use of Households for Submission to EUROSTAT for the year 2020, CRES]

4.4.3 Renewable Energy Sources in the building sector

The available data on the share of RES in terms of installations in buildings are presented in the following paragraphs.

Photovoltaics market

In 2009 PV systems on roofs up to 10 kW_p (for residential users and small businesses) received a very high guaranteed fixed price (Feed-in-Tariff), which gave a remarkable boost to PVs, as a ten-year program for the development of small photovoltaics in buildings was launched (JMD 12323/2009). In fact, as shown in Figure 4.22, based on the mapping - by the Hellenic Association of Photovoltaic Companies (SEF) - of the Greek PV market as it evolved over the years, mainly from 2010 onwards, a remarkable volume of installed systems is observed (especially in the years 2011, 2012, 2013 and 2020, 2021 the annual connected PV capacity presents some peaks).

Figure 4.22: Cumulative and annual connected capacity, from 2010 to 2021 (2022 figures are estimates) (Source: www.helapco.gr)

In 2020, with Law 4685/2020, the first phase of the re-simplification of licensing procedures began, when a substantial restart of the market took place, as is evident from the data presented in Figure 4.23. Similar is the situation depicted in Figure 4.24, where the investments in PV systems (annual and cumulative) for the period 2010-2022 are presented.

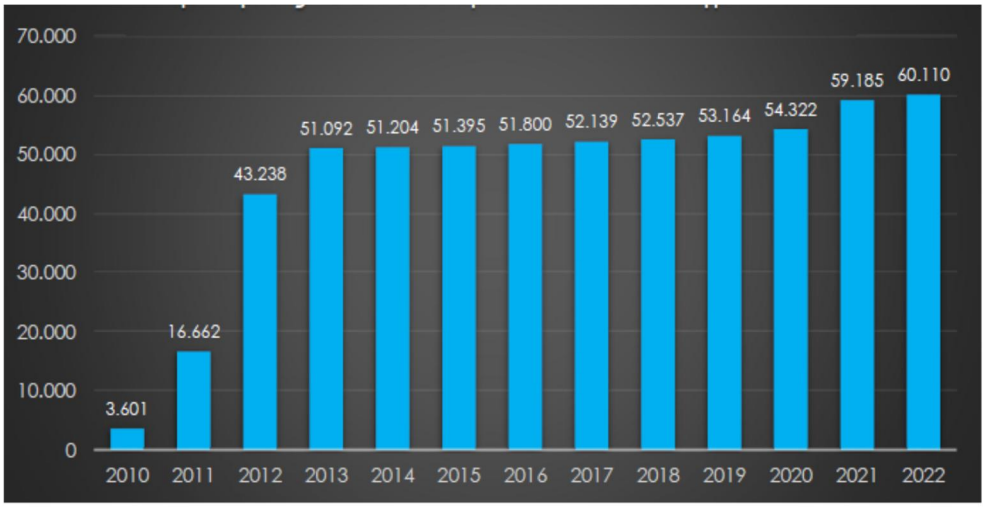


Figure 4.23: Number of connected PV systems from 2010 to 2021 (2022 figures are estimates) (Source: www.helapco.gr)

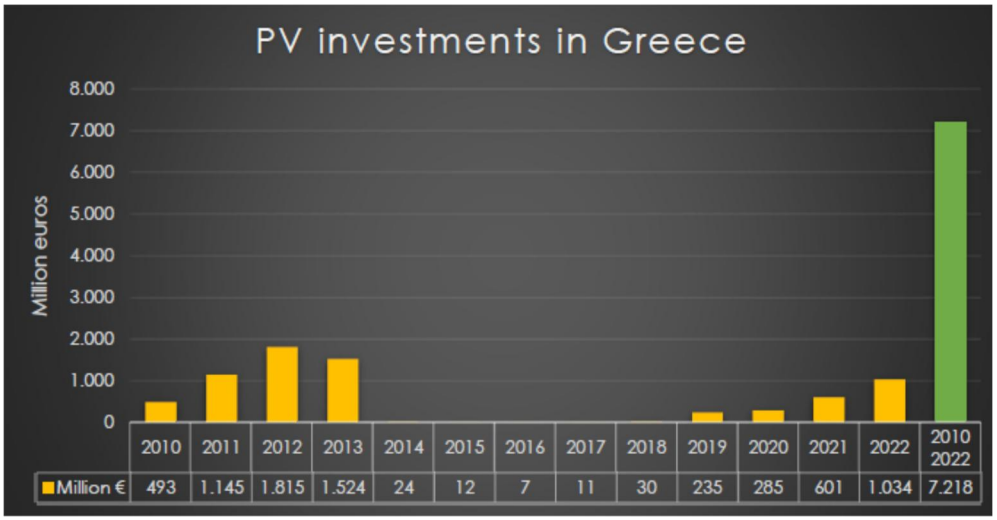


Figure 4.24: Annual and cumulative investments PV systems for the period 2010-2022 (2022 figures are estimates) (Source: www.helapco.gr)

It is a fact that during the last years there has also been a decrease in the average size (average capacity of small scales systems <10 kW_p) which is attributed to the fact that the new systems are intended for self-production and thus the installed size depends on the consumption of the self-producer and not on the maximum allowable capacity (which in the old program of 2009-2019 was at 10 kW_p).

Solar thermal systems market

According to the most recent study by the European Solar Thermal Industry Federation (ESTIF)[4], the evolution of the installed capacity of solar thermal systems in a European context is far from being homogeneous between the various countries or market sectors. Greece, however, which represents the second largest market in Europe (while holding the 5th rank in the world, in installed capacity of solar thermal panels per 1000 inhabitants), has shown over the last decade a remarkable development,

[4] ESTIF - Solar Heat Markets in Europe Trends and Market Statistics 2020 Summary (December 2021)

setting an enviable record of steady growth, despite being one of the countries most affected by the pandemic, exacerbated by logistical issues in terms of transport and logistics towards the end of 2020. Annual sales in the Greek market decreased by 15.7% compared to year 2019, however total installed capacity increased by 2.5%.

Sales in 2020 started at a good pace, leading to positive expectations. The decrease was mainly a result of the first lockdown, reaching 50% in April and May of the same year. Sales were also affected during other months, but to a lesser extent. This contraction reflects the specificities of the Greek market, where sales to niche trade, i.e. to wholesalers, are quite relative and therefore cannot be fully replaced by other channels, including online sales.

In addition, the impact of the pandemic on economic activities as a whole naturally resulted in sales in the hospitality/catering sector (hotels, restaurants) being greatly affected. On the other hand, the initial numbers indicate that exports were stable, characterized by a small increase in sales of solar panels and a larger increase in storage tanks. Expectations for 2021 were positive, with market participants expecting significant growth. In addition, the Greek government has developed measures to promote the adoption of solar thermal heating systems as part of its plans to achieve climate goals, hoping to pay more attention to an area where Greek companies and products are a benchmark in Europe and globally.

Table 4.10: The market size of solar thermal panels[3]

In Operation *		Market (=Newly Installed)		Annual evolution of the market (Total Installed Capacity)
2019	2020	2019	2020	2019/2020
Total of Glazed Collectors		Total of Glazed Collectors		Total of Glazed Collectors (%)
m^2	kW_{th} **			
4.866.050	4 989 550	361.350	304.500	2,5

** Capacity "in operation" refers to the solar thermal capacity built in the past and deemed to be still in use. Solar Heat Europe/ESTIF assumes a 20-year product life for all systems installed since 1990. Most products today would last considerably longer, but they often cease to be used earlier, e.g. because the building was demolished, or there has been a change of building use.*

*** The relation between collector area and capacity is 1m² = 0.7kWth (kilowatt-thermal).*

Geothermal systems in buildings

Geothermal exploitation in Greece includes 43 MW_{th} of low enthalpy geothermal energy for heating greenhouses and other agricultural applications, 43 MW_{th} of thermal spas and 191 MW_{th} of "geothermal" – or ground source - heat pumps (GSHPs - GHPs). All three sectors are expected to experience a high growth in the coming years. In addition, new district heating systems using geothermal energy are under development and the first pilot geothermal power plants exploiting high enthalpy resources are under investigation.

In Europe, Shallow Geothermal Energy with GHPs is the most developed sector of the geothermal market, while in Greece GHPs are mainly used for heating/cooling commercial stores, in swimming pools, university campuses, and in the hotel sector. As mentioned before, the heat pump market in Greece corresponds to the third and clearly most developed category of the Greek geothermal market. Heat pumps have managed to maintain a steady upward trend over the last 15 years, supported by the favourable legal framework and the national policy towards "decarbonization" of building infrastructure (small contribution to the greenhouse effect). Two new market segments are expected to develop in the coming years: space heating, once the planned municipal district heating systems under construction are completed, and geothermal electricity production, when the first pilot plants are built.

Table 4.11: Shallow geothermal energy, installed in Greece in 2019 [Source: EGC Country Update Papachristou et al. 2019]

	Geothermal Heat Pumps (GSHP), total			New (additional) GSHP in 2018 *		
	Number	Capacity (MW_{th})	Production (GWh_{th}/yr)	Number	Capacity (MW_{th})	Share in new constr. (%)
In operation end of 2018	~3300 (est.)	175	383	300	9	?
Projected total by 2020	**~3500**	**195**	**450**			

Figure 4.25 below presents the evolution of the installed capacity of GHPs in Greece during the years 1995–2019, where a clear gradual and notable increase is observed from 2005 onwards.

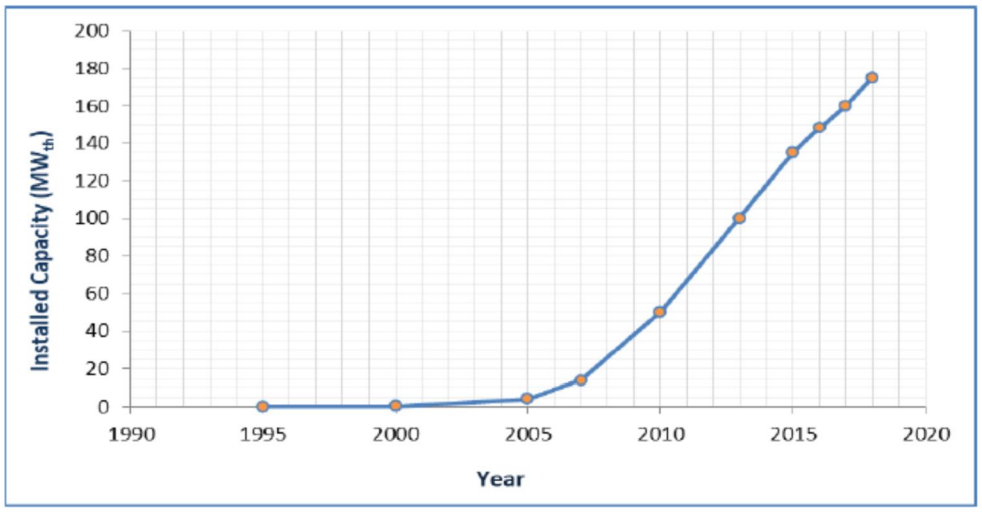


Figure 4.25: Total installed capacity of GHP in Greece during the last 25 years (1995-2019) [Source: https://helapco.gr/wp-content/uploads/KARYTSAS-GSHP_13_02_2020_FINAL.pdf]

Regarding the current picture addressing the existence of geothermal systems in buildings in Greece, a characteristic (and most recent) example is the city of Grevena city, which claims the title of the "green" city of geothermal energy, since in just five years all municipal buildings of the city, such as the Indoor Gym, the Swimming Pool, the Town Hall, The Library - Cultural Center and some of the city's schools possess – in some of them work shall begin – a heating and cooling system through shallow geothermal energy - Geothermal Heat Pumps (GHPs). More specifically, the installed geothermal capacity is 0.5 MW and once the construction works in four building complexes are completed, the portfolio of the Municipality of Grevena will rise to 2 MW.

Other cases of use of geothermal systems (GHP) in buildings in Greece are located in the new building of the Region of Central Macedonia (the system consists of two heat pumps (2×425 kW) and three, different type, ground heat exchangers operating simultaneously), at the hotel "Amalia" in Nafplio, with an open type GHP system and a total power of 704 k=]=W_{th}, as well as a residence in Pikermi with an open type GHP system and a total power of 8.70 kW_{th}.

5. Existing provisions in the field of Education and Training

5.1 Summary

In the first section, a detailed description of the Greek educational system is given, both of the general compulsory secondary education and the Continuing Vocational Education and Training (CVET), and of the general non-formal education of adults. The second section analyses the national VET (Vocational Education and Training) system related to construction sector professionals. The third section addresses the national higher education system for professionals in the construction sector and analyses the education offered to them.

Subsequent sections refer to the existing tools used to monitor developments in the construction sector market, such as sector skills observatories, existing measures taken to make renovation and construction sectors more attractive to women and young professionals, initiatives taken to retrain workers and professionals who work or have worked in areas related to fossil fuels and other sectors. In addition, informal training courses and programs offered to construction sector professionals are presented. Finally, relevant skill development actions supported by the European Union at the national and regional levels are mentioned.

5.2 Description of the Greek Educational System

According to the Greek constitution, free education must be provided to all children living in the country. Education is distinguished into:

- **Formal** which is provided within the framework of the formal education system, leading to the acquisition of certificates recognized at the national level by public authorities and is also part of the graded educational system.
- **Non – Formal**, provided in an organized educational framework outside the formal education system, can lead to the acquisition of certificates recognized at the national level. This includes initial vocational training, continuing vocational training, and general adult education.
- **Informal education/learning** which includes the learning activities that take place outside an organized educational framework throughout a person's lifetime, in the context of leisure time or professional, social, and cultural activities. Moreover, it encompasses all kinds of self-education activities, such as self-study with printed material or via the internet or using a computer or various educational infrastructures, as well as the knowledge, skills, and competencies a person gains from the professional experience provided in an organized educational setting outside the formal educational system, which can lead to the acquisition of nationally recognized certificates. It includes initial vocational training, continuous vocational training, and general adult education.

5.2.1 Organization of the formal educational system

Compulsory education in Greece consists of:

- Two-year compulsory attendance for 4-year-olds in pre-primary school.
- Six-year attendance of pupils in primary school.
- Three-year attendance of students in lower secondary education school.

Furthermore, the formal education system in Greece includes:

1. **Primary education:**
   - Two-year compulsory attendance for 4-year-old children (pre-primary school)
   - Six-year compulsory attendance, including grades 1, 2, 3, 4, 5 and 6, with six-year-old pupils enrolling in grade 1. After the end of primary education, pupils study in secondary education, a separate level of education.

2. **Secondary Education:** The purpose of the general compulsory secondary education provided in lower secondary school is to promote the comprehensive development of students in relation to the opportunities they have at this age and the corresponding requirements of life (Law 1566/1985). According to the Penal Code, it is punishable if a person has custody of a juvenile student but fails to register or fails to provide educational supervision. Secondary education includes two cycles:
   - The **first cycle** is the compulsory secondary education provided in Gymnasiums (lower secondary schools), both daytime and evening, with three-year duration. Daytime Gymnasiums are the main provider of general compulsory secondary education as they cater to the majority of the student population and account for over 90% of the educational units offering general compulsory secondary education. There are 1554 daytime gymnasiums that cater to students over the age of 14. Evening lower secondary schools (Esperina gymnasia) are attended by employed students over 14 years old, while attendance lasts for three years, including grades A, B, and C. These grades correspond precisely to those of the daytime gymnasium. In Greece, there are currently 44 evening lower secondary schools.
   - The **non-compulsory** secondary education which is divided into General and Vocational Education. Specifically, General education is provided in the daytime General Lyceums for a duration of 3 years. In the following sections, the different categories of non-compulsory secondary education provided in the daytime or evening Vocational Lyceums (EPAL), in the daytime or evening Vocational Training Schools of two-year duration, and the two-year Vocational Apprentice Schools of OAED (EPAS OAED).

5.2.2 General education

General education is provided by the **General Lyceums (GEL),** either day or evening, lasting three years. There are 1,111 **daytime General Lyceums**, which are the main providers of non-compulsory secondary general education as they cater to most of the student population that chooses general education at this level. There are 78 **evening General Lyceums**, aimed at employed and unemployed students who wish to complete their school studies. According to law 4547/2018, adult students and underage working students can enrol in evening lyceums. According to the same law, studies at the General Lyceum last 3 years and include grades A, B, C of the General Lyceum.

Additionally, non-compulsory general education also includes the **Second Chance Schools** which were established in 1997 by law 2525/1997 and with law 4763/2020 under the Ministry of Education and Religious Affairs, which, through the General Secretariat for Lifelong Learning and Youth, drafts their educational framework and oversees their operation. Second Chance Schools are public and cater to individuals aged 18 and over who have not completed the mandatory nine – year education and have a primary school diploma. The duration of the studies at the Second Chance Schools is two years, and their **funding** comes from both EU and national resources through the operational programs of the Ministry of Education and Religious Affairs. There are 66 Second Chance Schools and 12 Second Chance Schools operating within correctional institutions. Furthermore, in the 2020-2021 school year, there were 5352 trainees and 2198 graduates in SCS, while in January 2022, the number of trainees was decreased to 4,634.

5.2.3 Vocational education

Vocational education is provided by:

- The **vocational Lyceums (EPAL)**, either day or evening, with a three-year duration of studies, which include grades A,B,C. Students with a middle school diploma or an equivalent title are enrolled in A grade without examinations. Currently there are 333 daytime Vocational Lyceums in Greece, of which 6 are model schools. According to law 4547/2018, all adult students and underage working students have the right to attend Vocational Lyceums.
- The **Vocational Schools of Apprenticeship of OAED (EPAS OAED)** with a two-year duration.

The **Post-secondary vocational education and training at NQF Level 3** is provided by Vocational Training Schools (ESK) and Vocational Schools of Apprenticeship (EPAS) of OAED. These studies last two years and include grades A and B. Holders of a middle school diploma, or an equivalent title are enrolled in the A grade without examinations. ESK can be public or private, daytime or evening. The public ESK of the Ministry of Education and Religious Affairs as an entirety of responsibilities, positions, personnel, and material-technical infrastructure, are established under law 4763/2020 and operate as decentralized services under the General Secretariat of Vocational Education, Training, Lifelong Learning and Youth of the Ministry of Education and Religious Affairs. The EPAS Apprenticeship under OAED are public and operate based on the law 4763/2020 (Government Gazette 254A), and in the year 2021, there were 7,645 apprentices.

Finally, the **Post-secondary vocational education and training at NQF Level 5** is provided by:

1. **Vocational Training Institutes (IEK)** that offer initial vocational training to graduates of non-compulsory secondary education, namely General High Schools (GEL) and Vocational High Schools (EPAL), as well as to holders of equivalent titles. Vocational training lasts 4-5 semesters. For EPAL graduates and holders of equivalent vocational education titles, training can last 2-3 semesters. IEKs can be public or private and operate within the framework of non-formal education and can lead to the acquisition of nationally recognized certificates. Trainees who successfully complete their studies at the IEKs receive a Diploma of Vocational Specialty, Education, and Training, Level 5, after certification. IEK graduates who, after successful initial vocational training certification examination, hold a Diploma of Vocational Specialty, Education, and Training, Level 5, of the NQF or an equivalent title, can be placed in AEI (Institutions of Higher Education) departments of a specialty related to the aforementioned diploma.
2. **Post-High School Year - Apprenticeship Class** that provides initial vocational training services to graduates of non-compulsory secondary vocational education and holders of equivalent titles, who possess a basic level of knowledge, skills, and abilities. The Post-High School Year - Apprenticeship Class program lasts 11 months. Upon completion of the Post-High School Year-Apprenticeship Class, a VEK (Vocational Training Certificate) is awarded to the graduate by the school unit, following an assessment in the laboratory lesson and the learning program in the workplace. The VEK is a prerequisite for participation in the qualification certification exams and the acquisition of a level five (5) vocational education and training diploma, conducted annually by EOPPEP. Graduates of the Post-High School Year - Apprenticeship Class can optionally attend a 35-hour Preparatory Certification Program, aiming at better preparation for the qualification certification procedures and title acquisition at Level 5. Graduates of the Post-High School Year-Apprenticeship Class who, after a successful initial vocational training certification examination, hold a Diploma of Vocational Specialty, Education, and Training, Level 5, of the National Qualifications Framework or an equivalent title, can be placed in AEI (Institutions of Higher Education) departments of a specialty related to the aforementioned diploma. The Post-High School Year-Apprenticeship Class can be funded by national or union resources.

5.3 National System of Vocational Education and Training for professionals in the building sector

5.3.1 Status Quo of the vocational training in the building sector

The most common educational path consists of VET (EEK) programs offered at the vocational high school (EPAL), which can also lead to obtaining a specialization diploma. EPAL graduates can participate in national exams for admission to tertiary education. It is worth noting that according to the study «Vocational Education and Training in Europe»[5] the percentage of students admitted to tertiary education institutions who are EPAL graduates has increased by 5% in engineering and pharmaceutical

[5] Cedefop; National Organisation for the Certification of Qualifications and Vocational Guidance (EOPPEP) (2019). Vocational education and training in Europe: Greece [From Cedefop; ReferNet. Vocational education and training in Europe database]

schools, 10% for other educational departments, and 20% for the Higher School of Pedagogical and Technological Education (ASPAITE), which corresponds to EQF level 6.

Consequently, at the post-secondary level, vocational education and training are offered in:

- One-year Apprenticeship programs (EQF Level: 5, based entirely on work-based educational programs) in collaboration with OAED (Manpower Employment Organization).
- 2.5-year programs offered by public and private IEK (Institutes of Vocational Training) to post-secondary education graduates, allowing students to acquire a program completion certificate. Alternatively, students can choose certification through an examination conducted by EOPPEP (National Organization for the Certification of Qualifications and Vocational Guidance), which can lead to a level 5 qualification certification (EQF Level:5)

According to the data from the Ministry of Education, for the academic year 2022-2023, the admission of 6,460 male and female students to the Vocational Schools (EPAS) of the Public Employment Service (formerly OAED) was approved in a total of 51 vocational schools across the Greek territory. Of the total specialties offered, twelve are related to the construction sector and are displayed in table 5.2, while the corresponding number for EPAL (Vocational Lyceum) is limited to 4 specialties.

Similarly, in the public Institutes of Vocational Training (IEKs), which for the academic year 2022-2023 allocated positions for 23,500 students, as well as in the 84 private IEKs that are legally established under the General Secretariat of Vocational Education, Training, Lifelong Learning and Youth, there were four specialties related to the construction sector. These specialties are identified in the educational fields of Mechanics and Electrical, Electronics, and Automation. It is worth noting that both graduates of private IEKs and those from public institutions (DIEKs) have the right to participate in the examinations organized by EOPPEP, as the examination topics are common for all graduates. They take place on the same days and times and are based on a syllabus and range of subjects like those of the public IEKs, as this is shaped by the G.S. of Vocational Education, Training, LLL & Youth and is certified by EOPPEP.

The following tables list the specialties related to the construction sector, and more specifically to RES and energy-saving related aspects in EPAS, EPAL, IEK, and DIEK, as well as the subjects most closely related to the above actions (Table 5.2). They also cover professional education and training programs in Greece (Table 5.1) by EQF level, study duration, funding, and evaluation of the educational content regarding covering necessary or emerging skills in the context of achieving national energy targets by 2030. It should be noted that the assessment was conducted by identifying the curricula of the respective specialties (Table 5.3).

Table 5.1: Vocational Education and Training Programs in Greece

	Vocational High School Diploma	Vocational Training Schools (SEK) / Apprenticeship Schools (EPAS OAED)	Diploma of Vocational Specialty, Education, and Training - Public IEK	Diploma of Vocational Training at the Post-secondary Level - Private IEK	Diploma of Vocational Specialty, Education, and Training (EPAL - Apprenticeship Class
EQF Level	4	3	5	5	5
Duration (Years)	3	2	2.5	2.5	1
Is it part of compulsory education?	No	No	No	No	No
Is it part of the formal education system?	Yes	Yes	Yes	Yes	Yes
Is it initial vocational education and training?	Yes	Yes	Yes	Yes	Yes

Is it continuing educational and vocational training?	No	No	No	No	No
Is it free?	Yes	Yes	Yes	Yes	Yes
ECVET / Other Credits	N/A	N/A	N/A	N/A	N/A
Education Providers	Public Schools supervised by the Ministry of Education	Public schools supervised by the Ministry of Education and the Ministry of Labor	Public schools supervised by the General Secretariat for Vocational Education, Training, Lifelong Learning, and Youth and the Ministry of Education	Private schools supervised by the General Secretariat for Lifelong Learning and the Ministry of Education	Public schools supervised by the Ministry of Education

Table 5.2: Specialties related to the building sector within the Greek VET system

Education providers	Specialty	EQF LEVEL	Indicative curriculum	Number of courses
EPAS	Electrical Technicians	3	Electrical Engineering, Electrical Engineering Laboratory, Electrical Automation and Electronic Components, Indoor Electrical Installations, Automation and Automatic Control Systems, Electricity and Environment	13
EPAS	Technicians of Thermal and Hydraulic Installations	3	Elements of Mechanical Designs, Technical Engineering - Strength of Materials, Elements of Electrical Engineering, Introduction to Mechanical Engineering. Plumbing Installations, Central Heating, Air Conditioning Components, Natural Gas Technology, Mild Forms of Energy, Maintenance and Repair of Installations	14
EPAS	Installers of Refrigeration and Air Conditioning Projects	3	Design, Materials Technology, Engineering - Strength of Materials, Construction Technology, Work Safety, Machine Elements, Environmental Protection, Elements of Thermodynamics and mechanical fluids, electrotechnical applications, compressors, refrigeration technology, automation of refrigeration plants, air conditioning, design of refrigeration plants	15
EPAS	Fuel Gas Technicians (Natural Gas)	3	Basic Principles of Fluid Mechanics, Thermodynamics & Heat Transfer, Materials and Construction of Hydraulic Networks, Elements of Gaseous Fuel Technology, Materials & Construction of Gaseous Fuel Networks, Machining & Welding Technology, Technical Mechanical Design, Electrical Engineering Elements, Gas Fuel Boilers Burners, Gas Fuel Applications Devices, Manufacturing equipment, Operation, Maintenance & Repair of Central Heating Installations, Design of Fuel Gas Installations, Fuel Gas Installations, Instruments for Measuring, Automation & Control of Fuel Gases, Legislation & Regulations of Fuel Gases. Protection Environment, English Terminology	15

EPAS	Metal Construction Craftsmen	3	Welding (Theory and Practice), composition of metal structures, forming of metal structures, special topics of metal welding with various methods, electric welding, oxygen welding, composition of metal structures from ready-made semi-formed elements	14
EPAS	Technician of Electrical Systems, Installations and Networks	4	Design of Electrical Installations of buildings and industrial areas with circuits: Lighting, appliances, grounding, telephone, intercom, TV, fire detection, alarm, PC networks, lightning rods, heating, elevators, motion and lighting panels, motion automation (conventional or with PLC)	16
EPAS	Refrigeration Ventilation / AC Technician	4	Design, Materials Technology, Engineering - Strength of Materials, Construction Technology, Work Safety, Machine Elements, Environmental Protection, Elements of Thermodynamics and mechanical fluids, electrotechnical applications, compressors, refrigeration technology, automation of refrigeration plants, air conditioning, design of refrigeration plants	15
EPAL	Technical Engineer of Thermal Installations and Engineer of Oil and Natural Gas Technology	4	Design, Materials Technology, Engineering - Strength of Materials, Construction Technology, Work Safety, Machine Components, Environmental Protection, Thermodynamics and mechanical fluid components, electrotechnical applications, plant design, production of liquid and gaseous fuels, transportation, distribution and storage of fuels, plant automation, fuel quality control, fuel burner applications	19
IEK	Renewable Energy installation Technician	5	Electrical Engineering, Analog Electronics, Digital Electronics, Mechanical Engineering, Electrical Engineering, Industrial Electronics, RES, Electric Motion, Green Installation	14
IEK	Automation Technician	5	Electrical Engineering, Analog Electronics, Digital Electronics, Mechanical Engineering, Electrical Engineering, Industrial Informatics, Design, Industrial Electronics, Automatic Control Systems, Industrial Informatics, Computer Programming	14
IEK	Refrigeration, Ventilation and Air Conditioning Installations Technician	5	Design, Materials Technology, Engineering - Strength of Materials, Construction Technology, Work Safety, Machine Elements, Environmental Protection, Elements of Thermodynamics and mechanical fluids, electrotechnical applications, compressors, refrigeration technology, automation of refrigeration plants, air conditioning, design of refrigeration plants	15
IEK	Technical Engineer of Thermal Installations and Engineer of Oil and Natural Gas Technology	5	Design, Materials Technology, Engineering - Strength of Materials, Construction Technology, Work Safety, Machine Components, Environmental Protection, Thermodynamics and mechanical fluid components, electrotechnical applications, plant design, production of liquid and gaseous fuels, transportation, distribution and storage of fuels, plant automation, fuel quality control, fuel burner applications	19

Table 5.3: Specialties related to the building sector and evaluation of the educational content in relation to emerging skills

Professions related to the building sector	**EVALUATION OF EDUCATION CURRICULUM**							
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Electrical Technicians								
Technicians of Thermal and Hydraulic Installations								
Fuel Gas Technicians (Natural Gas)								
Metal Construction Craftsmen								
Technician of Electrical Systems, Installations and Networks								
Refrigeration Ventilation / AC Technician								
Technical Engineer of Thermal Installations and Engineer of Oil and Natural Gas Technology								
Automation Technician								
Renewable Energy installation Technician								

a. *skills for implementation of energy efficiency and renewable energy measures in buildings.*
b. *skills for delivering building deep renovation, including through modular and industrialised solutions.*
c. *skills for new and existing nearly Zero Energy Buildings (nZEBs) and bridging the gap towards Zero Emission Buildings (ZEBs).*
d. *skills for integration of renewable energy and efficient heating and cooling technologies, including in particular heat pumps roll-out; skills for installers to deliver heating and cooling upgrades as part of renovation projects.*
e. *skills related to whole life carbon (via the assessment of Global Warming Potential), circular construction and resource efficiency, and leveraging the Level(s) framework.*
f. *digital skills supporting greater energy performance of buildings, in particular through an enhanced use of Building Information Modelling.*
g. *skills for upgrading the smartness of buildings for greater energy performance (based on the Smart Readiness Indicator), looking in particular at sensors, building controls and building management system*
h. *skills for energy upgrade of historical (heritage) buildings*

Evaluation of whether the education system addresses the aforementioned skills.

Little to None | Partially | Adequately

5.3.2 Governance of vocational education and training policies

Public and private providers of VET (Vocational Education and Training) programs are monitored, evaluated, and typically funded by:

- The General Secretariat for Vocational Education, Training, Lifelong Learning, and Youth
- The secondary and/or vocational education departments of the Ministry of Education
- The organizations overseen by the Ministry of Education (e.g., EOPPEP, Universities).

According to law 4763/2020, the General Secretariat for Vocational Education, Training, Lifelong Learning, and Youth is responsible for designing, implementing, managing, and monitoring Greek educational policies and supervising the implementation and monitoring of VET and Lifelong Learning programs. Additionally, this law established advisory bodies at national and local levels to govern VET programs. At the national level, the Central Council for Vocational Education and Training (CCVET) was established, with a three-year term, consisting of representatives from the Ministry of Education and Religious Affairs as well as other Ministries, workers' unions, and chambers. The purpose of the CCVET is to make proposals and suggestions to the Minister of Education and Religious Affairs regarding the design of national policy on vocational education, training, and lifelong learning, especially in promoting

knowledge, sustainable development, leveraging human capacities, and linking education to the job market and employment.

Councils for Linking with Production and the Labour Market (CLPLM) have been established at the local level, aiming to connect VET programs to the local job market. Specifically, the CLPLM's mission is to submit suggestions and opinions to the CCVET on vocational training matters, especially regarding sectors and specializations to be operated in public IEK (Institutes of Vocational Training), Post-Lyceum Year - Apprenticeship Class, EPAL (Professional Lyceum), public ESK (School of Vocational Training) and EPAS (Apprenticeship School) of OAED, as well as special lessons, programs, and activities, beyond the approved core curriculum, which aim to enhance the developmental character of the specific region.

Furthermore, in the Ministry of Education and Religious Affairs, a Central Scientific Committee (CSC) is established, scientifically supporting the General Secretariat for Vocational Education, Training, Lifelong Learning, and Youth, as well as the CCVET. Its mission is scientific research, study, and documentation on issues related to improving the quality and effectiveness of vocational education and training and lifelong learning programs. The role of the CSC is to suggest, propose, or provide opinions to the General Secretaries of the Ministry of Education and Religious Affairs involved in vocational education, training, and lifelong learning.

5.3.3 Funding of vocational education and training policies

In Greece, formal VET (Vocational Education and Training) is primarily funded through the state budget from resources of the Ministry of Education and Religious Affairs, while adult education and training is also funded through the state budget and resources of the Ministry of Education and Religious Affairs, with the largest portion being covered by the co-financed section of the Public Investment Program (PIP) through the implementation of the Operational Programs of the NSRF (National Strategic Reference Framework).

Lastly, apprenticeship programs can be funded by national, private, and/or private capital, such as the European Social Fund+ (ESF+), with private participation reaching 45% of the financial compensation of the apprentices.

5.4 The national higher education system for building sector professionals

Professionals with a higher education degree who can be involved in the study and supervision of project implementation in the construction sector are engineering graduates from university and polytechnic schools. In the current education system, the specializations of engineers who have professional rights in the construction sector are:

- Civil Engineer
- Architect Engineer
- Mechanical Engineer
- Electrical Engineer
- Agronomist Surveyor Engineer
- Chemical Engineer
- Mining and Metallurgical Engineer
- Naval Engineer
- Spatial Planning, Urban Planning, and Development Engineer
- Environmental Engineer
- Mineral Resources Engineer
- Production and Management Engineer

Education in the aforementioned engineering specialties is provided in total by **14 higher education institutions and 56 departments**. The competent supervising authority for these educational institutions is the General Secretariat of Higher Education of the Ministry of Education and Religious Affairs. After successful completion of their studies and obtaining their degree, no additional certification of professional/academic qualifications is required. To acquire the professional rights recognized by public authorities for drafting and supervising studies, all graduates from tertiary education engineering specialties must obtain a professional practice license from the Technical Chamber of Greece (T.E.E.). For this reason, T.E.E. conducts relevant professional practice licensing exams twice a year.

Engineers who have graduated from foreign universities can also participate in these exams, provided they have successfully completed the recognition process of their degree by the Interdisciplinary Organization for the Recognition of Academic Titles and Information (DOATAP) and have received equivalence and correspondence of their degree with one of the engineering schools operating in Greece. Today in Greece, approximately 108,000 graduate engineers, members of T.E.E. (TCG), are employed, to which about 8,200 new engineers are added each year. Figure 5.1 presents the distribution of new graduates by engineering specialty.

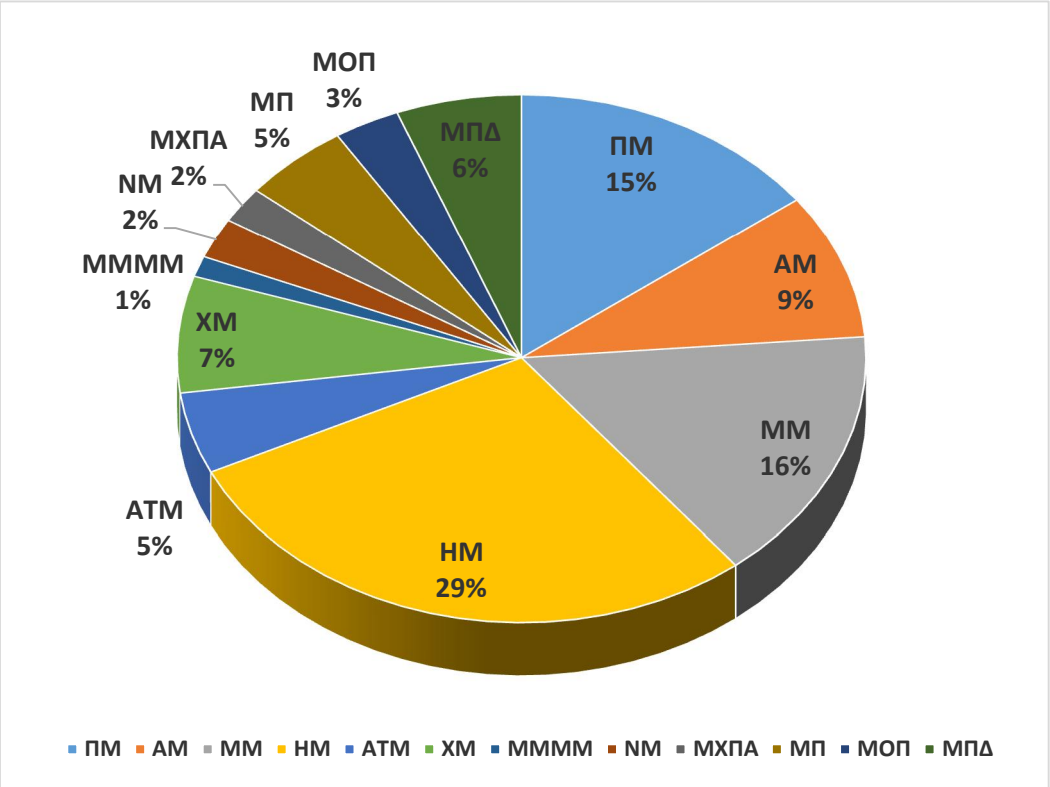


Figure 5.1: Distribution of higher education engineering graduates by specialty

Abbreviations:
ΠΜ → *Civil Engineer*
ΑΜ → *Architect*
ΜΜ → *Mechanical Engineer*
ΗΜ → *Electrical Engineer*
ΑΤΜ → *Rural and Surveying Engineer*
ΧΜ → *Chemical Engineer*
ΜΜΜΜ→ *Mining and Metallurgical Engineer*
ΝΜ → *Naval Engineer*
ΜΧΠΑ → *Spatial Planning, Urban Planning and Development Engineer*
ΜΠ → *Environmental Engineer*
ΜΟΠ → *Mineral Resources Engineer*
ΜΠΔ → *Production and Management Engineer*

In Greece, almost all engineering specialties of higher and upper education have established professional rights in the building construction sector (see Table 5.4), even those that seemingly are not related to construction activities, such as Naval Engineers, Chemical Engineers, Mineral Resource Engineers, etc. Although this may seem paradoxical, it is due to the development model followed by the country for many decades, with the construction sector serving as the 'locomotive' of the national economy. Simultaneously, other significant industrial sectors for the employment of various engineering specialties, such as Industry, Mining, Shipbuilding, etc., have shown very little growth, in some cases even shrinking, and thus could not provide sufficient job opportunities for new engineers, whose numbers gradually increased.

As a result, most engineers in the country have become involved in the building construction sector as designers and/or construction supervisors. Thus, engineering specialties whose theoretical subject is closer to that of Mechanical-Electrical Engineers have professional rights for the study, design and supervision of the electromechanical installations of a building, while engineering specialties whose theoretical subject is closer to that of Civil Engineers-Architects have professional rights related to the design and supervision of works for the building envelope.

Additionally, it should be emphasized that, under the current national legislation, all engineering specialties have the ability to practice as “Building Energy Auditors”. As building energy auditors, engineers are responsible for the design and construction of new low and nearly zero-energy buildings as well as for the energy classification and energy upgrading of existing buildings, playing a significant role in achieving the energy goals of the building sector by 2030..

However, this significant role of engineers is not reflected in the current curricula, which cater more to the needs of past decades and very little, if at all, to the modern requirements for energy conservation and environmental protection. By examining the curricula for the various engineering specialties (as presented in Table 5.5), it is observed that they mainly include the timeless required skills of the building construction sector (e.g., building stability, electromechanical equipment, etc.) and to a moderate to zero degree the necessary modern green skills that will contribute to achieving the sector's goals by 2030.

Thus, while most engineering specialties include courses related to energy conservation in buildings, energy design of buildings, heating and cooling systems, and renewable energy technologies, these provide only some basic knowledge and not the essential skills that will contribute to the construction of nearly zero-energy buildings. On the other hand, skills related to the implementation of deep renovation of buildings, among others through modular and industrialized solutions, the carbon footprint, circular construction, the enhanced use of BIM systems, smart operation, and energy management systems (BEMS) are not covered at all by the existing curricula.

The situation is slightly better with the available postgraduate programs related to the buildings construction sector (Table 5.6). Although there is no postgraduate program that fully meets modern requirements, from Table 5.7 where the indicative study content of each of these programs is presented as well as its assessment in relation to the required skills in the building sector. it is found that there are postgraduate programs, such as the “Energy Production and Management” (No. 2), “Renewable Energy Sources and Energy Management in Buildings” (No. 10), and “MSc in Energy Systems” (No. 17), which can cover some of the required “new” engineers' skills. Interestingly, these three available postgraduate programs respond rather well to meeting the skills for upgrading the smart operation of buildings for greater energy performance (based on the smart readiness indicator), examining especially sensors, building controls, and building management systems.

In addition to postgraduate programs, which in any case can only provide skills to a small number of engineers per year, engineers have the opportunity to develop their skills through training programs provided by the Continuing Education Centres (KE.Di.Vi.M.) as presented in Table 5.8. In this case too, the acquired skills fall short of the requirements, with the exception of the training program 'Design and Optimization of Zero Energy Consumption Buildings' (No. 10), which moderately to fully meets several modern skills.

Table 5.4: Professional rights and training of chartered engineers in relation to the building construction industry

Abbreviation	*Specialties of chartered engineers*	*Number of schools*	*Graduates/ year*	*Professional rights in the building construction industry*	*(1)*	*(2)*	*(3)*	*(4)*
ΠΜ	Civil Engineer	8	1.210	Elaboration of Architectural Studies, Passive Fire Protection studies, building acoustics and soundproofing of Building Projects. Elaboration of Static Studies (studies of bearing structures of buildings) of Building Projects, Surveying of existing buildings. Bioclimatic design of buildings. Interior Design. Control of anti-seismic behaviour of non-bearing elements and attachments. Drawing up studies of plumbing installations (water supply - drainage) of buildings. Elaboration of energy efficiency, upgrade and energy saving studies of the building envelope. Carrying out energy inspections and Energy Audits.	23	113	2	10
ΑΜ	Architect	7	737	Elaboration of Architectural Studies of Building Projects. Preparation of Special Architectural Studies, indicatively: buildings in a traditional settlement, a traditional or historical part of the city, a residential complex that has been designated as a historical preserved monument, as well as for declared preserved buildings or newer monuments. Elaboration of passive fire protection studies for building projects. Mapping of existing buildings. Elaboration of building acoustic studies and soundproofing. Interior Design Bioclimatic design of buildings and architectural ensembles. Elaboration of static studies except for special constructions: special foundations, prestressed concrete envelope constructions, metal constructions, wooden constructions. Elaboration of building plumbing studies. Elaboration of energy efficiency, upgrade and energy saving studies of the building envelope. Carrying out energy inspections and Energy Audits.	12	51	2	8
ΜΜ	Mechanical Engineer	9	1.279	Elaboration of Passive Fire Protection studies of Building Projects. Plans (two-dimensional) and sections of existing buildings for electrical and mechanical licensing except for building permits of any kind, except for monuments, declared preserved buildings, protected settlements and complexes. Drawing up studies of heating, cooling, air conditioning and ventilation facilities. Elaboration of studies on building service network facilities, namely: electrical networks and related facilities, plumbing, refrigeration and air conditioning facilities, liquid and gaseous fuel combustion facilities, all types of boilers, heat pumps and other systems, passive heating systems. Elaboration of studies of electrical installations and networks, transmission and distribution lines of low voltage, medium voltage, high voltage and extra high voltage. Elaboration of energy efficiency, upgrade and energy saving studies of the building envelope. Elaboration of studies of energy efficiency, upgrading and energy saving of facilities. Carrying out energy inspections and Energy Audits.	6	30	3	16

ΗΜ	Electrical Engineer	10	2.341	Elaboration of passive fire protection studies for building projects. Plans (two-dimensional) and sections of existing buildings for electrical and mechanical licensing except for building permits of any kind, except for monuments, declared preserved buildings, protected settlements and ensembles. Drawing up studies of heating, cooling, air conditioning and ventilation facilities. Elaboration of studies on building service network facilities, namely: electrical networks and related facilities, plumbing, refrigeration and air conditioning facilities, liquid and gaseous fuel combustion facilities, all types of boilers, heat pumps and other systems, passive heating systems. Elaboration of studies of electrical installations and networks, transmission and distribution lines of low voltage, medium voltage, high voltage and extra high voltage. Elaboration of energy efficiency, upgrade and energy saving studies of the building envelope. Elaboration of studies of energy efficiency, upgrading and energy saving of facilities. Carrying out energy inspections and Energy Audits.	5	25	1	2
ΑΤΜ	Rural and Surveying Engineer	4	409	Elaboration of Architectural Studies of Building Projects for simple architectural works and new building projects up to two floors high. Elaboration of passive fire protection studies for building projects. Mapping of existing buildings. Elaboration of static studies for simple building works and new building projects up to two storeys in height. Carrying out energy inspections and Energy Audits.	2	8	0	0
ΧΜ	Chemical Engineer	5	586	Elaboration of energy efficiency, upgrade and energy saving studies of the building envelope. Elaboration of energy efficiency studies, upgrading and energy saving of industrial/building facilities. Carrying out energy inspections and Energy Audits.	1	3	1	3
ΜΜΜΜ	Mining and Metallurgical Engineer	1	105	Elaboration of studies of energy efficiency, upgrading and energy saving of facilities (industries, buildings, etc.). Carrying out energy inspections and Energy Audits.	1	3	0	0
ΝΜ	Naval Engineer	2	204	Plans (two-dimensional) and sections of existing buildings for electrical and mechanical licensing except for building permits of any kind, except for monuments, preserved buildings, traditional settlements and ensembles. Elaboration of studies on building service network facilities, namely: electrical networks and related facilities, plumbing, refrigeration and air conditioning facilities, liquid and gaseous fuel combustion facilities, all types of boilers, heat pumps and other systems, passive heating systems. Elaboration of studies on other electrical installations. Drawing up studies of heating, cooling, air conditioning and ventilation facilities. Preparation of studies for natural gas installations, passive heating systems, water supply and drainage installations for building projects. Preparation and supervision of energy efficiency, upgrading and energy saving studies of the building envelope. Preparation and supervision of energy efficiency studies, upgrading and energy saving of industrial/building facilities. Carrying out energy inspections and Energy Audits.	1	4	0	0
ΜΧΠΑ	Spatial Planning, Urban Planning and Development Engineer	2	183	Elaboration of Architectural Studies of Building Projects for simple architectural works and new building projects of up to two floors outside of special purpose buildings and up to 200 sq.m. Mapping of existing buildings other than special-use buildings, monuments, declared listed buildings, protected settlements and ensembles Preparation of energy efficiency studies, upgrading and energy saving of the building envelope for building projects up to two floors apart from special-use buildings and up to 200 sq.m. Carrying out energy inspections and Energy Audits.	2	8	0	0
ΜΠ	Environmental Engineer	3	413	Mapping of existing buildings other than special purpose buildings, monuments, declared preserved buildings, protected settlements and ensembles. Carrying out energy inspections and Energy Audits.	2	10	1	5

ΜΟΠ	Mineral Resources Engineer	2	254	Elaboration of studies of energy efficiency, upgrading and energy saving of facilities (industries, buildings, etc.). Carrying out energy inspections and Energy Audits..	1	5	0	0
ΜΠΔ	Production and Management Engineer	3	483	Elaboration of passive fire protection studies for building projects. Plans (two-dimensional) and sections of existing buildings for electrical and mechanical licensing except for building permits of any kind, except for monuments, preserved buildings, traditional settlements and ensembles. Elaboration of studies in facilities of building service networks, namely: electrical networks and related facilities, plumbing, refrigeration and air conditioning facilities, liquid and gaseous fuel combustion facilities, all kinds of boilers, heat pumps and other systems, passive heating systems Elaboration of studies in other electrical installations. Elaboration of studies for heating, cooling, air conditioning facilities. Preparation of studies for natural gas installations, passive heating systems, water supply and drainage installations for building projects. Preparation and supervision of energy efficiency studies, upgrading and energy saving of industrial/building facilities. Carrying out energy inspections and Energy Audits.	0	0	0	0
	Total	56	8.202					
	(1) Average number of courses related to the building sector (2) Average number of course ECTS related to the building sector (3) Average number of courses related to energy savings in the building sector (4) Average number of course ECTS related to energy savings in the building sector							

Table 5.5: Indicative curriculum related to the building industry and evaluation in relation to energy efficiency

Abbreviation	Specialties of chartered engineers	Indicative curriculum	Curriculum Evaluation							
			(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
ΠΜ	Civil Engineer	Statics and dynamics of structures. Concrete constructions. Steel constructions. Aluminum constructions. Building materials and Technology of building materials. Materials for maintenance, repair and reinforcement of constructions (monuments, preserved and historical buildings). Utilization of by-products in construction - ecological building materials. Construction. Physics of buildings. Hydrothermal behaviour of structural elements. Energy design of buildings. Energy efficiency. Architectural design of buildings. Environmental design of buildings. Seismic engineering and antiseismic technology. Constructions from natural and artificial stones (masonry, etc.). Mixed constructions. Maintenance, repair and reinforcement of constructions (monuments, listed buildings, etc.). Industrialized building and prefabs. Life cycle analysis in building constructions. Antiseismic technology and pathology of reinforced concrete structures								
ΑΜ	Architect	Architectural Design, Antiseismic design and behaviour of various building materials in developing deformations. Passive, active and sustainable design strategies. building design of conventional construction with reinforced concrete load-bearing structure and configuration of the load-bearing structure. Frames. Ceilings. Light partitions - dry construction. Introduction to the electromechanical installations of buildings. Elements of Bioclimatic Architecture. Composite, composite and multilayer								

		constructions. Applications of the load-bearing body and the Building Envelope in Light Constructions. (Foundations, masonry, curtains, coverings, ceilings, roofs). Environmental behaviour and life cycle of lightweight materials. maintenance, restoration, integration of new uses and the promotion of historical buildings. methodology for planning interventions in historic buildings with traditional as well as modern techniques								
ΜΜ	Mechanical Engineer	Heating - Cooling - Air conditioning. Mild Forms of Energy. Smart Energy Buildings. Thermal behaviour of buildings. Energy design of buildings. Energy management								
ΗΜ	Electrical Engineer	Electrical installations. Renewable energy sources. Energy Analysis of buildings. Mechanical Installations of Buildings. Energy Planning and Air Conditioning of Buildings. Energy Management and Environmental Policy								
ΑΤΜ	Rural and Surveying Engineer	Reinforced concrete. Architecture. Foundations - Supports								
ΧΜ	Chemical Engineer	Heating - Cooling - Air conditioning in buildings, Thermal insulation of buildings. Renewable energy sources								
ΜΜΜΜ	Mining and Metallurgical Engineer	Energy and Environment, Energy saving, energy studies and energy efficiency certificates								
ΝΜ	Naval Engineer	Cooling - Air conditioning								
ΜΧΠΑ	Spatial Planning, Urban Planning and Development Engineer	Architectural composition and construction, Construction and Building Materials								
ΜΠ	Environmental Engineer	Energy Saving in Buildings – Energy Inspection, Energy Design of Buildings, RES Technologies, Ecological Building Materials – Environmental Assessment of Constructions. Seismology and Seismic Code. Structural Analysis and Reinforced Concrete								
ΜΟΠ	Mineral Resources Engineer	Concrete - Structural Constructions. Construction Analysis and Reinforced Concrete								
ΜΠΔ	Production and Management Engineer	-								

a. skills for implementation of energy efficiency and renewable energy measures in buildings.
b. skills for delivering building deep renovation, including through modular and industrialised solutions.
c. skills for new and existing nearly Zero Energy Buildings (nZEBs) and bridging the gap towards Zero Emission Buildings (ZEBs).
d. skills for integration of renewable energy and efficient heating and cooling technologies, including in particular heat pumps roll-out; skills for installers to deliver heating and cooling upgrades as part of renovation projects.
e. skills related to whole life carbon (via the assessment of Global Warming Potential), circular construction and resource efficiency, and leveraging the Level(s) framework.
f. digital skills supporting greater energy performance of buildings, in particular through an enhanced use of Building Information Modelling.
g. skills for upgrading the smartness of buildings for greater energy performance (based on the Smart Readiness Indicator), looking in particular at sensors, building controls and building management system
h. skills for energy upgrade of historical (heritage) buildings

Evaluation of whether the education system addresses the aforementioned skills.

Little to None | Partially | Adequately

Table 5.6: Postgraduate degree programs related to the construction and building industry.

A/A	*Title*	*University*	*Fees*	*Duration (Semesters)*	*ECTS*	*Number of students per year*
1	Structural Design and Analysis of Constructions	National Technical University of Athens	Free	3	90	35
2	Energy Production and Management	National Technical University of Athens	Free	3	60	40
3	Environmental Design	Hellenic Open University	3.250 €	4	120	250
4	Seismic Engineering and Antiseismic Constructions	Hellenic Open University	3.250 €	4	120	100
5	Energy Systems	Hellenic Mediterranean University	Free	3	90	20
6	Management and Optimization of Energy Systems	University of Western Attica	3.500 €	4	120	25
7	Energy Systems	University of Western Attica	4.290 €	4	120	30
8	Anti-earthquake and Energy Upgrade of Constructions and Sustainable Development	University of Western Attica	3.000 €	4	120	40
9	Architectural and Domestic Restoration of Historic Buildings and Ensembles	University of Western Attica	3.500 €	3	90	38
10	Renewable Energy Sources and Energy Management in Buildings	University of Western Macedonia	2.100 €	3	90	50
11	Reuse of Buildings and Blocks	University of Thessaly	2.500 €	3	90	20
12	Analysis and Management of Energy Systems	University of Thessaly	2.700 €	3	90	30
13	Protection, restoration and promotion of historical buildings and ensembles	Technical University of Crete	2.000 €	4	120	20
14	Environmental Protection and Sustainable Development	Aristotle University of Thessaloniki	500 €	2	75	30
15	Environmental Engineering and Science	Aristotle University of Thessaloniki	2.250 €	3	90	40
16	Interventions in existing buildings and urban ensembles: reinforcements, reuse and spatial renewals	International University of Greece	Free	3	90	20
17	MSc in Energy Systems	International University of Greece	4.000 €	3	90	30

Table 5.7: Indicative curriculum of post-graduate studies and evaluation related to energy efficiency.

A/A	Title	Indicative curriculum	Curriculum evaluation							
			(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
1	Structural Design and Analysis of constructions	Advanced Structural Dynamics, Structural Reliability, Envelope Theory Experimental Earthquake Technology, Advanced Masonry Engineering, Repair and Reinforcement Design Theory, Advanced Concrete Technology, Steel Building Design								
2	Energy Production and Management	Energy Saving in Buildings, Electrical Installations, Solar Energy - Geothermal - Biomass, Thermal Engines, Thermal Plants and Cogeneration Thermodynamics & Heat Transfer								
3	Environmental Design	Sustainability, Ecology, Environmental Sociology and Psychology, Environmental Ethics Soil, Water and Air Pollution Environmental Assessment, Environmental Impact Studies, Environmental Risk Assessment, Environmental Legislation, Environmental Design of Buildings, Environmental Upgrading of Existing Buildings								
4	Seismic Engineering and Anti-seismic Constructions	Earthquake Design Principles of Building Structures, Design Rules for Reinforced Concrete Building Structures according to Eurocode 8, Design Rules for Steel Building Structures according to Eurocode 8, Design Rules for Composite Building Structures according to Eurocode 8, Design Rules for Wood and Masonry Building Structures according to Eurocode 8, Analysis Methods and Rules for Building Redesign constructions according to Eurocode 8								
5	Energy Systems	Energy Systems Management, Solar & PV Systems, Building Energy Management Electric Energy Measurements & Power Quality, Energy System Simulation, Smart Building & Grids								
6	Management and optimization of Energy Systems	Energy Efficiency Optimization in the Building Sector, Energy and Ecological Design of IT Equipment, Energy Efficiency Optimization in Industrial Processes, Advanced Building Automation Applications, Smart Grids & Distributed Power Generation, Energy Management - Energy Controls, Evaluation of Energy Investments								
7	Energy Systems	Foundations of Energy, Renewable Energy Technologies, Energy Economics, Environmental Impact Assessment, Building Energy Management, Demand Management and Energy Storage, Electrical Power Systems and Power Electronics, Energy Systems Optimisation, Strategic Technology Business Planning								
8	Anti-earthquake and energy upgrade of constructions and sustainable development	Analysis and Design of Reinforced Concrete Structures. Energy Design and Building Upgrade. Antiseismic Design of Structures. Metal Design. Construction. Bioclimatic Design of Buildings Special Issues of Construction Repairs and Reinforcements. Valuation and Redesign of Existing Constructions. Project Management. Vulnerability of Structures and Calculation of Losses against Natural Hazards								
9	Architectural and domestic restoration of historic buildings and ensembles	History of Architecture. Redevelopment and Revival of Historic Centers and Ensembles –Interventions Management. Identification and Analysis of Historic Urban Buildings in Modern Greece. IT and Plumbing Installations and Energy Upgrades in Historic Buildings. Restoration of Historic Buildings. Reuse of Historic Buildings								

10	Renewable energy sources and energy management in buildings	Energy economy and energy markets. heat transfer mechanical energy systems. Renewable energy technologies. Electrical energy systems. Automation of energy saving systems. Building energy systems. Design of smart buildings. Use of passive & bioclimatic systems								
11	Reuse of buildings and sets	Modern Architecture in old buildings and historical ensembles. Capture and documentation of buildings and complexes. Energy saving in existing envelopes. New Architecture in Historic Environment - Recovery Strategies. Static adequacy and reinforcement of existing envelopes, E/M installations in existing envelopes. Reuse of anonymous traditional Architecture buildings. Industrial buildings - new uses								
12	Analysis and management of energy systems	Introduction to thermal sciences, technologies of renewable sources of electrochemical power, diagnosis and maintenance of energy systems, optimal design, materials for energy infrastructures, structural design of infrastructures for production, storage and transportation of energy resources, solar thermal systems, energy and environment.								
13	Protection, restoration and promotion of historical buildings and ensembles	Laboratory of documentation and analysis of a historical building or ensemble. Maintenance and restoration of monuments. Theoretical principles and application. Pathology and mechanisms of deterioration of materials in monuments - Techniques of diagnosis and interventions. Structural damage and intervention methods in monumental constructions. Advanced technologies of geometric documentation of monuments. Information Technology and Cultural Heritage. Lighting and acoustics in historical buildings and ensembles								
14	Environmental protection and sustainable development	Environmental impact assessment. Economics of natural resources and the environment. Decision and risk analysis. Environmental data acquisition, processing and management: Geographic information systems. Photogrammetric, remote sensing and geoinformation methods and systems. Air pollution. Management of natural hazards. Environmental and energy consideration of building constructions. Renewable energy sources-Environmental impact								
15	Environmental engineering and science	Anti-pollution technology of atmospheric pollutants. Ecological engineering and technology – Ecohydrology. Energy and buildings – Renewable energy sources in buildings and settlements. Circular economy and green entrepreneurship. Renewable energy technologies. Climate change impacts, adaptation and vulnerability to them. Energy assessment of buildings - simulations (KENAK). Environmental assessment of constructions – environmentally friendly materials. Energy and Environmental Design of Buildings – Simulation Models								
16	Interventions in existing buildings and urban ensembles: reinforcements, reuse and spatial renewals	Captures of buildings and urban space with advanced tools. Technical Geology, Seismology and Soil Mechanics. Bioclimatic design and upgrading of buildings and open spaces. Static-Dynamic Analysis of Existing Constructions. Valuation Methods of Materials and Structural Elements. Systems of Repair - Reinforcement of Constructions Simulation and Analysis of Structural Reinforcement. Pathology and Vulnerability of Existing Buildings								
17	Energy Systems	Quantitative methods. Energy design of buildings. Project financing. Project management. Heating, ventilation and air conditioning (HVAC). Efficient renovation of								

		buildings. Integrated renewable energy systems in buildings. Simulation and analysis of the energy performance of buildings. Energy and environmental law. Environmental risk management. Energy transmission and storage. Forecasting methods. Green planning and planning for warm climates. Life cycle assessment. Modelling and simulation of building integrated solar energy systems. Smart cities	

a. skills for implementation of energy efficiency and renewable energy measures in buildings.
b. skills for delivering building deep renovation, including through modular and industrialised solutions.
c. skills for new and existing nearly Zero Energy Buildings (nZEBs) and bridging the gap towards Zero Emission Buildings (ZEBs).
d. skills for integration of renewable energy and efficient heating and cooling technologies, including in particular heat pumps roll-out; skills for installers to deliver heating and cooling upgrades as part of renovation projects.
e. skills related to whole life carbon (via the assessment of Global Warming Potential), circular construction and resource efficiency, and leveraging the Level(s) framework.
f. digital skills supporting greater energy performance of buildings, in particular through an enhanced use of Building Information Modelling.
g. skills for upgrading the smartness of buildings for greater energy performance (based on the Smart Readiness Indicator), looking in particular at sensors, building controls and building management system
h. skills for energy upgrade of historical (heritage) buildings

Evaluation of whether the education system addresses the aforementioned skills.

Little to None | Partially | Adequately

Table 5.8: Indicative content of training programs provided by Continuing Education and Lifelong Learning Centres ((K.E.DI.VI.M.). and evaluation of the content in relation to energy saving

A/A	Title	Duration (Hours)	Cost	Curriculum	Curriculum evaluation							
					(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
1	Study - Design - Construction - Control of Low Voltage Electrical Installations	50	350 €	Surge Protection, Design Rules, Study and Design of Internal Electrical Installation, Electrical Installation Control Documentation, Electrical Installation Grounding								
2	Digital Operation of Smart Sensors for Smart Cities	100	350 €	Basics of Electronics, Introduction to Microcontrollers, Component Design and Manufacturing Technologies in Buildings Introduction to Sensors. Introduction and use of microcontrollers. Presentation of required software. Demonstration of using sensors to take measurements								
3	Application of KENAK regulation and KENAK-TEE software for conducting energy inspections of buildings	350	280 €	Energy inspections and related technical instructions. Interventions to improve the energy performance of buildings. Examples of Energy Inspection of Residential and Tertiary Buildings.								
4	Sustainable Energy Design of Buildings and the Built Environment.	350	1.275 €	Integrated Building Environment Design. Bioclimatic Design of Outdoor Spaces. Sustainable Upgrading of the Built Environment. Quality of Indoor Environment. Heating and cooling buildings: Conventional and bioclimatic methods. Ventilation. Lighting. Energy produce. Complete Integration of RES in the Design of the Building								

5	Special Issues of Energy Performance of Buildings.	120	680 €	Lighting. Energy produce. Complete Integration of RES in the Design of the Building. How RES Are Marketed - Buildings as a Case-Study								
6	Introduction to Energy Performance of Buildings.	130	680 €	Quality of Indoor Environment. Heating and Cooling of Buildings: Conventional and Bioclimatic Methods. Ventilation. European Directive on the Energy Performance of Buildings								
7	Introduction to Energy and Bioclimatic Design of Buildings and Urban Structures.	100	553 €	Quality in Sustainable Architecture. Integrated Building Environment Design. Bioclimatic Design of Outdoor Spaces. Sustainable Upgrading of the Built Environment								
8	Indoor Environment: Architectural Design - Bioclimatic Design - Quality	75	510 €	Architectural Design of Interiors from the 17th to the 19th century. Architectural Design of Interiors in the 20th century. Bio-climatic architecture. Light and Colour in Architectural Design of Interiors. Indoor air quality								
9	Design and Optimization of Zero Energy Consumption Buildings	180	700 €	International Standards and Legislation for Buildings. Mitigation and Adaptation Techniques to fight Climate Change. Indoor air quality in buildings. Advanced Control Systems for Buildings. Thermal Comfort in Buildings. Existing Zero Energy Buildings Analysis. Components of the Energy Consumption of Buildings. Design of Renewable Energy Systems in the Built Environment. Natural lighting in buildings. Passive Cooling Techniques for Buildings. Artificial Lighting Systems for Buildings. Heat and Mass Transfer in Buildings. Passive Heating Techniques for Buildings. Energy Optimization Techniques for Buildings. Solar and Renewable Systems and Techniques for Buildings. Monitoring Techniques for Buildings, Design of Zero Energy Buildings. Energy and Environmental Simulation Tools for Buildings								
10	Modern Air Conditioning Applications (Study, Installation, Repair)	180	468 €	Psychrometry. Cooling Circuit and Heat Pump. Air conditioning units. Study of Air Conditioning Installation. Operation Control Systems and Faults								

a. skills for implementation of energy efficiency and renewable energy measures in buildings.
b. skills for delivering building deep renovation, including through modular and industrialised solutions.
c. skills for new and existing nearly Zero Energy Buildings (nZEBs) and bridging the gap towards Zero Emission Buildings (ZEBs).
d. skills for integration of renewable energy and efficient heating and cooling technologies, including in particular heat pumps roll-out; skills for installers to deliver heating and cooling upgrades as part of renovation projects.
e. skills related to whole life carbon (via the assessment of Global Warming Potential), circular construction and resource efficiency, and leveraging the Level(s) framework.
f. digital skills supporting greater energy performance of buildings, in particular through an enhanced use of Building Information Modelling.
g. skills for upgrading the smartness of buildings for greater energy performance (based on the Smart Readiness Indicator), looking in particular at sensors, building controls and building management system
h. skills for energy upgrade of historical (heritage) buildings)

Evaluation of whether the education system addresses the aforementioned skills.

Little to None Partially Adequately

5.5 Existing tools to monitor market developments in technology, skills requirements and training

This section analyses a number of organisations and observatories that are useful tools for monitoring and analysing market developments. These tools and organizations provide important information on technological progress, required skills and educational needs emerging in the labour market in Greece.

Employment, Social Security, Welfare and Social Affairs Expert Unit

The Ministry of Labour and Social Affairs by Law 4921/2022 takes over the responsibilities of the abolished National Institute of Labour and Human Resources (EIAED) through the Unit of Experts on Employment, Social Security, Welfare and Social Affairs (Law 4921/2022), which are:

- the collection and provision of statistical data on labour relations and employment policies, etc,
- the preparation and approval of the National Annual Report on the labour market; And
- the preparation and preparation of the preparation of the Employment Market and Employment Survey in Greece
- the promotion of vocational training and lifelong learning for the country's workforce in relation to national employment policies
- the development of tools for the implementation and promotion of Continuing Vocational Training and Lifelong Learning
- the design and implementation of training and retraining actions for the workforce, as well as the implementation of specific training programmes for vulnerable social groups, in accordance with the current legislation on vocational training and lifelong learning.

Observatory of Economic and Social Developments

The Observatory of Economic and Social Developments is part of the **Labour Institute of the General Confederation of Workers (INE-GSEE)** and focuses on workers from all professional sectors: academia, policy makers and ultimately all citizens. It provides science-based analysis on a range of social and economic issues directly related to workers' interests in relation to the current situation.

In addition to this, INE-GSEE is active in many areas, such as research and development of employment policies, analysis of working conditions and investigation of their impact on workers' health and safety, education and training of workers, publication of reports, studies and analyses on labour and employment issues, and provision of advice and support to workers.

General Confederation of Greek Professionals, Craftsmen & Traders - Institute of Small Enterprises (IME GSEVEE)

IME GSEVEE promotes the design and implementation of relevant research and studies for the collection and processing of valid and reliable data, the implementation of national and European projects, as well as the formulation of documented policy proposals and working papers with reference to the key findings resulting from the skills needs research activities. Indicatively, it is mentioned that IME GSEVEE actively participated as a coordinator-partner in the pilot phase of the implementation of the National System for the Identification of Labour Market Needs (Mechanism for the Identification of Labour Market Needs - Ministry of Labour, Social Security and Social Solidarity), in the identification and forecasting of skills needs, in cooperation with the other national institutional social partners and with the scientific support of the Hellenic Institute of Social Development.

In addition, IME GSEVEE implements relevant actions to explore skills needs at national and European level. One of the flagship actions implemented during the current period (2017-2020) by IME GSEVEE is the development of a mechanism for forecasting and monitoring factors of change in the productive environment of industries, occupations and skills (EPANEK 2014-2020).

Institute of Economic & Industrial Research (IOBE)

The Institute for Economic and Industrial Research (IOBE) was founded in 1975 as a private, non-profit, public benefit research organisation. IOBE researches the current and anticipated problems of the Greek economy and its sectors and provides analysis and recommendations for action to policy makers in the context of economic policy making. It seeks to identify, at an early stage, the economic issues that may become vital for the future and to propose solutions for timely them. IOBE called upon its deputies to perform the following functions:

- To conduct applied research on the main structural and sectoral problems of the Greek economy
- To monitor and analyse short-term economic trends, to record the business climate, as well as to prepare forecasts and assess the prospects of the Greek economy.
- To provide reliable and continuously updated economic information on specific sectors of the Greek economy.
- To cooperate with foreign research institutes and international organisations on issues of common interest and to participate in international research projects on economic issues and policies.
- To contribute to the public debate on economic issues.

Institute for Educational Policy (IEP)

The Scientific Unit for Vocational Education and Apprenticeship advises and recommends to the Board of Directors of the IEP on all issues concerning the Vocational Lyceums and the "Post-secondary year-apprenticeship class". Using scientific and pedagogical criteria, the Vocational Education and Apprenticeship Unit recommends on the definition of sectors and specialisations of VET schools, timetables, curricula, course assignments to teacher disciplines, teaching manuals and other educational material for vocational education, the implementation of surveys in secondary vocational education structures and other related issues. As of the school year 2017-2018, 36 specialties are operating in the third grade of E.PA.L. schools, according to the provisions of PE.1489 B', 26/05/2016. Students who successfully complete their studies in the E.PA.L. receive a High School Diploma and a Diploma of Speciality level 4 of the National Qualification Framework. In addition, those who wish to do so may continue their studies in the "Post-secondary year - Apprenticeship class", upon successful completion of which and after successful participation in certification examinations, they receive a level 5 degree of the NQF. During their participation in the 'Post-secondary apprenticeship year', which lasts for nine (9) months, apprentices receive a daily allowance, which is set at seventy-five percent (75%) of the legal, statutory, minimum daily wage of an unskilled worker.

Cedefop Skills Intelligence

Cedefop Skills Intelligence is an online platform providing information and analysis on the latest trends and developments in skills and Vocational Education and Training (VET) in Europe. It is designed to help policy makers, researchers and other stakeholders to better understand the current and future demand for skills, as well as the supply of skills and the policies and practices that can help close the skills gap. The platform includes a range of tools and resources, including visualised data, country profiles and policy summaries, as well as interactive features such as online surveys and forums. It covers a wide range of topics related to skills and VET, including skills forecasting and matching, qualifications frameworks, apprenticeships, adult learning and digital skills. Cedefop Skills Intelligence is part of the wider work of the European Centre for the Development of Vocational Training (Cedefop), which is a decentralised agency of the EU. Cedefop's mission is to support the development and implementation of European vocational education and training policies and works closely with the European Commission, EU Member States and the social partners to achieve this objective.

5.6 Existing measures to make the renovation and construction sectors attractive to women and young people

Currently, in Greece, there is a lack of measures to make the renovation and construction sector more attractive to women and young talent. Although the construction sector is an important pillar of the Greek

economy, it remains largely male-dominated and few women choose to pursue a career in this sector. Moreover, there is a lack of initiatives aimed at attracting new talent in the construction and renovation sectors. This lack of measures can be attributed to several factors, including social stereotypes towards gender roles and limited access to education and training opportunities. To address this issue, there is a need for targeted policies and initiatives that promote gender diversity in the industry and provide opportunities for young people to acquire the necessary skills and knowledge to succeed in these sectors.

Pact4Youth: supporting the EU Pact for Skills. Foundations for Youth Employability in the Construction Sector (2022-2024)

The European Construction sector lags in generational renewal, but at the same time, the youth unemployment rate is unsustainable. This imbalance is clearly detrimental, so the main objective of this project is to act in favour of youth employability in the construction sector, focusing on skills, as the green and digital transitions present significant opportunities to create new jobs in the sector, which will need many workers with the right skills. The project aligns and supports this Pact by developing concrete actions to increase opportunities for young people in the sector, address the shortage of skilled workers and pave the way for small and medium-sized enterprises (SMEs) to adapt to the future context. The countries involved in the project (Cyprus, Greece, Italy, Greece and Spain, Southern European countries) share common challenges in relation to the construction sector, in particular the lack of skilled workers, the shortage of young workers and women and the high youth unemployment rates at national level. The profile of the partners corresponds to sectoral employers' organisations and VET providers.

The project will develop the following outputs:

- Roadmap and action plan for youth employability
- Mediation services and accompanying measures
- Signing of cooperation agreements between SMEs and training centres for the implementation of work-based learning programmes
- Practical training days to increase young people's interest in the construction sector
- Increasing the participation of SMEs in apprenticeship processes
- Awareness, communication and dissemination campaigns targeting SMEs and young people
- Adherence to the EU Skills Pact

5.7 Existing measures for the retraining of workers and professionals previously or currently working in fossil fuel (or other) related sectors and areas

According to the available data, up to 2021 there were only few measures in Greece for the re-skilling of workers and professionals who were or are currently active in fossil fuel-related or other sectors and areas. It should be noted that a significant part of the workforce in the building sector occupations consists of self-employed craftsmen and technicians (rather than employees in relatively large economic units), who since 2015 have had no opportunity for financial support to upgrade and modernise their skills, which has accumulated significant vocational training needs.

This lack of measures can be a challenge for workers and professionals as Greece has embarked on a transition to a low-carbon economy. However, there have been some initiatives to address this issue. For example, the Greek government has announced plans to invest in training and education programmes for workers in industries affected by the transition to clean energy (degasification sites). In addition, several private and non-profit organisations have launched programmes to provide vocational training and support to workers seeking to transition to new industries that could be used by workers in fossil fuel industries, although not focused on them. However, a comprehensive and coordinated effort is needed to ensure that workers and professionals have the necessary skills and opportunities to succeed in the new low-emissions economy.

POWER UP - Supporting former workers of energy production sector to re-enter the labour market (2022-2024)

The project aims to provide vocational education and training (VET) to former fossil fuel power plant workers to support them in their transition to another job. In 2021, half of Europe's 324 fossil fuel power plants either closed or announced that they will close by 2030 (Europe Beyond Coal, 2021). Project actions and products include:

- Conducting research and developing a guide to the transition of fossil fuel power plant workers to other jobs.
- Development of electronic vocational education and training material for unemployed people in the sector on technical and soft skills and pilot implementation. This material also aims to encourage unemployed people to participate in training activities.
- Creation of an electronic tool for job search, which provides training and counselling tools for beneficiaries, as well as a tool for coupling with the local labour market.
- Dissemination actions to raise awareness on the importance of sustainable transition and reducing the carbon footprint per household. Policy proposals for stakeholders.

5.8 Informal training courses and programmes

A significant number of courses and training programmes on the EU and RES technologies are offered in Greece. The majority of these courses are offered without specific entry requirements for participants, which makes them open to all those interested in their subjects and not only to engineers, technicians, workers, installers, etc. Another result of this possibility of admission for any interested party is the limited level of specific knowledge offered, so that they are considered to offer introductory knowledge or skills, which are probably not considered sufficient in most of them.

Finally, participants in informal training programmes, e.g. short briefings from equipment or software supply companies, etc., are not certified by an authority or certification body, but are usually issued with a certificate of attendance by the training provider itself. On the contrary, in all co-funded programmes (which constitute the majority of actions), participation in a certification exam by an external examining body (based on ISO 17024) is mandatory. The (formal and institutional) recognition by the labour market of the 'accreditation of the training outcome' offered by these programmes is recognised as an important problem.

A large part of the providers of this type of informal training are non-educational actors, such as producers and importers/traders. This type of training is product-specific and lasts from a few hours to a few days. In addition, professional, trade and industry associations and chambers of professionals offer training courses which are geared to the needs of their members, covering part of the skills required in the specific sectors related to RES and the EU. Indicative tables of informal training, courses and webinars are included in the Annex.

Federation of Greek Electricians: According to the federation, there are about 3.767 members of the federation. The federation, in 2022, offered the 150-hour training programme entitled "Enhancing employee knowledge and skills in thematic areas of energy saving in buildings through appropriate installations and building materials and renewable energy applications" which is currently underway. The scope of this training programme is:

- Management of Energy Saving Projects, Energy Performance Improvement of Buildings and Energy Upgrading of Buildings
- Heating, cooling and ventilation systems using Natural Gas and Renewable Energy Sources (Solar Thermal, etc.)
- Energy Efficiency and Energy Saving in Building Insulation

Federation of Craftsmen Plumbers of Greece - OVYE: According to data from the federation, it has about 76 members. The federation, in 2022 offered the 150-hour training program entitled "Strengthening the knowledge and skills of workers in thematic subjects of energy saving buildings through project management, plumbing and insulation" which is currently underway. The scope of this training programme is:

- Techniques for the promotion and sale of energy-efficient building products and systems for the energy upgrading of buildings (Green Marketing)
- Energy Saving & Energy Efficiency Improvement of Building Facilities - Energy Saving & Energy Efficiency Improvement of Building Facilities
- Applications of renewable energy technologies for building energy needs

5.9 Relevant skills development actions at national/regional level supported by the EU (through structural funds, ESF+, NextGenerationEU etc.)

Regarding skills development actions at national/regional level supported by the EU (through structural funds, ESF+, NextGenerationEU, etc.), the only one found in this regard should be mentioned:

NextGenerationEU "Skills upgrading and retraining programmes in high demand sectors with a focus on digital and green skills"

Training of 80,000 beneficiary workers and unemployed through the KE.Di.Vi.M. of universities and licensed K.D.B.M. in the framework of the project "Skills upgrading and retraining programmes in high demand sectors with emphasis on digital and green skills". The objective of the project was to qualitatively upgrade the knowledge and skills of the unemployed in digital and green skills through continuing vocational training programmes that respond to the needs of the economy. The beneficiaries were individuals/citizens, both employed and unemployed persons registered in the Unemployment Registry of the Ministry of Social Affairs and Employment over 18 years old. This programme was, through face-to-face training and e-learning on theoretical training programmes, with a total duration of 50 to 200 hours. This programme was funded by the action "SUB2: Horizontal upskilling/reskilling programs to targeted populations" of NextGenerationEU, with the implementation area all over Greece and the implementation period: 2021 - 2022.

6. Relevant building skills projects

Regarding the main projects (funded by the EU and nationally) that have been or are being implemented in Greece and are related to skills development in the construction industry, it should be noted that the focus on the needs of this sector primarily emerged from the European initiative BUILD UP Skills, which was launched by the EU in 2011. The goal of this initiative was to increase the number of skilled professionals in the sector (at the technical/craftsman level, i.e., "blue-collar workers") by developing national qualification platforms and roadmaps and providing training in energy efficiency and renewable energy sources in buildings. The BUILD UP Skills initiative had two main pillars:

I. **National qualification platforms and roadmaps by 2020,** and,
II. **Qualification and training certification schemes.**

Thus, with the co-funding of the "Intelligent Energy for Europe" program, within the framework of Pillar I of the BUILD UP Skills initiative, the project **"BUILD UP Skills - Greece" (BUS-GR)** was implemented, with the following elements:

Title	**BUILD UP Skills - Greece (BUS-GR)**
Timeframe	08/06/2012 - 07/12/2013
Eligible Budget & Funding programme	€375,502 Programme "Intelligent Energy for Europe» (Contract nr: IEE/12/ BWI/430/SI2.622870) ⇨ 90% funding
Partners	Centre of Renewable Energy Sources and Savings– CRES (Coordinator), www.cres.gr National Technical University of Athens - Decision and Management Systems Laboratory, www.epu.ntua.gr Institute of Small Enterprises of the Hellenic Confederation of Professionals, Craftsmen, and Merchants (IME GSEVEE), www.imegsevee.gr Technical University of Crete - Renewable and Sustainable Energy Systems Lab, www.resel.tuc.gr National Organization for the Certification of Qualifications and Vocational Guidance (EOPPEP), www.eoppep.gr Technical Chamber of Greece (TEE), www.tee.gr Labour Institute of GSEE (INE GSEE), www.inegsee.gr Region of Western Greece, www.pde.gov.gr Educational Policy Development Centre of GSEE, www.kanep-gsee.gr
Brief description of main outputs	Form a national platform (National Qualification Platform- NQP) on Energy Efficiency and RES related training programs and qualification schemes for the building construction sector workers. Identify and quantify the need for qualified workforce in Greece in order to describe the current status quo. Design and set up a national training and qualification strategy (the Roadmap) up to 2020 for the achievement of national sustainable energy goals. Ensure the roadmap adoption by all relevant stakeholders in Greece via the appropriate endorsement activities

Based on the priorities of Pillar II of the BUILD UP Skills initiative, which included supporting actions for the development of new or upgrading of existing large-scale training and certification schemes for the workers in the construction sector (craftsmen and other on-site workers) based on the recommendations of the respective 'Skills Roadmap' (of Pillar I or any equivalent), the project **BUILD UP Skills UPSWING** was submitted for funding, have been approved, and ultimately implemented in Greece. The key elements of the project are as follows:

Title	**UPgrading the construction Sector Workforce traINing and qualification in Greece - BUILD UP Skills UPSWING**
Timeframe	01/09/2014 - 31/08/2017
Eligible Budget & Funding programme	€551.178 Programme "Intelligent Energy for Europe» (Contract nr: IEE/13/ BWI/715/SI2.680180) ⇨ 75% funding
Partners	Centre of Renewable Energy Sources and Savings– CRES (Coordinator), www.cres.gr National Technical University of Athens - Decision and Management Systems Laboratory, www.epu.ntua.gr Technical University of Crete - Renewable and Sustainable Energy Systems Lab, www.resel.tuc.gr Institute of Small Enterprises of the Hellenic Confederation of Professionals, Craftsmen, and Merchants (IME GSEVEE), www.imegsevee.gr Labour Institute of GSEE (INE GSEE) www.inegsee.gr National Organization for the Certification of Qualifications and Vocational Guidance (EOPPEP), www.eoppep.gr Technical Chamber of Greece (TEE), www.tee.gr
Brief description of main outputs	Certified and updated (with an introduction to those of the special tasks required to improve EE) occupational profiles for insulation technicians, aluminium & metal constructions craftsmen, installers-maintainers of burners. Certified and updated specialized technical and vocational training courses on EE and Energy Saving (ES) Horizontal training unit (Module) on EE and the possibilities for Energy Saving Systems in buildings, designed for all construction industry workers. Suitable educational materials, guides, and practical tools for the three target professions and their trainers (plus a question and answer repository/ question bank for certification exams) intended for both trainees and trainers. 3 pilot 'train the trainers' courses, and 9 pilot courses of vocational training 45 specialized trainers with competence to implement the training programs (3 x 15) ⇨ Final number: 58 135 qualified and certified craftsmen (3 x 3 x 15) ⇨ Final number 139 Supporting measures and observatory mechanism for the implementation and sustainability of the training programmes and the qualification's certification widely (and over time)

The implementation field of the BUILD UP Skills initiative expanded to include other professionals in the construction sector under the Horizon 2020 program with several projects which developed certification and training programs in various countries. Specifically, there was no Greek participation in this cycle's projects which were related to:

- Training medium and high-level professionals on EE and RES in buildings in the Czech Republic and Slovakia (ingREeS),
- Enhancing skills for engineers and architects for constructing nearly Zero Energy Buildings - nZEB (MEnS, PROF-TRAC),
- Creating and upgrading training programs for trainers, construction workers, designers and others based on the concept of Passive House (Train-to-NZEB),
- Creating and updating qualification and training programs for EQF4 level, technicians and on-site workers in the Netherlands (BUStoB).

On the other hand, there was Greek participation in the project **Fit-to-nZEB** (Innovative training on energy-efficient building renovations), where the consortium extended the network of educational centres developed in the Train-to-NZEB to Croatia, Greece- partner: Hellenic Passive House Institute (EIPAK)- and Italy, focusing on energy-efficient building renovations.

Of the six new projects added to this updated version of the BUILD UP Skills initiative under H2020, a notable number of them, such as BIMplement, BIMcert, BIMEET, and Net-UBIEP, aimed to training building professionals on how to use and implement the Building Information Modeling (BIM). Greek participation was present in the **BIMEET** project (**BIM-based EU-wide Standardized Qualification Framework for achieving Energy Efficiency Training**), whose consortium gathered universities and technological institutions from five EU countries (Finland, France, Greece, Luxembourg, and the United Kingdom) to provide the construction sector with a better understanding of market needs, along with innovative training programs. The partner from Greece was the Centre for Renewable Energy Sources and Saving (**CRES**).

More specifically, within the framework of the BIMEET project (from 1/9/2017 to 29/2/2020), a specific methodology was developed to identify roles, skills, and training needs in the field of BIM for energy efficiency. A Twitter repository was used to record emerging skills and roles, and an educational portal was created to gather content from various data sources related to BIM. With this tool, users can monitor emerging trends and incorporate them into future educational content. The educational portal effectively serves as a storage source for information on BIM and energy efficiency and serves as a database for available BIM training.

In the next round of projects related to the BUILD UP Skills initiative approved under the Horizon 2020 Program (call for proposals no. H2020-LC-SC3-EE-2019), Greece participation in the project **The nZEB Roadshow**. This project, which started on 1st June 2020, and concluded on 31 May 2023, involved marketing and communication activities at the national level in five EU countries, organizing nZEB (Nearly Zero Energy Buildings) weeks in selected cities in each participating country. The initiative encompassed a wide range of events, including exhibitions of construction and real estate products, practical demonstrations and real-time construction, training for designers and workers, professional orientation, and employment centres focusing on Small and Medium-sized Enterprises (SMEs) in the construction sector. Pre-fabricated modular mobile buildings were used as information centres to raise awareness about the benefits of nZEB. The coordinator of project "The nZEB Roadshow" was ENEFEKT from Bulgaria, and the Greek partner was the Hellenic Passive House Institute (EIPAK).

Another project that emerged as a direct result of the participation of various stakeholders in the BUILD UP Skills initiative (especially in Pillars I and II) was the Erasmus+ project titled "**Building up green Skills for Trainers from the Construction industry – BuS.Trainers**". In this project, which was approved for funding under the "Sector Skills Alliances for Design and Delivery of VET" field of the Erasmus+ program, two partners from Greece participated (CRES, IME GSEVEE) as follows:

Title	**Building up green Skills for Trainers from the Construction industry – BuS.Trainers**
Timeframe	01/12/2016 - 31/01/2020
Eligible Budget & Funding programme	968.645€ Programme Erasmus+ «Sector Skills Alliances for Design and Delivery of VET» (Contr. Nr. 575829-EPP-1-2016-1-ES-EPPKA2-SSA) ⇨ 100% funded
Partners	FUNDACION LABORAL DE LA CONSTRUCCION – FLC, Spain (COORDINATOR) INSTITOUTO MIKRON EPICHIRISEON GENIKIS SYNOMOSPONDIAS EPAGGELMATION BIOTECHNON EMPORON ELLADOS - IME GSEVEE, Greece MALTA INTELLIGENT ENERGY MANAGEMENT AGENCY – MIEMA, Malta

	Laboratorio Nacional de Energia e Geologia I.P. – LNEG, Portugal THE GOZO BUSINESS CHAMBER ASSOCIATION – GBC, Malta ASSOCIAZIONE NAZIONALE COSTRUTTORI EDILI – ANCE, Italy FORMEDIL ENTE UNICO FORMAZIONE E SICUREZZA – FORMEDIL, Italy CENTRO DE FORMACAO PROFISSIONAL DA INDUSTRIA DA CONSTRUCAO CIVIL E OBRAS PUBLICAS DO SUL – CENFIC, Portugal CENTRE FOR RENEWABLE ENERGY SOURCES AND SAVING – CRES, Greece UNIVERSITAT DE VALENCIA – UVEG, Spain CONFEDERACION NACIONAL DE LA CONSTRUCCION – CNC, Spain
Brief description of main outputs	Jointly develop a comprehensive training system for professional trainers in order to improve teaching in sustainable construction, through interconnected activities. The approval of a new European sectorial qualification standard will be sought, the Green VET Trainer in construction, following the methodology of the European Qualifications Framework (EQF), oriented to learning outcomes and supported by the principles of European Credit System for Professional Education and Training (ECVET) and the European Quality Assurance in Vocational Education and Training (EQAVET). Development of a platform for the continuous informing and training of the trainers in order to have a continuous professional development. The platform (http://formacion.ecotrainers.eu/moodle/) functions in five (5) languages (Spanish, Portuguese, Greek, Maltese, Italian) and offers additional services and tools on the professional guidance, references, guidebooks etc.

In addition to **BuS.Trainers**, another Erasmus+ Programme project emerged as a direct consequence of the participation of stakeholders from various countries in the BUILD UP Skills initiative (Pillars I and II). This project was entitled "**Water Efficiency and Water-Energy Nexus in Building Construction and Retrofit – WATTer Skills**". The WATTer Skills project, which was approved for funding under the "Strategic Partnerships for vocational education and training" field of the Erasmus+ program, was of great significance since it marked the first attempt to address the training needs of professionals in the construction sector regarding water efficiency and the water-energy connection. **CRES** participated from Greece in this project, and its key characteristics are as follows:

Title	**Water Efficiency and Water-Energy Nexus in Building Construction and Retrofit – WATTer Skills**
Timeframe	01/09/2017 - 31/12/2020
Eligible Budget & Funding programme	253.418€ Programme Erasmus+ « Strategic Partnerships for vocational education and training» (Contr. Nr: 2017-1-PT01-KA202-036002) ⇨ 100% funding
Partners	AGENCIA PARA A ENERGIA - ADENE, Portugal (COORDINATOR) CENTRE FOR RENEWABLE ENERGY SOURCES AND SAVING – CRES, Greece FORMEDIL ENTE UNICO FORMAZIONE E SICUREZZA – FORMEDIL, Italy FUNDACION LABORAL DE LA CONSTRUCCION – FLC, Spain
Brief description of main outputs	IO1 - Definition of the skills map for the efficient use of water and the connection of water and energy at a European level. Collection of criteria and monitoring indicators.

	IO2 – Qualification Framework: Definition of the training programmes and skills qualification/certification scheme. Proposition of a common qualification framework IO3 – Development of training courses curricula, contents and e-learning platform: Formulation of the training course structure and curricula, Development, validation and implementation of the training contents in an e-learning platform, Pilot training programmes for the validation and recognition from the market, specifically of the “WET – Water Efficiency Technician” and the “WEE – Water Efficiency Expert», Technical and technological validation from experts and target groups committees. IO4 – Accreditation system based on EQF and ECVET: Proposal of a recognition and accreditation system and for National and EU level. Proposal for the accreditation system to be based on the ECVET (fostering mobility).

It is worth mentioning that from 2012 (when the BUS-GR project started) to 2017 (when the BUILD UP Skills UPSWING project concluded), **IME GSEVEE**, as a research entity for small and medium-sized enterprises (SMEs) in Greece that supports scientifically the Hellenic Confederation of Professionals, Craftsmen, and Merchants (GSEVEE), which is a third-level employers' organization across Greece and among the major national social partners), proceeded in a significant activity in **diagnosing skills and professions needs,** as one of its thematic activity fields.

Indicatively, IME GSEVEE actively participated during 2015 as coordinator in the pilot implementation phase of the **National Labour Market Needs Diagnosis System** (Ministry of Labour, Social Security & Social Solidarity), in the context of skills recognition and forecasting of the skill needs, in collaboration with other national institutional social partners and with the scientific support of EIEAD. The full project title was “Actions of the social partners to identify and forecast skills needs within the framework of the National Labour Market Needs Diagnosis System – MIS 520388”, and was funded by the O.P. "Human Resource Development", NSRF 2007-2013. The Deliverables of this project were:

1. *General survey of employers,*
2. *Qualitative studies of skill needs (aluminium-metal construction and energy efficiency*),
3. *Methodological guide for implementing qualitative studies of skill exploration.*

Furthermore, one of the flagship actions implemented during the previous programming period by IME GSEVEE concerns the development of a **mechanism for forecasting and monitoring the factors affecting changes in the productive environment of sectors, professions, and skills** (EPAnEK 2014-2020). Within this framework, an action titled "**Workshop for forecasting and monitoring changes in professions**" is being carried out, which essentially constitutes a system for exploring, analysing, understanding, and documenting imminent transformations in twenty specific professions, including those of aluminium-metal constructor, electrical installer, fuel-gas burner installer and maintenance technician, glazier technician, plumber, refrigeration technician, hence, professions of the construction sector. The methodology used to explore these professions included, among others, analysing the current status (status quo) of each profession, identifying and studying specific factors (e.g., business environment, new technologies, skills) that influence them, and designing adaptation plans for the forthcoming changes based on Roadmaps.

Finally, regarding the provision of vocational training activities, it is worth mentioning a national project carried out that aimed at acquiring knowledge and skills through training programs to enhance the professional qualifications of the workforce already employed or aspiring to be employed in construction-related specialties in the strategic sector of Materials-Construction, with focus on Energy Efficiency issues. The detailed description of this project is:

PROJECT TITLE: ***Training and certification of knowledge and skills in energy saving in selected construction sector professions*** **- MIS 5002684**

FUNDING PROGRAMME: Competitiveness, Entrepreneurship & Innovation" (EPAnEK) Operational Programme of the EU National Strategic Reference Framework (NSRF) for the period 2014-2020

TIMEFRAME: 06/2018 - 06/2022 (the physical object of the project was completed on 30/11/2021)

The aim of the project was to gain knowledge and skills for the upgrade of the professional qualification of the beneficials on the strategic sector Materials- Construction, focusing on Energy Saving issues. In that way, the project strengthened the possibility of maintained job positions in the workers in the construction sector, while at the same time responding to changes in the economic, business and technological environment affecting the workforce.

In this context, this project included the following actions:

I. Development of five 50-hour professional training programs based on a market needs diagnosis and relevant requirements for the development of new skills and knowledge, titled: "Energy-saving techniques for plumbers, electricians, glazier installers, aluminium and metal constructors, refrigeration technicians."
II. Provision of subsidized ongoing professional training based on the aforementioned educational programs, either through conventional methods (in-person with physical presence), or through distance learning (synchronous and asynchronous e-learning), or through blended learning (combination of conventional and asynchronous e-learning).
III. Certification (including remote online surveillance) of the acquired knowledge and skills by accredited certification bodies, according to the international standard ISO/IEC 17024.

In the 69 implemented vocational training programs were trained in total 1.467 employees from private enterprises across the country through distance learning method (both synchronous and asynchronous e-learning). These employees were from various sectors/ fields of the economy and participated to the certification processes based on accredited Certification Schemes according to the international standard ELOT EN ISO/IEC 17024:2012, "Conformity assessment - General requirements for Persons certification bodies" (1.379 individuals successfully passed the certification examinations).

It is worth mentioning that this project has already been replicated in Greece. The Public Employment Service has adapted the initiative to provide training to unemployed individuals registered to the Service on energy efficiency in the construction sector. However, since this new target group lacks recent work experience and may face challenges in adapting to energy-related issues, the duration of the training has been increased from 50 hours to 70 or 80 hours, with corresponding adjustments to the digital educational material.

In this report on projects related to the topics addressed by the BUILD UP Skills initiative, and specifically regarding the skills of workers in the construction sector, the participation of two entities from Greece in the "**Skills Blueprint for the Construction Industry - Construction Blueprint**" project cannot be overlooked. This project is a European initiative under the Erasmus+ program, Key Action 2 of the Sector Skills Alliances (Lot 3), for the implementation of a new strategic approach to sectoral skills alliances. It involves a collaboration of 24 partners from 12 different countries, with the lead organization being the "Fundación Laboral de la Construcción" (Construction Labor Foundation) from Spain. From Greece, the Panhellenic Association of Engineers Contractor of Public Works (PEDMEDE) as the National Representative of the Construction sector, and the IIEK AKMI as a provider of Vocational Education and Training (VET) are participating to the project.

The main target of the **Construction Blueprint** project is to develop a new strategic approach for the Skills Alliance Sector in the construction sector, which will serve as the basis for the restructuring of the vocational education and training system, in order to meet the needs of the labour market. The project had a duration of 4 years, from January 2019 until December 2022, and a budget of approximately €4,000,000.

The Skills Blueprint for the Construction Industry was developed through a Sectorial Skills Strategy that gathered conclusions from other initiatives and followed a comprehensive approach, identifying political, economic, social, technological, legal, and environmental factors that may affect the demand for skills and the supply of training in the sector. During the project, the following actions were carried out, leading to specific deliverables and milestones:

- Collection of best practices at the national and regional levels for describing and promoting other relevant initiatives aimed at successfully addressing skill gaps and mismatches, integrated into an interactive map.
- Design and pilot implementation of educational programs for energy efficiency, circular economy, and digitization in the construction sector. Additionally, various Massive Open Online Courses (MOOCs) on these topics were made available.
- Creation of an observatory tool to provide valuable information regarding specific skill needs at the regional/national level.
- Identification and selection of professional profiles that need updating in terms of energy efficiency, circular economy, and digitization.
- Conduction of a promotional campaign for the construction sector to attract young people and women, as well as to present and promote solutions for facilitating labour mobility within Europe
- Creation of a new virtual tool (website) where all project results would be accessible to interested parties, along with a Sector Skills Alliance platform for developing partnerships.

The Construction Blueprint project began its development with the participation of key stakeholders (in the fields of Education, Economy, Policy, Environment, and Civil Society/Culture) in order to completely exploit their experience and know-how. This collaboration, along with the Sector Skills Alliance, will leverage the promotion of a sustainable sectoral strategy and successful implementation of the project. Finally, it is worth mentioning that one of the easily accessible online courses available on the project's e-learning platform is related to Energy Efficiency (with the other two being on Circular Economy and Digitalization). These courses address to individuals involved in the Construction sector and provide valuable knowledge and skills in these specific areas.

7. Skills gaps between the current situation and the needs for 2030

7.1 Introduction – National targets for 2030

Improving the energy efficiency of the country's building stock is a primary priority of the National Energy and Climate Plan. The national strategic energy targets for 2030, related to the country's building stock, are qualitatively summarized as follows:

1. Improvement of the energy efficiency of the country's building infrastructure.
2. Penetration of RES (Renewable Energy Sources) and new energy-saving technologies into the country's building stock.
3. Reduction of Greenhouse Gas emissions of the building sector.
4. The need to upgrade skills and provide continuous training for the country's construction workforce on RES and EE.

In this direction, according to the NECP[6], there will be an energy upgrade of 12-15% of buildings and/or building units within the decade 2021-2030 through targeted policy measures that will be designed and implemented with the realization of the NECP by the year 2030. Also, there is a plan to provide targeted incentives for interventions to improve energy efficiency in the private building stock through the adoption of an ambitious strategy for the renovation of the building stock as a whole, so that by the year 2030 an energy renovation of 12-15% of the building stock has been achieved. Overall, the improvement of the energy efficiency of the building stock is expected to lead to an increase of €8 billion in domestic added value and to create and maintain over 22,000 new full-time jobs. Furthermore, based on the Long-term Building Renovation Strategy Report[7], the goal is set to reduce the final energy consumption in buildings by 8% compared to 2015 through the renovation of 23% of the residential building stock and 9% of the service stock.

Subsequently, in Chapter 7.2, an assessment of the evolution of the labour force in the construction sector by the end of the decade is made. Specifically, in paragraph 7.2.1, the current situation is briefly analysed, while in paragraph 7.2.2, an estimate is made of the workers who will need to enter the sector and be appropriately trained to serve its needs. The estimates to be presented are based on available data from ELSTAT and various relevant Greek entities. Chapter 7.3 describes the skill gaps observed in the construction sector's workforce. Along with the needs for acquiring new skills, reference is made to the training centres and trainers that will be required to achieve the educational goals and the major issue of certifying the new skills from the planned National Certification Platform.

7.2 Labour force evolution in the construction sector

7.2.1 Status Quo

According to the study "Structural Characteristics of the Greek Economy, Crisis, and Productive Reconstruction»[8], by INE GSEE, the construction sector belongs to the leading sectors of the Greek economy. The growth of these leading sectors is expected to have significant multiplier effects on the economy, impacting both production and employment, wages, and the endogenous growth of other professions and entire sectors of the economy (production and trade of building materials, project insurance, other financial services, etc.). For this reason, their expansion, either for the production of final or intermediate products and services, is considered significant.

[6] National Energy and Climate Plan, Ministry of Energy (2019) https://ypen.gov.gr/energeia/esek/

[7] Long-term Building Renovation Strategy Report, Ministry of Environment & Energy, 2021 https://ypen.gov.gr/energeia/energeiaki-exoikonomisi/ktiria/ltrs/

[8] «Structural Characteristics of the Greek Economy, Crisis, and Productive Reconstruction», George Oikonomakis, Maria Markaki. INE GSEE, 2020

The construction sector in Greece is emerging from a prolonged crisis in the previous decade, where it faced continuous contraction due to the economic crisis, with a significant decrease in production, employment, and its contribution to the creation of GDP. Specifically, the construction sector has experienced a contraction of the order of 80% from 2006 to 2012. New constructions and workers in the sector had decreased significantly, with more than two out of five workers having lost their jobs from 2008 to 2012. Indicatively, 50% of all new unemployed in Greece during the same period came from the construction sector, totalling over 125,000 job positions. Overall, the construction sector experienced the most significant decrease in employment between 2009-2021, with a reduction of 228,400 people.[9]

However, despite the very disappointing statistical data up to 2012, there is an overall upward trend from 2013, albeit with periods of temporary decline in the sector's growth. Particularly encouraging is that there has been an explosive growth in the sector after 2019. The construction activity (economic results of the sector) in Greece showed a very positive trend in the 4th quarter of 2022, presenting the largest increase since 2016, with an upward trend in building construction (24.4%) and infrastructure projects (35.9%). The growth of construction activity from 2020 until today shows small fluctuations but is generally positive, and the growth rate is one of the highest of the last two decades, reaching historic peaks.

In 2022, there was a decrease in the growth rate and a negative change in the surface area of new constructions compared to the previous year. This indicates a slowdown in construction activity, even though the construction of new buildings continues, but with a smaller surface area. Forecasts for the construction activity suggest that the sector's rapid growth in Greece is due to the need to recover the lost ground after the 2009 economic crisis. However, forecasts and comparisons with trends in Europe suggest that this upward trajectory cannot be sustained for an extended period of time.

For Greece it is not anticipated a reduction in construction activity in the long term, but a significant decrease in its growth rate has prevailed until now, contrary to the trend in Europe where a downward trajectory is projected until 2025, according to global macroeconomic models[10]. Contributing to the continuation of a positive climate for the development of the sector, according to the technical world, are the high targets for energy upgrading in existing buildings and the established regulations for high energy efficiency in the new buildings expected to be constructed. These are policies that can contribute to our country's environmental goals and, at the same time constitute a significant business development opportunity for the critical construction sector for the Greek economy. Scientific bodies and institutional factors[11] fully converge on the position that energy efficiency in buildings is the most powerful lever for energy savings and the reduction of greenhouse gas emissions, with a clear profit for society.

Greek buildings significantly lag in terms of their energy performance. The introduction of insulation is the most effective way to improve this situation, despite the challenges faced in the application of the regulations. Therefore, the construction sector should turn to the renovation and reconstruction of the existing building stock, a move that, beyond the social and environmental benefits, will also contribute to the replacement of a large portion of the jobs that were lost in recent years.

7.2.2 Future labour force demand in the building construction industry

In this section, a quantitative assessment of the professionals needed to enter the construction sector by 2030 is carried out. In this way, the country's obligations can be met both for the energy upgrading of the existing building stock and for the construction of new buildings in accordance with the newly established energy performance standards.

[9] «The Greek economy and employment, Annual Report 2022». INE GSEE https://www.inegsee.gr/wp-content/uploads/2022/07/Ethsia_Ekthesi_2022.pdf

[10] https://tradingeconomics.com/greece/construction-output

[11] Lambrakopoulos St. (2020), "The evolution of the construction industry: from the creation to the maintenance of the building stock", IME GSEVEE Research Papers 19/2020, Athens: IME GSEVEE, pp. 136

To estimate the evolution of the workforce in the construction sector, the methodology was divided into two stages. In Stage A, an assessment is made of the workforce required to have entered the sector and be trained by the end of the decade for the energy upgrading of existing buildings within a ten-year horizon. Accordingly, in Stage B, the number of workers needed to enter the construction sector in total to cover future construction activity up to 2030, in line with the energy standards of the EU, is estimated.

Stage A: Interventions in the existing building stock

The first relevant study that was identified in the literature was conducted by the Foundation for Economic and Industrial Research in 2018[12]. According to it, supporting activities for the energy upgrading of buildings, beyond the significant environmental benefit it can provide, can also yield particularly significant developmental benefits during a period when boosting economic activity and employment is a central social demand. Additionally, the same study correlates the cost of investments for the energy upgrading of buildings with the resulting increase in employment due to the implementation of these actions. Specifically, it was found that for every €1 million invested in the energy upgrading of buildings Greece's GDP increases by €1.4 million, the public revenue by €0.5 million, while **employment is bolstered by 37 job positions**.

The long-term renovation strategy report of the public and private building stock by the Ministry of Environment and Energy[13] not only reviews the national building stock, the long-term energy milestones for the years 2030, 2040, and 2050, but also presents both techno economically optimal solutions for the renovation of the building stock and estimates of energy savings and the overall benefit arising from them. According to this report, by 2030, energy upgrades are calculated for 728,000 buildings in the residential sector. However, these upgrades are neither specified nor quantified, except for the average annual rate of energy renovation of the building envelope in the residential sector, that reaches 1.28%.[14]

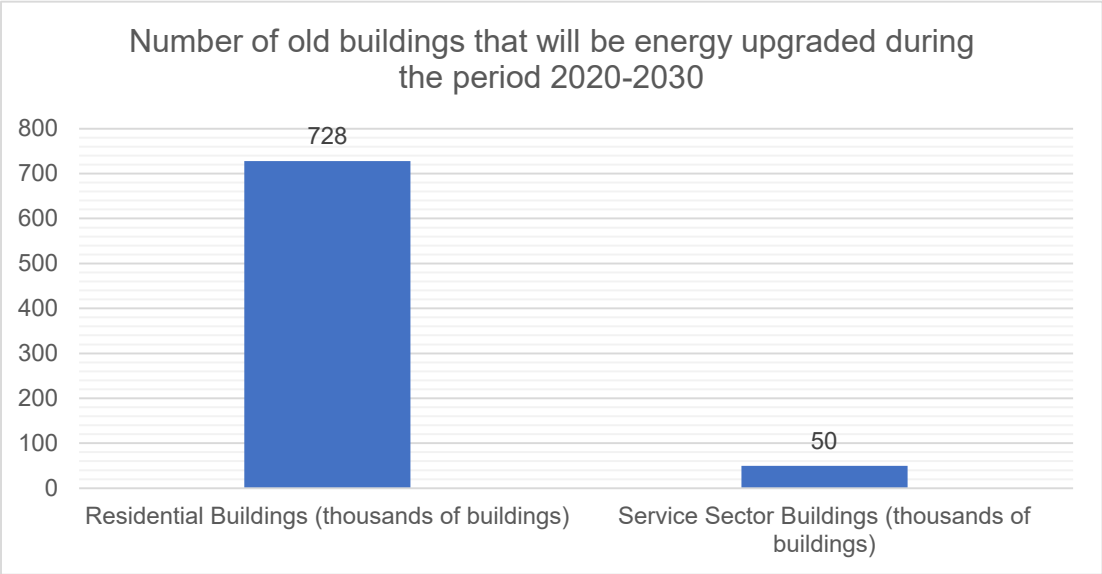


Figure 7.1: Number of old buildings that will be energy upgraded during the period 2020-2030 [Long-term Strategy for the Renovation of the Building Stock, 2021]

Similarly, in the tertiary sector, the number of buildings reaches 50,000 with an average annual energy renovation rate of the envelope at 0.6%. Therefore, to achieve the objectives of the National Energy and Climate Plan (NECP) and the long-term strategy for energy and climate, in the building sector, by 2030,

[12] "Improving the energy efficiency of buildings as a growth driver of the Greek economy" IOBE 2018. http://iobe.gr/docs/research/RES_05_C_04122018_REP_GR.pdf

[13] Long-term Strategy for the Renovation of the Building Stock (Ministerial Decision YPEN/DEPEA/20334/148/ 01.03.2021, Official Government Gazette B' 974)

[14] Average rate based on the Primes model.

a total of 778,000 buildings require energy upgrades, with the policies and incentives for energy savings achieving an intervention penetration of 23% and 9% for the residential and non-residential building stock, respectively. At this point, it's worth noting that the goals for the services sector are lower because the rate of new construction is significantly higher in this sector. Therefore the potential for energy renovation of the envelope of old buildings is clearly smaller.

Finally, it's also worth noting that, according to the NECP, the energy upgrade of buildings and/or building units within the decade 2021-2030 is expected to lead to an increase in investments of 8 billion euros, an increase in domestic added value, and at the same time, the creation and maintenance of over 22,000 full-time employment positions, annually, throughout the period[15]. While the Long-term Strategy does not specify particular energy-saving actions, the effort to estimate the evolution of the labour force due to the energy upgrade actions of the building stock will be based on correlating the estimated economic costs required to achieve energy goals with the total full-time job positions created by these costs.

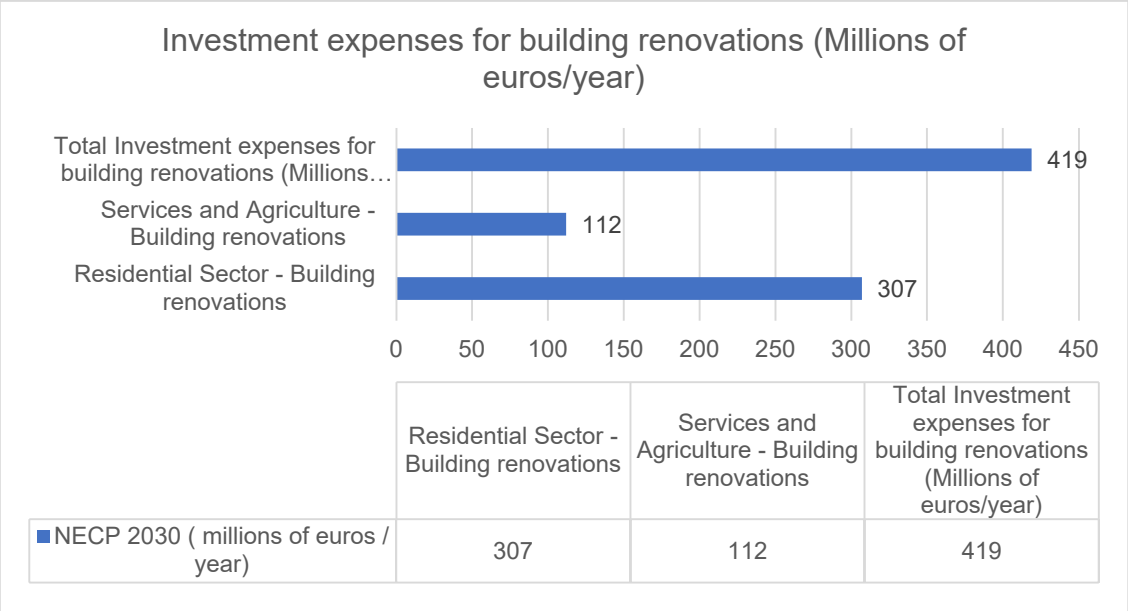


Figure 7.2: Annual Investment expenses for building retrofits until 2030 [Long-term Strategy for the Renovation of the Building Stock, 2021]

According to the long-term strategy for 2050 from the Ministry of Energy and Environment, in the building sector, 307 million euros[16] will be allocated annually, which can create 11,359 job positions per year, assuming that every 1 million euros spent on energy-saving actions leads to the creation of 37 job positions. The corresponding number for the tertiary sector reaches **4,144 positions**. At the same time, the overall 419 million euros that constitute the total investment cost for building upgrades per year is expected to result, by the end of the decade, in **155,030 job** positions in total by 2030.

The above total costs concern the upgrade of only the building envelope, so the calculated job creations exclusively pertain to works improving the building envelope. It's worth noting that in the Long-Term Strategy Report, no quantitative data is provided for specific energy-saving interventions in the building envelope. However, only their classification into light, medium, and radical interventions is made, providing at the same time the average annual rates of energy envelope upgrade for three income classes according to the simulations of the economic-energy model PRIMES.

[15] National Plan for Energy and Climate, YPEN (Ministry of Environment and Energy), https://energy.ec.europa.eu/system/files/2020-01/el_final_necp_main_el_0.pdf

[16] "Long-term Strategy for 2050", YPEN (Ministry of Environment and Energy), https://ec.europa.eu/clima/sites/lts/lts_gr_el.pdf

Furthermore, due to the lack of more data, the further analysis of the 37 jobs created per million-euro investment in energy savings in positions related exclusively to the building sector, both white and blue-collar, presents a significant challenge. The multifaceted nature of energy-saving actions, which might include insulations, window upgrades, HVAC system improvements, lighting improvements, solar panel installations, the deployment of 'smart' devices in buildings, and automation, among others, makes it hard to correlate specific energy-saving actions with specific professions, as engineers, technicians, and laborers work collectively, not independently. Thus, classifying individuals into these traditional categories becomes increasingly complex within the context of evolving roles and skill sets.

As the convergence of responsibilities and the increasing demand for interdisciplinary expertise blur the boundaries between white and blue-collar professions in the construction industry, and due to the interdisciplinarity of the actions, we assume that 50% of these positions pertain to jobs related to the building sector – that is, 18 jobs for technicians - engineers for every 1-million-euro investment in energy savings actions. Also, based on the 2010 study entitled “Energy Saving in Buildings: Creating new economically sustainable jobs”[17], the added value of technicians' work (engineers and technicians) accounts for 50% of energy-saving investments in buildings.

So, as shown in Table 7.1, the calculated job creations per year and in total by the end of the decade for actions related to the upgrade of building envelopes in the residential sector and the services sector are presented. In this case, a total of 75,420 job positions are calculated, with 55,260 being full-time positions related to upgrades of building envelopes in the residential sector. In contrast, 20,160 are related to upgrades of building envelopes in the services-agriculture sector.

Table 7.1: Estimated jobs for building envelope upgrade

	Jobs created on an annual basis	Jobs created until 2030
Residential Sector - Building Envelope Retrofits	5.526	55.260
Services and Agriculture- Building Envelope Upgrade	2.016	20.160
Total	**7.542**	**75.420**

As the long-term strategy does not specify particular energy-saving actions, the abovementioned analysis does not cover the broad spectrum of upgrades to the building stock. Consequently, efforts to estimate the evolution of the workforce due to energy upgrade actions of the building stock will initially be based on creating a standard building for the residential sector and, correspondingly for the tertiary sector.

To achieve this, it is essential to make some assumptions concerning the general features of these two standard buildings, such as square meters, penetration rates of heating systems in these buildings (e.g., the penetration rate in heat pumps or the installation of a solar water heater or the installation of a natural gas boiler, etc.), as well as considering some indicative energy-saving actions related to insulation works, replacement of heating systems, installation of photovoltaic systems, and more.

For the residential sector, for the renovation of a standard house (85 sq.m.), it is assumed that:

- The roof will be fully insulated.
- The terrace will be fully insulated.
- The frames will be replaced either with metal ones or with wooden ones.
- The heating system will be replaced entirely.
- A solar water heater is installed.

Similarly, for the renovation of a standard building in the tertiary sector (670 sq.m.), it is assumed that:

[17] “Energy Saving in Buildings: Creating new economically sustainable jobs”

- The roof will be fully insulated.
- The terrace will be fully insulated.
- It has a fully heat-insulated envelope.
- The frames will be replaced either with metal ones or with wooden ones.
- The lighting system and the electrical installations are fully replaced.

At the same time, it is assumed that for all the buildings that are to be upgraded, both in the residential and in the tertiary sector, the following is carried out:

- Energy inspection.
- Thermal insulation adequacy study.
- Supervision of thermal insulation.
- Heating study.
- Supervision of heating installation.

Furthermore, for residential buildings, a penetration of photovoltaic systems (PV) in 15% of the total households set to be upgraded and 50% in the total buildings to be upgraded in the tertiary sector is assumed, with corresponding percentages applying for the respective study preparations. Additionally, the study and supervision of electrical installations are identified in all tertiary sector buildings.

Also, since there are no scientific studies for determining the average manpower requirements for implementing the aforementioned energy upgrade actions, a field survey was conducted. Information provided by craftsmen and engineers in the construction industry, after communicating with them, was utilized for that. Moreover, the analysis timeframe was set for a decade, and for the working days per year for craftsmen and engineers, the value of 220 was used.

Given the number of buildings that need to be upgraded by the end of the decade for both the residential and the tertiary sectors, the assumptions regarding the upgrade actions and the penetration percentage of these in the buildings of the two sectors, the total person-days per square meter, and the person-days per year, the need arises for:

- 14,593 blue-collar technicians (insulation technicians, carpenters, plumbers, electricians, burner technicians, etc.) for the upgrade actions of the 728,000 buildings in the residential sector and 7,523 for the upgrade actions of the 50,000 buildings in the tertiary sector.
- 1,837 engineers (energy inspectors, mechanical engineers, electrical engineers, civil engineers, architects, etc.) for the upgrade actions of the 728,000 buildings in the residential sector and 435 engineers for the upgrade actions of the 50,000 buildings in the tertiary sector.

Consequently, as the analysis for approximating the number of employees in the building sector required for the upgrade of the existing buildings of the residential and tertiary sectors used the primary upgrade actions, the results derived pertain to the minimum number of workers required to meet national needs by 2030. Furthermore, considering that the 220 workdays/year used in the analysis do not realistically represent the net working-time of each worker, it is suggested to use an employment increase factor of 25% for both the technicians and the engineers, with the final results appearing in table 7.2.

Table 7.2: Estimated full-time Jobs for energy retrofits in residential and tertiary sector buildings.

	Estimated full-time Jobs for energy retrofits in residential buildings until 2030. (Residential Sector)	Estimated full-time Jobs for energy retrofits in tertiary sector buildings until 2030.	Total Jobs
Blue Collar Workers	58.372	30.093	88.465
White Collar Workers	7.346	1.740	9.086
Total			97.552

Stage B: Construction of new buildings - Needs estimation for new construction up to 2030

Estimating the new workforce to meet the country's needs for the reconstruction of new energy-sustainable buildings by 2030 requires a different approach from that taken for the case of the reconstruction of existing buildings. Thus, initially, a forecast of the future construction activity in Greece up to the year 2030 was made, through which the workforce that will constitute the Greek construction sector as a whole at the end of the decade was estimated in Stage B1. Then, in Stage B2, the total required number of technicians, workers and engineers directly involved in EE and installation of RES systems in buildings was calculated to meet the national energy targets until 2030.

Trends analysis

The current recovery from the construction industry crisis over the past decade that led to a significant shrinking of the construction industry and building activity beyond all forecasts, as well as the COVID-19 health crisis that imposed the slowdown of the sector's recovery and the war in Ukraine that significantly affected material prices, considers it imperative to simulate some alternative scenarios for forecasting the future course of construction in the Greece. More specifically:

- The objective of Stage B is to verify the outlook with one of the forecasting scenarios that will be simulated. Thus, it was considered important to model an optimistic and a pessimistic scenario that will frame the maximum and minimum possible limit of building activity development until 2030.
- In addition, a moderate scenario was created which is considered as more realistic and more likely to be verified in the future.

For the creation of alternative scenarios, the analysis of different factors and trends in the Greek society and construction industry was considered.

Demographics

The forecasting model used to construct the three scenarios for the development of the construction industry, considered declining population data for Greece until 2030, according to EUROSTAT study[18]. The estimation of the small decrease of Greece's population until 2030 is foreseen at 4.08%. According to the National Energy and Climate Plan, projections for household developments up to the year 2030 with both forecasting models used show a contraction in the estimated number of households. Moreover, in terms of the size of the average household, a contraction is also expected.

The estimation for population reduction by 2030 is also derived from a relevant report by IOBE[19]. In particular, Greece's population is expected to continue the decline recorded over the past decade, with no particular prospects of recovery. As regards the structure of the population, demographic ageing (also supported by increased life expectancy) will not be halted.

Building construction activity

Building construction activity in Greece, during the fourth quarter of 2022, increased by 31,3% compared to the corresponding quarter of the previous year, accelerating from the decline of 20,6% in the previous quarter. It was the largest increase in building activity since the third quarter of 2016, as both building construction (24.4% vs. 7.4% in the third quarter) and infrastructure projects (35.9% vs. 30.3%) increased further. According to Figure 7.3, the growth of building construction activity since mid-2020, with small fluctuations, has been following an upward trend to date. The increase rate is one of the highest recorded in the last two decades, and is approaching peaks historically.

[18] "EUROPOP2023 - Population projections at national level (2022-2100) (proj_23n)" ,2023. https://ec.europa.eu/eurostat/web/population-demography/population-projections/database

[19] "Demographic problem in Greece: Challenges and policy proposals". IOBE, June 2022

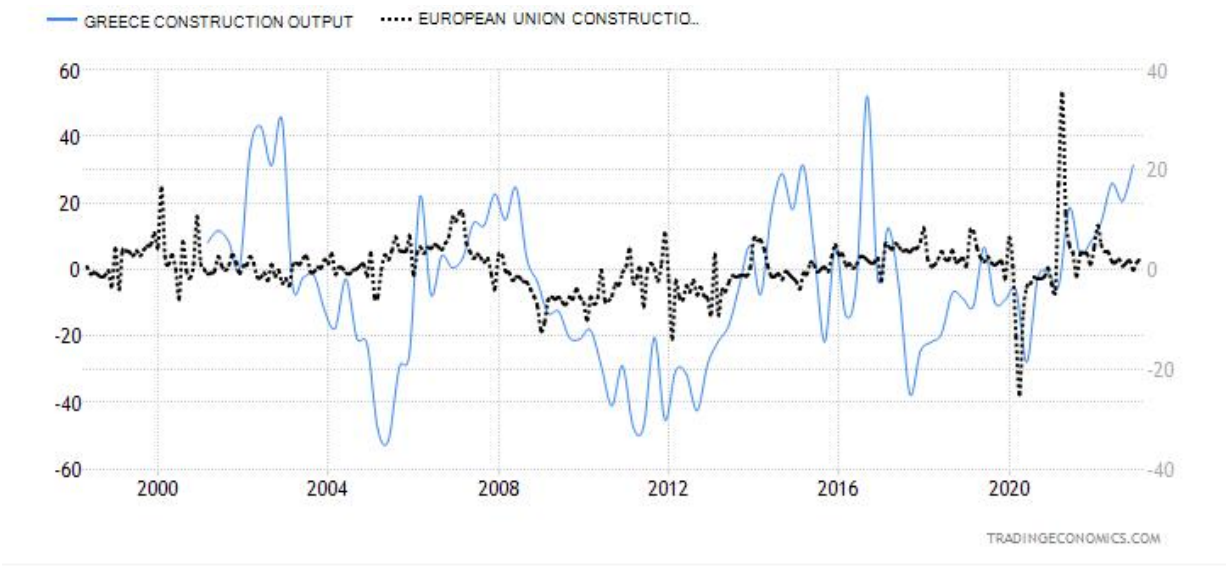


Figure 7.3: Growth rate of building construction activity in Greece and the European Union

Regarding new permits, according to ELSTAT data, in 2022, although positive, the growth rate of new permits for the construction of buildings decreased compared to previous years, while the percentage change of new square meters of surface is negative compared to the previous year. This indicates that there is a slowdown in building activity, and while the construction of new buildings continues, their surface area is now reduced.

Table 7.3: Data on building construction activity in Greece over the last five years (2018-2022)[20]

	Number of building construction permits	Change	Surface built (Sq.m.)	Change
2018	15,180.00	**10%**	3,408,521	**22.77%**
2019	17,229.00	**13%**	3,724,180	**9.26%**
2020	18,768.00	**9%**	4,055,202	**8.89%**
2021	23,807.00	**27%**	5,968,688	**47.19%**
2022	24,913.00	**5%**	5,440,016	**-8.86%**

In Europe, despite the significant increase in construction activity over the last 2 years, it is expected that the development will follow a downward path until 2025, according to global macroeconomic models and the expectations of Trading Economics analysts[10]. In the long term, construction production in Greece is projected to reach around 6.50% in 2024 and 2.00% in 2025[21], but there are no forecasts until 2030 due to high precariousness in forecasting models. In the same forecasts, it is estimated that in the case of Greece, contrary to the forecasts for the EU, there will be no reduction in building activity but a significant reduction in its high growth rate that is currently in force.

The analysis of building activity trends indicates that the upward trend of the sector is largely due to the effort to bridge the gap created by the sector's recession after 2009. However, the sector's development forecasts and comparison with trends in Europe indicate that the rapid growth of the sector cannot be sustained for a long time.

[20] ELSTAT. CONSTRUCTION ACTIVITY SURVEY: November 2022. https://www.statistics.gr/el/statistics/-/publication/SOP03/-

[21] https://www.ifo.de/en/press-release/2023-01-18/european-construction-industry-will-see-weaker-growth-future

Availability of building stock

Regarding the building stock in Greece and its connection to the need for the construction of new buildings, according to Eurostat, it was 3,949,900 dwellings on the year 2019. The homeownership rate in the country, although high, has declined significantly in recent years. In the period from 2005 to 2021, the homeownership rate in our country fell from 84.6% to 73.3%, dropped by 11.3 percentage points. A large part of the above homes may have been "lost", according to data from E-Real Estates - Nationwide Network of Real Estate Agents, due to the initiation of auctions, as well as due to the pandemic crisis.

At the same time, part of property owners with debts to banking institutions may have "wanted" to pay off the amount of debt by selling their property, choosing now to live in rented housing. In addition, a part of the owners chose to "exploit" their properties through short-term lease and/or sell their home due to the increase in sale prices to domestic or non-domestic investors (Golden Visa), who probably do not own but offer the properties in short-term or long-term renting.

An important element of our analysis is the big number of vacant houses. The number of vacant buildings increased significantly in the period 2001-2011 according to census data. According to ELSTAT data, the 2011 census recorded 897,968 vacant houses out of use, i.e. suitable for rent, sale or demolition, a number that constituted 14% of the total housing stock of a total of 6,371,901 dwellings in the country. It should be noted that if secondary and/or holiday homes are also taken into account, the number rises to 2.24 million residences or 35% of the total.

However, based on the censuses, there is a strong geographical diversification of the building stock. The largest number of vacant buildings is found in large urban centres, where most of the population with housing needs are concentrated. Consequently, those vacant dwellings cannot be regarded as holiday homes but as potential main residences[22].

Real estate demand for the tourism industry

Tourism is one of the real estate sectors that contributes to the demand for the construction of new buildings. Individual activities are the hotel industry, short-term renting and holiday homes. According to data from the Institute of the Association of Greek Tourism Enterprises (INSETE), Enterprise Greece, as well as private economic studies (Deloitte), Greece is among the top hotel investment destinations in Europe along with Spain and Portugal. Indicative is the high attraction of new investments in the past two years, despite the pandemic crisis, when, according to data from the Hellenic Chamber of Hotels (HCH), in 2020 an additional 81 new hotel units with a total of 10,052 beds started operating nationwide, while in 2021 another 69 units were added. The prospects of the sector are positive with numerous units throughout Greece (mainly in Athens, Crete, Rhodes, Corfu, Thessaloniki, Khalkidhiki) being under construction or reconstruction.

Short-term rental is an industry that has grown rapidly in recent years and has absorbed a significant number of properties. However, regarding the assumption of short-term rental as a reason for reducing owner-occupied housing, it cannot be strengthened, and this is because, in 2019, which was the best year for this industry, the percentage of owner-occupied dwellings is higher than in 2020 and 2021. The effect of short-term rental on the need for the construction of new homes does not seem to be significant as on the one hand it absorbs existing residences and on the other hand the empty building stock approaches 1/3 of the total, providing strong building potential for renovation and utilization.

As far as holiday homes are concerned, the attractive prices and availability of real estate make Greece an attractive destination for private buyers, mainly from northern Europe, who are looking for a holiday home, but there are no official data on the level of demand, only indicative trends emerging from companies in the real estate sector being positive.

[22] Changes in property ownership at Exarchia - Athens Social Atlas

Cost of new constructions

Inhibiting the construction of new buildings today is the fact that construction prices have risen rapidly - as in most European countries. In addition, rising interest rates and the energy issue that has arisen due to the war in Ukraine may lead to financing difficulties, especially for buyers of small homes. Despite government efforts to cover energy costs, not all expected negative factors due to high inflation have been absorbed. As shown in the following chart, according to ELSTAT data, the general material price index has been on a continuous upward trend since 2020, which may explain the dramatic decrease in new permits in 2022.

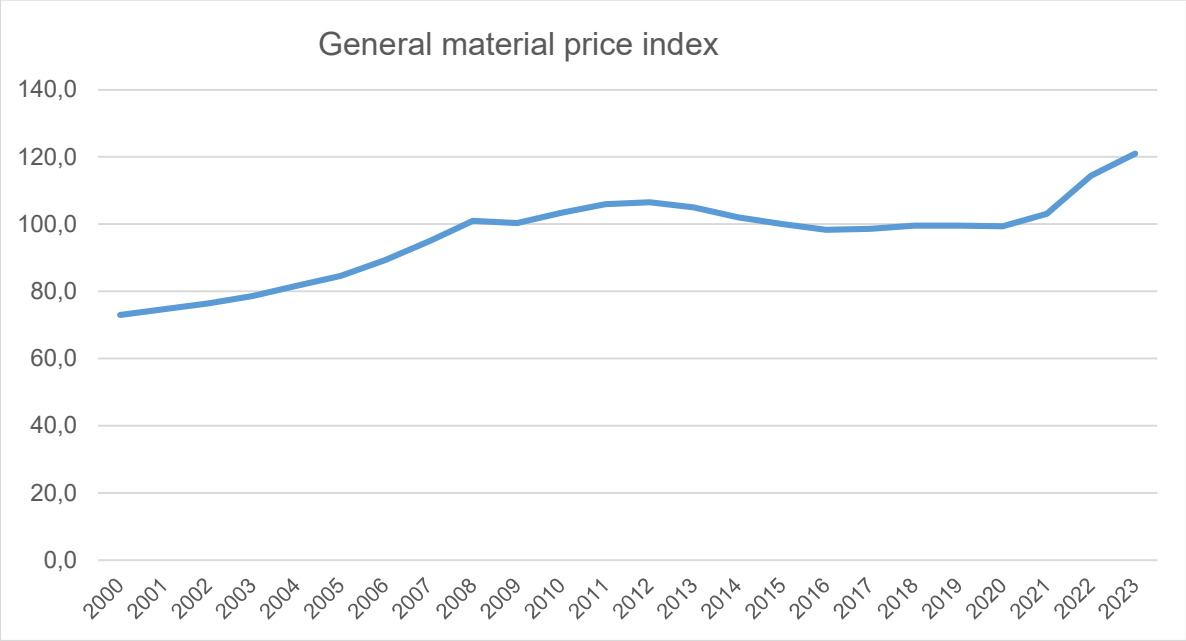


Figure 7.4: General Index of Material Prices for the period 2000 – 2020 (Base year 2015=100.0)

National policies related to the buildings sector

One of the current support programmes is to subsidise loans for 10,000 new home buyers (buying their first property), thus helping to support the property market. However, these loans do not relate to new construction but to the purchase of real estate aged 15 years or older. Therefore, these efforts are not expected to contribute to the development of the new housing construction industry. Other support programmes in place concern energy upgrading and building renovation.

The above actions are expected to affect the purchase and sale and construction activity of existing buildings, as well as to bring back to use a significant number of vacant houses. The impact of these on the construction of new buildings is expected to be negative, as it will slow down the demand for the construction of new houses[23].

Forecasting model development methodology

The current model took into account the continuous shrinkage of the country's total population until 2030 and a number of other factors as diagnosed in the above analysis, data that suggest a continuous but decreasing need for new housing construction. On the other hand, the forecasting model became independent of the country's economic and development data, such as GDP, due to the high instability they present in the context of the economic crisis that the country went through in combination with the unexpected health crisis.

[23] Housing research. Eteron - Institute for Research and Social Change. https://stegasi360.eteron.org/kena-ktiria/

Additional factors for the independence of forecasts from economic/growth data are the intensifying international geopolitical developments and their impact on the national economy and domestic economic activity, as well as the emerging international crisis[24] in the real estate sector (mainly the commercial) that cannot be estimated how it will affect the Greek construction sector. In addition, building activity and the construction industry in general, have fluctuated in GDP in recent years, with an increasing trend in the sector. Finally, the growth of the sector shows signs of resilience to international geopolitical and economic developments, due to the shift of the Greek economy towards the tourism sector targeting the global tourism public.

In summary, the important elements and data of the analysis that pushed the forecasting model in the direction it followed, are:

- Greece is one of the countries whose population is shrinking the most in the Eurozone and demographic ageing (aided by increasing life expectancy) will not be halted. The impact of this factor on the construction of new buildings is expected to be negative, as it will slow down the demand for the construction of new housing.
- European statistics place Greece as the 19th EU country in terms of home ownership rates.
- Regions such as Attica, which gathers by far the largest building activity, are considered to be saturated in terms of construction with little space for further reconstruction.
- There are thousands of apartments and detached houses closed but able to return to use with appropriate incentives, which prevents the rebuilding of new homes.
- There is a positive growth potential for the tertiary sector, mainly in the tourism sector, without, however, significantly affecting the overall building activity of new buildings.
- The current housing policies are expected to affect the buildings buying and selling activity in existing buildings, as well as to bring back to use a significant number of vacant houses. The impact of these on the construction of new buildings is expected to be negative, as it will slow down the demand for the construction of new houses.
- Older statistics show the strong growth of the sector after rapid recessions. Moreover, there is no long-term stagnation in the annals of the sector.
- Construction prices have risen rapidly and combined with rising interest rates are already negatively affecting demand for new construction and the issuance of new permits.
- The evolution trend of the construction sector across Europe is expected not to increase until 2030, which may negatively affect the current high growth rates of the Greek construction industry.
- The demand for building stock for the short term is stabilizing in the coming years, as the supply of available overnight stays approaches for 2023 the already expected very high demand.

From the above it follows the conclusion that the activity of the construction sector in Greece is currently on the rise, approaching its historical maximum values, which combined with unfavourable international developments, probably indicates that it will be difficult to achieve further high growth until 2030. Nevertheless , its return to high levels of earlier years is expected after at least a decade, i.e. after 2030.

Assessment of new construction needs

The three scenarios simulated based on all the aforementioned data are presented in detail below and are quantified in the diagram of the Figure 7.5 in units of area of new buildings.

- **Optimistic scenario**: Significant average percentage increase, equal to 6% p.a., until 2030 and return of the country's building activity to 2010-2011 levels.
- **Moderate scenario**: Moderately average percentage increase, equal to 4% p.a., until 2030 and return of the country's building activity to 2011 levels.
- **Pessimistic scenario**: Low average percentage increase, equal to 1% p.a., until 2030 and return of the country's building activity to 2011-2012 levels.

[24] https://www.bankrate.com/real-estate/is-the-housing-market-about-to-crash/

	New floor area constructed (sq.m.)			
Year	Optimistic scenario +6%/p.a.	Moderate scenario +4%/p.a.	Pessimistic scenario +1%/p.a.	
2007	20582961	20582961	20582961	Historical data
2008	16681420	16681420	16681420	
2009	12610640	12610640	12610640	
2010	10168531	10168531	10168531	
2011	6079203	6079203	6079203	
2012	4167280	4167280	4167280	
2013	2939452	2939452	2939452	
2014	2563185	2563185	2563185	
2015	2466924	2466924	2466924	
2016	2345741	2345741	2345741	
2017	2776236	2776236	2776236	
2018	3408521	3408521	3408521	
2019	3724180	3724180	3724180	
2020	4055202	4055202	4055202	
2021	5968688	5968688	5968688	
2022	5440016	5440016	5440016	
2023	5766417	5657617	5494416	**Predictions**
2024	6112402	5883921	5549360	
2025	6479146	6119278	5604854	
2026	6867895	6364049	5660902	
2027	7279969	6618611	5717511	
2028	7716767	6883356	5774687	
2029	8179773	7158690	5832433	
2030	8670559	7445038	5890758	

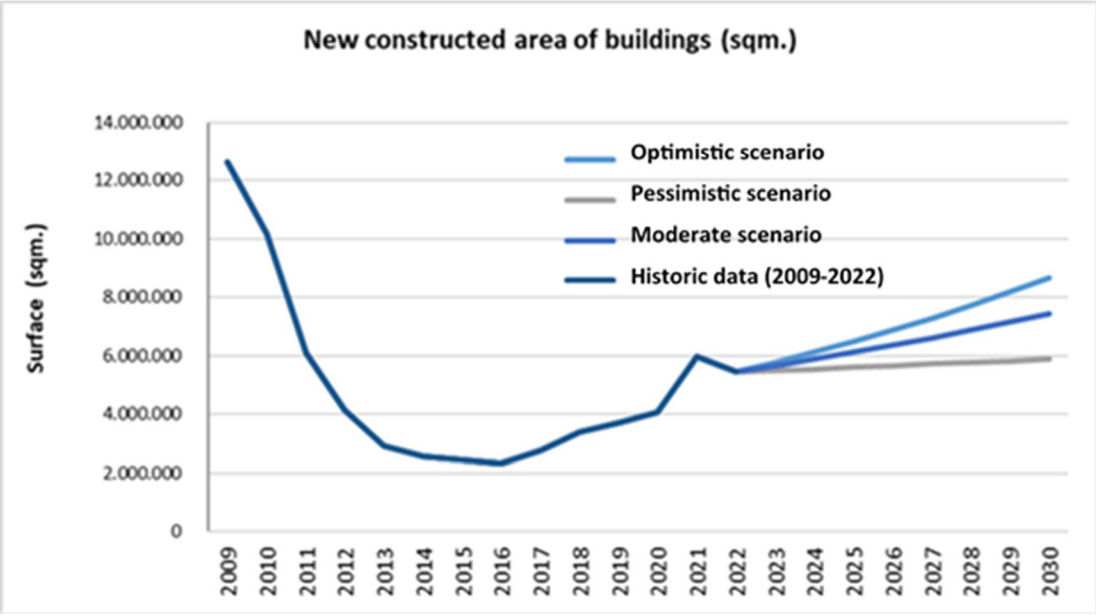


Figure 7.5: Simulation of the three future scenarios of the evolution of total building activity (new constructions) in Greece for the years 2023-2030, in square meters, (EPU NTUA, 2023)

Stage B1. Needs estimation for workers in the construction industry for the construction of new buildings by 2030

The estimation of the workforce that will be needed in the buildings construction industry as a whole in the year 2030, was based on the known numbers of workers and construction activity of previous years. The size of this potential is to a large extent proportional to the demand for building reconstruction. Therefore, this approach was considered to be the safest for predicting the future number of employees in the sector in 2030.

Analysing the data on building activity and number of employees in the construction industry for the year 2020, the following results were extracted for 2030:

- **Optimistic scenario:** 132,531 employees
- **Moderate scenario:** 109,545 employees
- **Pessimistic scenario:** 81,747 employees

In the first two scenarios, growth of the sector is expected and consequently absorption of additional labour compared to the existing one.

Stage B2. Estimation of the number of workers that will be required for energy-saving works in new buildings as well as for the construction of net-zero buildings by 2030

The entire construction sector calculated above also includes employees who are not affected by this report, such as office workers, managing entrepreneurs, transport drivers, etc. The professions related to energy saving work in buildings as well as to the construction of energy-autonomous buildings consist of the following categories:

Facilities

- **Electricians - Electrical installations** (solar panels for PV systems, sustainable lighting, power quality, electrical monitoring of buildings, smart home / BMS systems).
- **Mechanical installations** (heating systems, air conditioning systems, domestic hot water production systems - solar thermal, heat pumps, energy production (biomass - sun), ventilation systems, thermal monitoring of buildings).
- **Roofing technicians** (solar panels, PV, wind energy).

Constructions

- **Builders - Plasterers** (thermal insulation work, moisture insulation works).
- **Carpenters** (highly energy efficient wooden constructions of floors, facades, roofs, windows, doors)
- **Roofing technicians** (roof insulation).
- **Glazing** (installation of glazing on windows, doors and frames. *Note: this category includes the manufacturers and installers of frames*).

Specifically, these are the professional categories 4120, 4321, 4332, 4329, 4331, 4332, 4333, 4334, 4339, 4391, 4399, 2511, 2512, 2312, 1623 according to NACE, as presented in detail in Table 7.4, along with the absolute numbers of employees that make up them today. These data were extracted from ELSTAT and refer to the year 2020.

It should be noted that for the category Construction of residential and non-residential buildings (4120), it is practically not possible to distinguish them further, which led to the estimation that only a part (30%) of them is actively involved in Energy Efficiency (EE) and RES applications in buildings. This is because these occupations do not require any kind of training or specialization from workers and so the same worker can practice more than one of them if there is a need in construction.

Table 7.4: Absolute number of blue-collar workers involved in energy saving and the installation of RES in buildings, by NACE classification

Code NACE	Description	Number of workers	Average annual workers inflow (2017-2020)
4120	Construction of residential and non-residential buildings	13.659	1.072
4321	Electrical installation	17.574	274
4322	Water, gas, heating, air conditioning installation	8.022	16
4329	Other building installation	5.908	76
4331	Plastering	1.651	36
4332	Joinery installation	8.022	142
4333	Floor and wall covering works	3.981	48
4334	Painting, glazing	4.839	56
4339	Other finishing construction n.e.c.	931	12
4391	Roofing, roof construction	462	4
4399	Other specialised construction activities	13.054	222
2512	Manufacture of metal building components	8.908	101
2312	Further processing of flat glass	900	10
1623	Manufacture of joinery product	3.118	32
	Total	**91.029**	**2.101**

An additional element that hinders the above is the increased absorption of unskilled workers, including unregistered immigrants, due to the significant growth of Greek construction and the shortage of labour due to the significant reduction of workers in the construction industry in the decade 2010-2020. Of all the above employees, we consider that a part is currently employed in the construction of new buildings, while the rest are employed in renovations/reconstructions of the existing buildings. This hypothesis was considered to carry out the necessary calculations as there is no data available on how the workers of the NACE registration are distributed, in new constructions and existing ones. Finally, based on statistics per NACE code for the years 2017-2020, the average annual inflow of employees was estimated at 2,101 workers cumulatively.

In addition to blue-collar workers, white-collar workers involved in energy saving and installing RES in buildings have been assessed. According to data obtained from the Technical Chamber of Greece and the Professional and Scientific Association of Technological Education of Engineers, their registered members in specialties related to the building sector were estimated at 142,451. From this total, the total number of white-collar employees involved in EE and installation of RES in buildings was estimated at 21,368 employees.

Table 7.5: Estimation of the total number of "white collar" workers involved in EE interventions and installation of RES in buildings

White Collar Workers	Estimated Number
Engineers registered in the Technical Chamber of Greece (specialties related to the building sector: architects, civil, electrical, mechanical, environmental, topographers)	92,451
Registered members E.E.T.E.M	50,000
Registered members of "white collar" employees who may be employed in the building sector (new buildings)	142,451
Estimated number of "white collar" employees in RES and RES in the building sector (new buildings)	21,368

Table 7.6: Aggregated employment results related to the construction of new buildings for the year 2030

Reference year (2030)	Blue- and white-collar workers in the building sector	Blue- and white-collar workers in EE and RES activities in the building sector	Gap of blue- and white-collar workers in EE and RES in the building sector
Optimistic scenario	132,531	93,810	39,891
Moderate scenario	109,545	77,540	23,620
Pessimistic scenario	81,747	57,863	3,944

In conclusion, employees in the construction sector related to the construction of efficient buildings and the installation of RES systems in them, currently amount to 52,383 and constitute the **70.78%** of the employees in the building industry. Thus, with a similar percentage match to the sizes of the construction industry projected for 2030, the total number of craftsmen and workers in EE and RES in buildings at the end of the decade is obtained.

The additional number required to meet Greece's energy targets is also calculated, compared to the existing one having taken into account the corresponding annual inflow of workers in the construction of new buildings. All the above data are collected in Table 7.6.

Total workers needs by 2030

The total workers gap projected for Greece until 2030, according to the methodology followed, is calculated by summing up the craftsmen that emerged in stages A and B and is analysed again in 3 forecasting scenarios.

$$\textit{Workforce Gap in EE and RES}_{2030} =$$
$$\textit{Necessary number of employees in energy upgrades}_{2030} +$$
$$\textit{Necessary number of employees in EE and RES in new constructions}_{2030} -$$
$$\textit{Existing number of employees in EE and RES}_{2020} -$$
$$\textit{Total employee input}_{2030}$$

Table 7.7 summarizes the results obtained.

Table 7.7: Estimated total workers in EE and RES activities in buildings gap in Greece until 2030

	Total workers needed by 2030	Workforce Gap by 2030
Optimistic scenario	191,362	92,939
Moderate scenario	175,092	76,668
Pessimistic scenario	155,415	56,992

7.3 Necessary skills and identified gaps between the current situation and the needs for 2030

7.3.1 Challenges in the training of the construction sector workforce

The restart of the construction sector after a prolonged period of recession, caused by the economic crisis experienced in Greece, coincides with increased education needs for blue-collar and white-collar professionals operating in the building construction industry. These professionals require the necessary skills to achieve the energy goals by 2030. As the majority of professionals in the construction sector

are self-employed or work in very small companies, their access to appropriate education is significantly limited by the constraints of financial resources and available time.

This problem is exacerbated by the lack of adequate support measures for professionals and the absence of incentives from the government to create added value in the services provided by professionals through education and certification. Additionally, the insufficient implementation and inadequacy of the existing institutional framework create distortions in the market, which act as barriers to the education of construction sector professionals.

In turn, the above-mentioned problems reinforce the issue of the lack of suitable educational programs, as their development is deemed unsustainable for any educational organization, especially in the private sector.

7.3.2 New skills needed to be acquired

To identify the new skills that technicians and other onsite workers (“blue collar”), as well as engineers, designers, architects, etc. (“white collar” professionals) employed in the building construction industry need to develop, specific questionnaires were developed and sent to the members of the National Qualifications Platform (NQP) of the BUS-REGRoUP project. The NQP members were asked to select the appropriate skills for their sector and rank them in order of importance. In each case, interested parties had the option to add any additional skills they deemed necessary to achieve the energy-saving goals set for 2030.

The required skills for the technicians, as included in the respective questionnaires, were as follows:

- Δ1. Skills for implementing measures to improve energy efficiency and incorporate renewable energy sources in buildings.
- Δ2. Skills for the deep renovation of buildings, including joint and industrial solutions.
- Δ3. Skills for new and existing nearly zero-energy buildings (nZEBs) and bridging the gap to zero-emission buildings (ZEBs).
- Δ4. Skills for integrating renewable energy sources and efficient heating and cooling technologies, including the increased use of heat pumps - skills for installers to provide heating and cooling upgrades in renovation projects.
- Δ5. Skills related to the carbon footprint during the life cycle of a material/system (through assessing potential planetary overheating), circular construction, and efficient resource use.
- Δ6. Digital skills supporting the increased energy efficiency of buildings, especially through enhanced use of Building Information Modelling (BIM).
- Δ7. Skills for upgrading the smart functionality of buildings for greater energy efficiency (based on the smart readiness indicator), focusing particularly on sensors, building controls, and building management systems.
- Δ8. Skills for the energy upgrading of historic and heritage buildings.

Then, the responses collected were weighted in terms of their importance based on the hierarchical ranking chosen by the respondents and were assigned to construction activities based on the NACE classification.

The table below (Table 7.8) presents the three most important skills requirements per NACE category (type of construction activity), while the weighted result of the questionnaire answers is presented in the chart of Figure 7.6. In his chart the required new skills per category of construction activity according to NACE are further distinguished.

Table 7.8: The three most important skills by NACE category

Type of construction activity	Classification of activities according to NACE	Most Important Required Skills	Available Education	Certification of qualifications
Building construction	F41.2.0 -Construction of residential and non-residential buildings	Δ2, Δ8, Δ1	NO	NO
Plastering, coating and insulation	F43.3.1 - Plastering F43.3.3 - Floor and wall covering works	Δ8, Δ2, Δ5	NO	NO
Electrical installations	F43.2.1 - Electrical installations	Δ7, Δ1, Δ6	NO	NO
Mechanical installations	F43.2.2 - Water, gas, heating, air conditioning installation	Δ1, Δ4, Δ7	NO	NO
Painting, glazing	F43.3.4 - Painting, glazing	Δ1, Δ8	NO	NO
Roof construction	F43.9.1 - Roof construction	Δ5, Δ5, Δ8	NO	NO
Joinery installation	F43.3.2 - Joinery installation	Δ2, Δ8	NO	NO
Manufacture of metal building components	C25.1.2 - Manufacture of metal building components	Δ1, Δ8	NO	NO

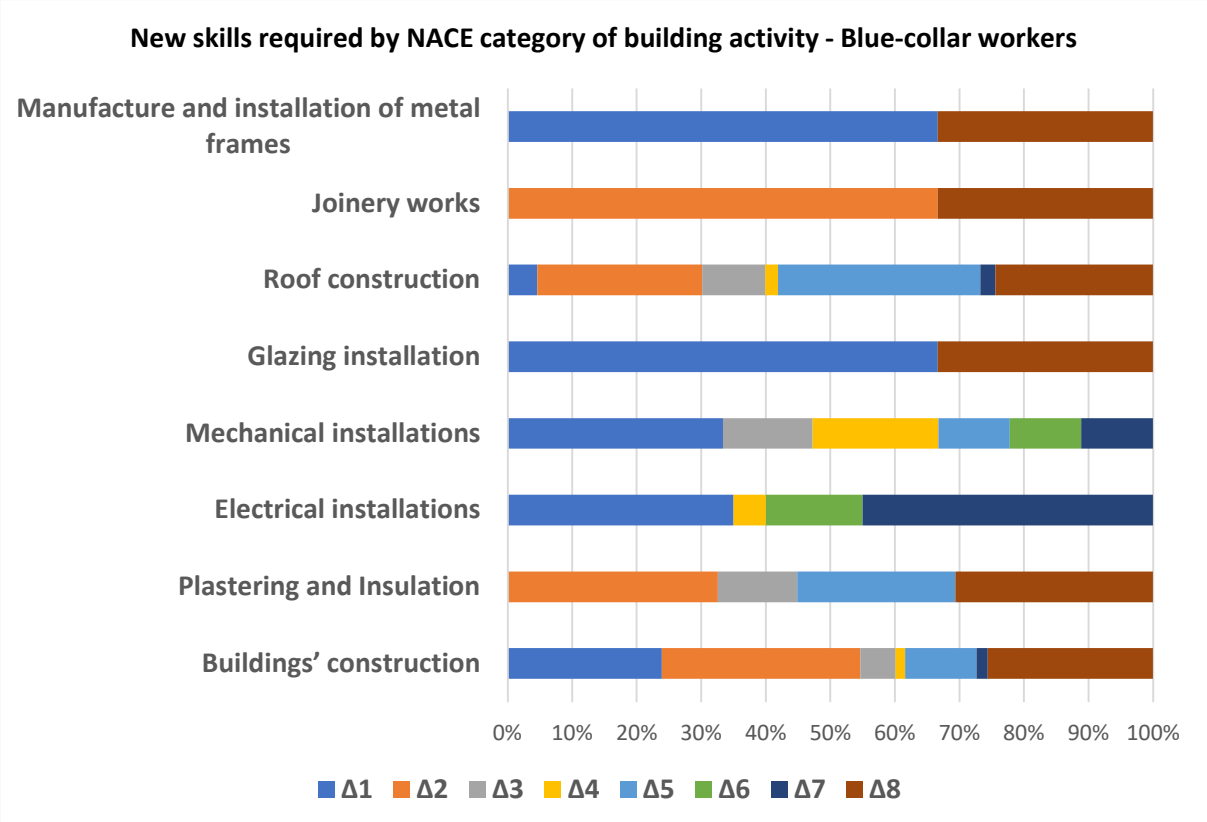


Figure 7.6: New skills required by NACE category of building activity

From the analysis of the questionnaires, it was revealed that the majority of technicians and other onsite workers ("blue colar" workers) employed in the building construction sector consider it important to acquire skills related to the implementation of measures to improve energy efficiency and integrate renewable energy sources (RES) systems into buildings. Following, with almost equal importance, are the skills related to upgrading the smart functionality of buildings (especially examining sensors, building controls, and building management systems), the carbon footprint during the lifespan of a material/ system, circular construction, and the efficient use of resources. Additionally, skills related to the implementation of radical building renovations are considered important, including through joint and industrial solutions.

The following graph presents in detail the results of evaluating the significance of the necessary new skills for technicians and other onsite workers ("blue colar" workers) active in the building construction sector.

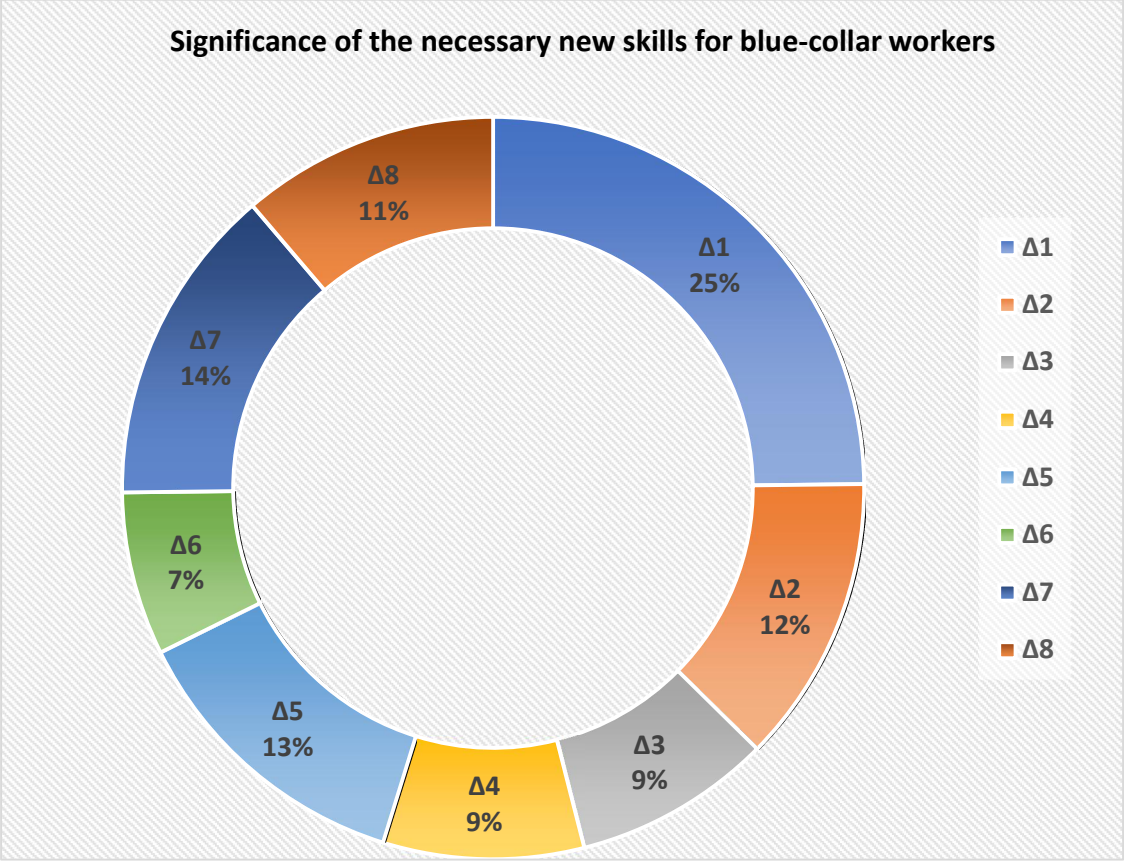


Figure 7.7: Significance of the necessary new skills for craftsmen ("blue collar" workers) operating in the building construction industry

Corresponding questionnaires were sent to the members of the National Qualifications Platform, in order to identify the new skills needs of engineers and other "white colar" professionals active in the building construction industry. The same analysis methodology was followed, except from the fact that in the case of "white colar" workers the classification based on specialties followed the coding by ISCO, because it offered better analysis of engineering specialties in comparison to the corresponding NACE classification.

The table below (Table 7.9) shows the three most important skills for each engineering specialty according to ISCO coding. Also, the overall result of the processing of the questionnaires concerning the required new skills of engineers and other "white collar" workers that are active in the building construction industry is summarized in the graph of Figure 7.8.

Table 7.9: The three most important skills for each engineering specialty according to ISCO coding

Engineering Specialty	ISCO CODE	Most important required skills	Training available	Certification of qualifications
Civil engineers	2142	Δ1, Δ2, Δ5	NO	NO
Building architects	2161	Δ1, Δ3, Δ5	NO	NO
Mechanical engineers	2144	Δ1, Δ4,Δ5	NO	NO
Electrical engineers	2151	Δ1, Δ4, Δ7	NO	NO
Cartographers and surveyors	2165	Δ1, Δ5, Δ2	NO	NO
Chemical engineers	2145	Δ1, Δ5,Δ4	NO	NO
Mining, metallurgical and related engineers	2146	Δ1, Δ4, Δ6	NO	NO
Urban and mobility planners	2164	Δ1, Δ5, Δ4	NO	NO
Environmental engineers	2143	Δ5, Δ1, Δ3	NO	NO
Professional engineers not elsewhere classified	2149	Δ1, Δ5, Δ4	NO	NO

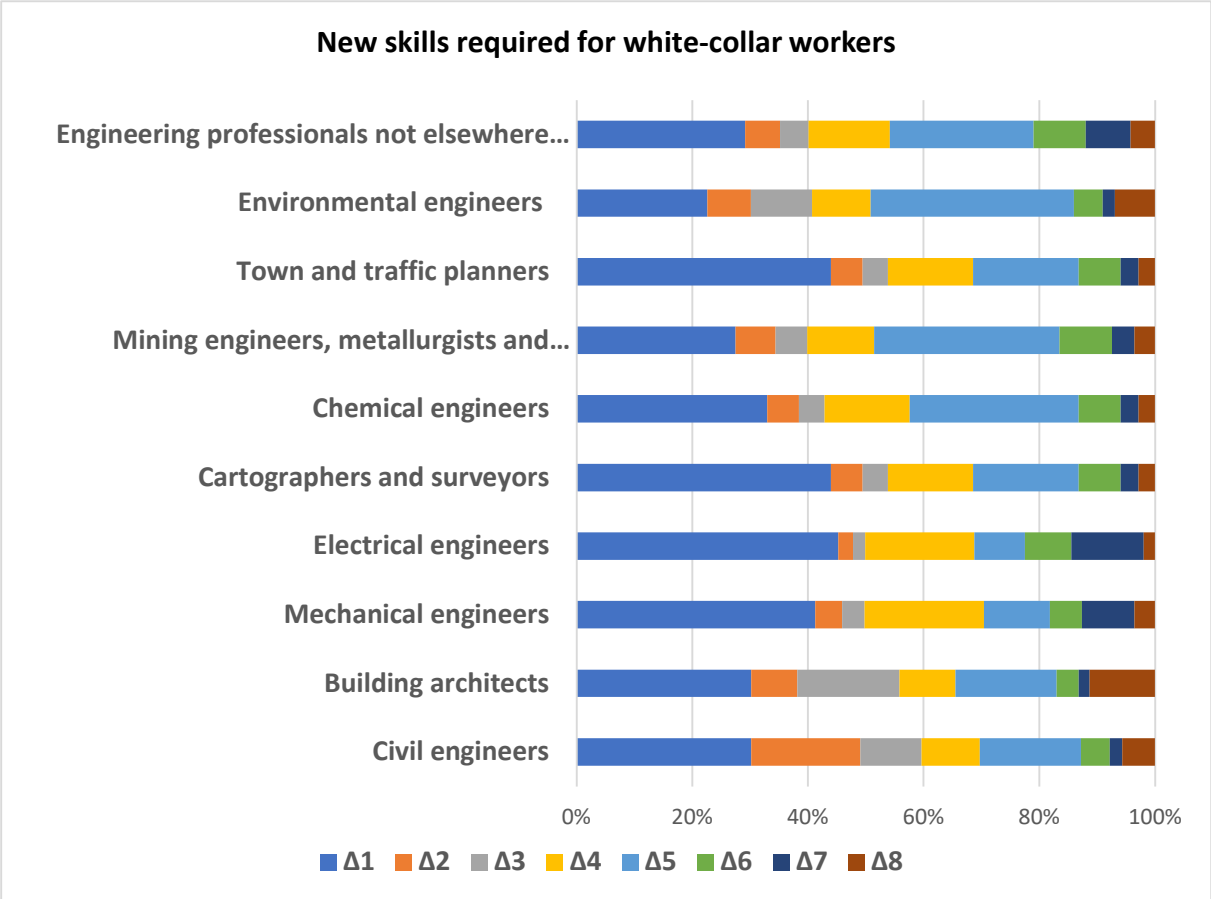


Figure 7.8: New skills required for engineers active in the building construction industry

From the analysis of the answered questionnaires, it is evident that the most essential skills considered necessary for engineers and other "white collar" workers engaged in the building construction sector relate to the implementation of measures to improve energy efficiency and the integration of renewable energy sources into buildings. Following these, the skills related to carbon footprint during the lifecycle of a material/system and circular construction, as well as efficient resource utilization, are also important.

These two categories of skills account for 55% of the significance for engineers, while the importance of the remaining six skill categories is almost balanced.

The increased significance of skills related to the implementation of measures to improve energy efficiency and the integration of renewable energy sources can be explained by the fact that all engineering specializations function as energy auditors. Apart from assessing the existing energy status of a building, they are also responsible for proposing improvement measures.

Similarly, the high importance of skills related to the carbon footprint during the lifecycle of a material/system and circular construction can be attributed to the promotion of the circular economy by the government within subsidized programs related to the construction industry, which is part of engineers' professional activities.

These assessments are further supported by the fact that the core engineering specializations show high significance in those skill categories directly related to their field of expertise. For instance, mechanical and electrical engineers consider skills related to efficient heating/cooling systems as significant. In the graph below, the results of the evaluation of the importance of essential new skills for engineers engaged in the building construction sector are presented in detail.

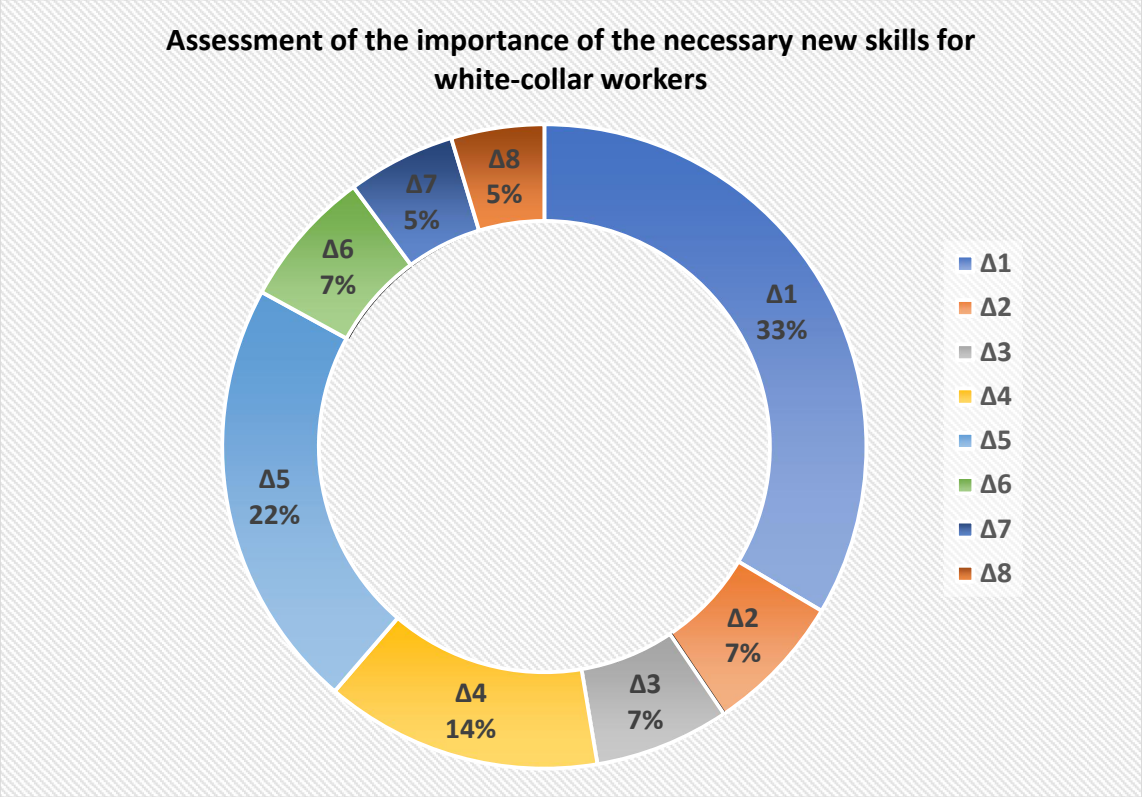


Figure 7.9: Assessment of the importance of the necessary new skills for Engineers operating in the building construction industry

7.3.3 Need for training of workers

Based on the results of the above paragraphs, it becomes apparent that there is a significant need for training the workforce in the buildings construction sector in Greece to achieve the targets for reducing environmental emissions and the country's energy goals by 2030.

To summarize, the most important skills that “blue collar” workers in the building construction sector will need to acquire by 2030 (based on the classification of activities according to NACE) are the following:

- Craftsmen engaged in building construction (F41.2.0) should acquire skills for implementing deep renovation of buildings, including through modular and industrial solutions, for the energy upgrade of historic and listed buildings (cultural heritage), as well as general skills for implementing measures to improve energy efficiency and integrate renewable energy sources into buildings.
- Craftsmen engaged in plastering and insulation (F43.3.1, F43.3.3) should acquire skills for the energy upgrade of historic and listed buildings (cultural heritage), for implementing deep renovation of buildings, including through modular and industrial solutions, as well as skills related to the carbon footprint over the lifecycle of a material/system (through the assessment of the global warming potential), circular construction, and efficient use of resources.
- Craftsmen engaged in electrical installations (F43.2.1) should acquire skills for upgrading the smart operation of buildings for greater energy efficiency (based on the smart readiness indicator), examining especially sensors, building controls and management systems (BMS), for implementing measures to improve energy efficiency and integrate renewable energy sources into buildings, as well as digital skills that support greater energy efficiency of buildings, primarily through the enhanced use of building information modelling (BIM).
- Craftsmen engaged in mechanical installations (F43.2.2) should acquire skills for implementing measures to improve energy efficiency and integrate renewable energy sources into buildings, skills for integrating renewable energy sources and efficient heating and cooling technologies, including especially those required for heat pumps, skills for installers to provide heating and cooling upgrades in the context of renovation projects, as well as skills for upgrading the smart operation of buildings for greater energy efficiency (based on the smart readiness indicator), examining especially sensors, building controls, and building management systems.
- Craftsmen engaged in painting and glazing (F43.3.4) should acquire skills for implementing measures to improve energy efficiency, integrating renewable energy sources into buildings, and upgrading the energy efficiency of historic and listed buildings (cultural heritage).
- Craftsmen engaged in roof construction (F43.9.1) should acquire skills related to the carbon footprint over a material/system's lifecycle (through the assessment of the global warming potential), circular construction, and efficient resource use, as well as skills for the energy upgrade of historic and listed buildings (cultural heritage).
- Craftsmen engaged in carpentry (F43.3.2) should acquire skills for implementing deep renovations of buildings, including through modular and industrial solutions, and for upgrading the energy efficiency of historic and listed buildings (cultural heritage).
- Craftsmen engaged in the construction of metal doors and windows (C25.1.2) should acquire skills to implement measures to improve energy efficiency, integrate renewable energy sources into buildings, and upgrade historic and listed buildings (cultural heritage).

The wide dispersion of expertise among construction industry professionals and the heterogeneity of their skill levels pose a significant challenge for designing effective training programs. In any case, employee training should cater to the needs of both unskilled workers and the corresponding needs for upskilling experienced technicians in new specialized skills, as well as horizontal skills common to all specialties. Simultaneously, a range of incentives should be developed to accompany the acquisition of the necessary new skills with the creation of added value for the technician, thus generating interest in participating in educational programs.

A similar significant need for training exists for “white collar” workers, who should acquire essential knowledge in energy conservation and the utilization of renewable energy technologies in buildings. Besides the required new skills for designing more efficient energy saving interventions, engineers should also acquire skills related to the practical implementation of their proposals to guide technical staff in their proper execution.

The most important skills that the “white collar” workers in the building construction sector will need to acquire by 2030 are presented below:

- Civil Engineers, Cartographers, and Surveyors should acquire skills for implementing measures to improve energy efficiency and integrating RES systems to buildings, for carrying out deep renovation of buildings, including through modular and industrial solutions, as well as skills related to the carbon footprint over the lifecycle of a material/system (through the assessment of the global warming potential), circular construction, and efficient use of resources.
- Architects, Environmental Engineers, Urban Planners and Traffic Designers should acquire skills for implementing measures to improve energy efficiency and integrating renewable energy sources into buildings, skills for new and existing nearly zero-energy buildings (nZEBs), bridging the gap towards zero-emission buildings (ZEBs), as well as skills related to the carbon footprint over the lifecycle of a material/system (through the assessment of the global warming potential), circular construction, and efficient use of resources.
- Mechanical Engineers, Chemical Engineers, and Professional Engineers not classified elsewhere should acquire skills for implementing measures to improve energy efficiency and integrating renewable energy sources into buildings, integrating renewable energy sources and efficient heating and cooling technologies, including especially those required for heat pumps, skills for installers to provide heating and cooling upgrades in the context of renovation projects, as well as skills related to the carbon footprint over the lifecycle of a material/system (through the assessment of the global warming potential), circular construction, and efficient use of resources.
- Electrical engineers should acquire skills for implementing measures to improve energy efficiency and integrating renewable energy sources into buildings, integrating renewable energy sources and efficient heating and cooling technologies, including those required for heat pumps, and skills for installers to provide heating and cooling upgrades in the context of renovation projects, as well as skills for upgrading the smart operation of buildings for greater energy efficiency (based on the smart readiness indicator), examining especially sensors, building controls, and building management systems.
- Mining Engineers, Metallurgists and practitioners of related professions should acquire skills for implementing measures to improve energy efficiency and integrating renewable energy sources into buildings, skills for integrating RES systems and efficient heating and cooling technologies, including especially those required for heat pumps, skills for installers to provide heating and cooling upgrades in the context of renovation projects, as well as skills related to the carbon footprint over the lifecycle of a material/system (through the assessment of the global warming potential), circular construction, and efficient use of resources.

7.3.4 Needs for education/training centres and trainers

The existing **education and/or training centres** where basic and continuing training of professionals (IVET & CVET) of all disciplines takes place are very heterogeneous. Their network consists of specific vocational training courses and vocational training seminars. However, as already mentioned, in the vocational training on energy saving and utilization of RES systems, Greece has lagged far behind. The BUS-REGRoUP project and the synthesis of the National Roadmap represent a great opportunity for the country's maturation in these areas, with great benefits as already described.

The vocational training centres that will be established (or updated, if already existing) should provide both theoretical and practical training, be evenly distributed throughout Greece, in order to facilitate the workers participation and homogeneity. Also, particular importance should be given to maintaining their permanent and repetitive character at regular intervals (depending on the type of skill concerned).

There is currently no mechanism for evaluating and selecting the appropriate trainers for professional training programs on energy saving and installation of RES systems. Nevertheless, there is a belief from experts in the field that trainers should be people in the field, experts in the construction of sustainable buildings who will also have practical experience.

In line with other economic sectors in Greece and the creation of vocational training programs for employees, it is empirically estimated that for every 15 trainee professionals per year there is one trainer. Thus, taking into account the uniform training of construction workers in the remaining 7 years until 2030, approximately **1,300 trainers** will be required.

7.3.5 Certification of qualifications

As immerged from the consultation with the members of the National Qualifications Platform of the BUS-REGRoUP project, an important parameter for the participation of building construction professionals in training programs is the recognition of their “new” qualifications and the creation of added value in the market. At the same time, in the building construction sector, which has a high percentage of undeclared and unskilled work, there is a need of citizens for high quality services, which will ensure the final result of energy saving interventions and encourage investment in them. Both of these stakeholder needs can best be served through the certification of acquired qualifications.

More specifically:

- The certification and recognition of workers' qualifications, especially those resulting from non-formal or informal learning, in accordance with the European Qualifications Framework (EQF), can contribute to tackling unemployment and the (upward) professional mobility of workers in a way that improves workers' salaries and career development opportunities.
- The certification of qualifications should not be limited to an academic type of recognition, without the useful and practical value that this can give to the labour market. In other words, the utilitarian and pragmatic nature of national qualifications frameworks (initially) and then of a common European one must be highlighted, in order to effectively tackle the phenomenon of unemployment, poverty and the consequent social exclusion.

In this way, thousands of employees who, either through their work or through their experience, possess qualifications that they could not prove, are given the opportunity through national qualifications frameworks to certify them, classifying them in the national scale that each EU member state must create based on its own educational professional etc. standards.

7.3.6 Monitoring mechanisms

Although chapter 5.5 referred to certain mechanisms within state organizations and the social partners (GSEE, GESEVE, etc.), which monitor the evolution of workforce needs in various sectors of economic activity (including their training needs), it is estimated that a corresponding monitoring mechanism should be created exclusively for the building construction sector.

The main reason for the creation of the new monitoring mechanism is the specific needs of the building construction industry, combined with the increased energy saving needs in buildings until 2030. The specificities of the industry include the fragmentation of the expertise of the “blue” and “white collar” professionals employed, their different training needs and the many stages involved in completing an intervention (construction of products / systems, implementation study, implementation of intervention, supervision, etc.). At this point, the high percentage of unregistered and unskilled labour should be highlighted, as well as the constant emigration of skilled craftsmen and engineers to foreign countries due to better working conditions.

Something that this mechanism should have is the on-time assessment of the existing available workforce and its training needs compared to the rest of the existing mechanisms, given that possible long-term plans may result in the delay in the implementation of the energy saving interventions and the utilization of RES in buildings required to achieve the energy targets. The ongoing digitalisation of state functions could make a significant contribution to this.

At the same time, there should be an open channel of communication with the members of the National Qualifications Platform of the BUS-REGRoUP project. In this way, there can be early diagnosis of the human resources needs and training needs of both blue or white collar professional, early diagnosis of the barriers posed by the existing institutional framework and the continuous feedback of the mechanism with the results of the actions implemented. Obviously, the effectiveness of a mechanism, which will operate in the logic of PLAN – DO – CHECK – ACT must be supported by the state taking the necessary measures for the implementation of the proposals that have been designed (e.g., incentives for the training of professionals, development of the necessary training programs, etc.).

More specifically, the new monitoring mechanism should include 4 main pillars of several structural measures to ensure effective and timely assessment of workforce needs and skills development, as follows (see also Figure 7.10):

Figure 7.10: The 4 main pillars of the monitoring mechanisms

Pillar 1: Establishment of a Centralized Skills Monitoring Body:

- Establishment of a centralized skills monitoring body that will oversee all the monitoring processes and mechanisms.
- Adoption of the BUS-REGRoUP methodology by the monitoring body and the pertinent official bodies/ministries, to monitor workforce needs in the building construction sector. The upgrade of the methodology may be needed according to the future needs.
- Development of a digital online platform (Early-Warning Systems) that tracks the skills and qualifications of the workforce. The platform should allow for continuous monitoring, reporting, and updating of skills data. This can help identify skill mismatches and gaps early on.
- Creation of an interactive online tool where workers can assess their skills, identify gaps, and find relevant training programs
- Adopt a PLAN-DO-CHECK-ACT (PDCA) cycle to continuously monitor and improve the effectiveness of the skills monitoring mechanism.

Pillar 2: Data Collection and Analysis

- Regularly update the system with real-time data from industry stakeholders, educational institutions, and labour market analyses. These data may refer to workforce demographics, employment rates, skill levels, and industry demands. Analytics services will be useful to identify trends and predict future skill needs.

- Regular surveys and assessments to gather data on the skill levels, qualifications, and training needs of both blue and white-collar professionals.
- Regular updates on workforce needs analysis using the BUS-REGRoUP methodology and the new up-to-date data.
- Publishing of periodic reports that analyse the collected data and provide actionable insights for policymakers, educators, and industry stakeholders.
- Regularly evaluation of the outcomes of the training programs and interventions, using performance metrics and feedback from industry stakeholders to refine and enhance the monitoring process.

Pillar 3: Collaboration and feedback

- Establishment of partnerships with educational institutions and training providers (vocational schools, universities, and training providers) to ensure that curricula are aligned with industry needs.
- Creation of a feedback loop where the monitoring mechanism can inform educational institutions of emerging skill requirements, enabling them to adapt their programs accordingly.
- Continuation of the open channel of communication with members of the National Qualifications Platform of the BUS-REGRoUP project.
- Engagement of the industry stakeholders, employers, professional unions and associations in regular discussions and workshops to identify skills gaps and training needs.

Pillar 4: Government Support and Policy :

- Official provision of governmental support for the monitoring mechanism, including funding, regulatory support, and policy development
- Facilitation of the state support for the implementation of the monitoring mechanism through necessary measures, such as collaboration in databases exchange for skills and workforce status and potential needs, incentives to bodies engaged in the monitoring process etc .
- Introduction of state policies that encourage continuous professional development and upskilling, such as tax breaks, subsidies, or grants for training initiatives.

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8. Barriers

8.1 Barriers to access to training for “blue collar” workers

In order to determine the barriers related to the education of technicians employed in the building construction sector in new necessary skills for achieving the energy and climate objectives of 2030, questionnaires were developed and sent for completion to the members of the National Qualifications Platform of the BUS-REGRoUP project. After consultation, the following barriers were included in the questionnaires, while there was the possibility to list any other additional barrier each interested party considered significant.

The barriers contained in the questionnaire are as follows:

B.1. Language issues for immigrant workers in construction, hindering their participation in education.
B.2. Cost of training.
B.3. The existence of many individual and very small businesses in the construction sector that have difficulty accessing training programs.
B.4. Lack of time to participate in education programs.
B.5. Insufficient institutional framework.
B.6. Lack of suitable educational programs.
B.7. Lack of interest on the part of construction sector professionals
B.8. Lack of certification schemes
B.9. Ignorance of the end-users regarding the certification of qualifications, resulting in no added value being attributed to them
B.10. Informal (unreported) labour in the construction sector

Interested parties were asked to specify which of the above barriers they believe are most relevant to the sector they represent, as well as to rate their significance on a scale from 1 (not at all important) to 5 (very important). The results of the processing of the provided answers are presented in the following Figure 8.1.

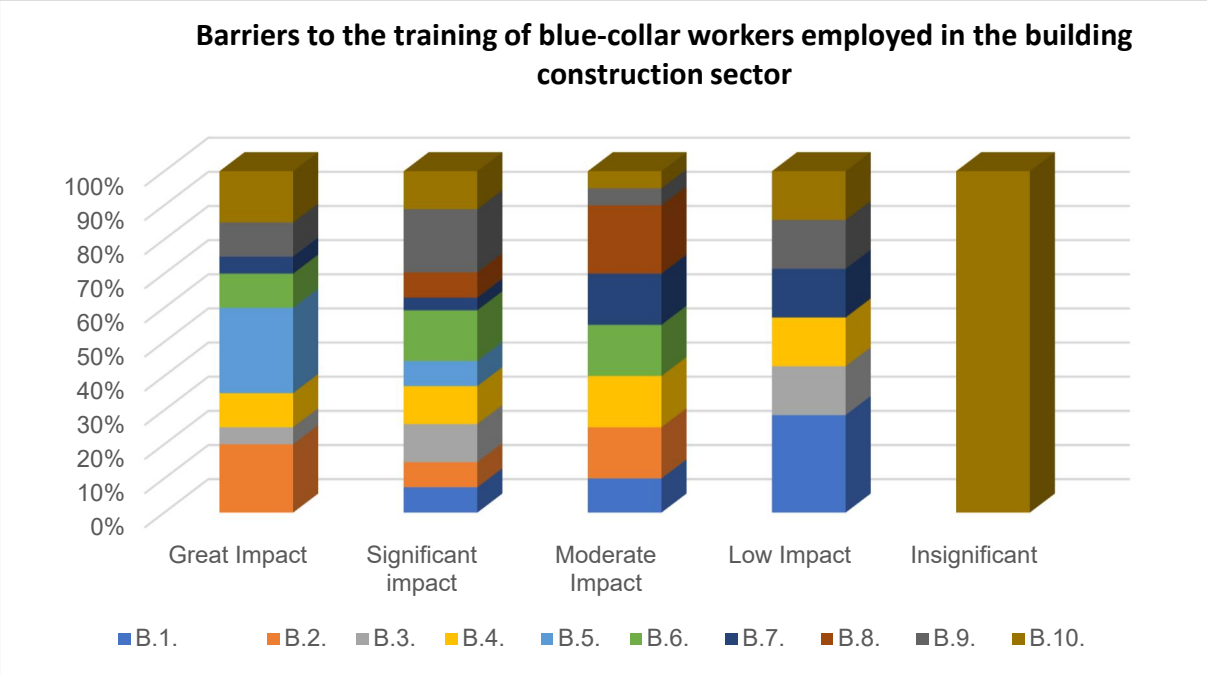

Figure 8.1: Barriers to the training of “blue collar” workers employed in the building construction sector

In order to have a comprehensive assessment of the barriers and their significance, the answers provided by the members of the National Qualifications Platform were weighted based on the respective rating of the significance of each barrier. In this way, the evaluation that is presented in the following graph (Figure 8.2) emerged and pertains to the significance of each barrier for the entirety of the different specializations in the building construction sector.

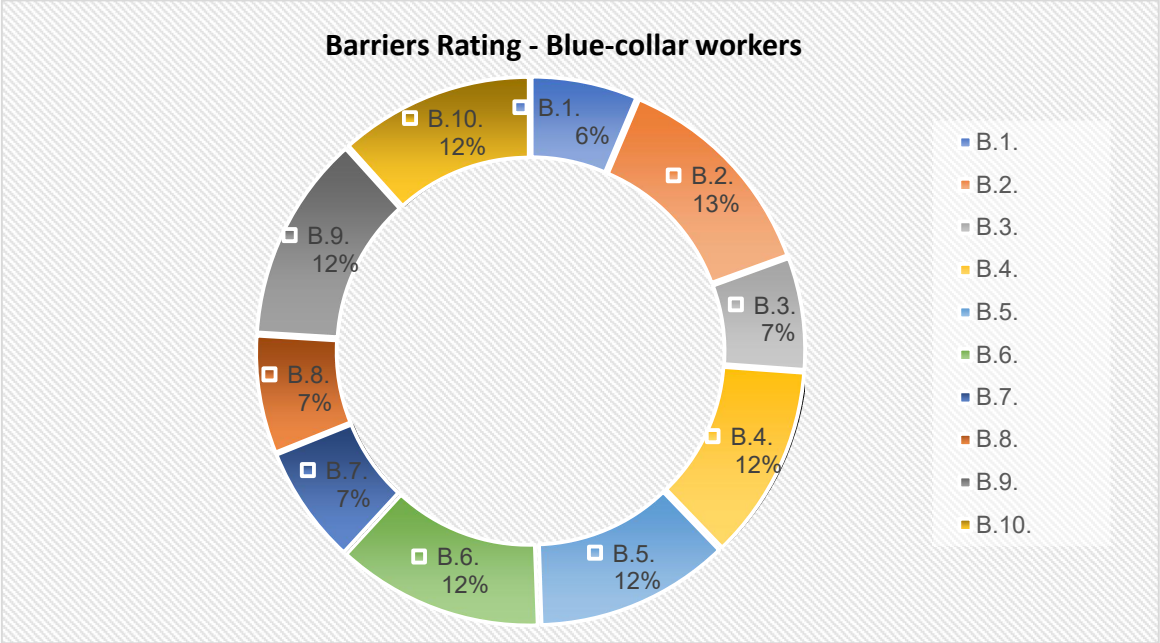

Figure 8.2: Barriers significance rating in the training of "blue collar" workers employed in the building construction sector

From the above analysis, it emerged that the "blue collar" workers who are employed in the building construction sector identified 6 main barriers that equally limit their access to educational programs through which they would have the opportunity to acquire the new skills required to achieve the energy goals by 2030. These barriers concern the cost of training, the lack of time on the technicians' part to participate in training programs, the inadequate institutional framework, the absence of suitable training programs, the ignorance of end-users regarding the certification of qualifications, as a result of which no added value is attributed to them, and, finally, the undeclared work in the construction sector. Rating the aforementioned six barriers as equally significant for "blue collar" professionals cannot be considered random, given that they are interdependent and function complementary to each other.

The prolonged economic crisis that the country experienced a few years ago led to a stagnation of construction activity and, consequently, to the finances of professionals in the building construction sector, who, in their overwhelming majority, operate as self-employed or work in very small businesses with few people. The economic inability of "blue collar" workers, combined with the lack of suitable support programs from the state, does not allow them to cope with the high cost of participating in a high-level educational program. Also, the financial difficulties experienced by "blue collar" professionals limit the available time for participation in educational programs, which require significant monitoring time to provide participants with the appropriate tools for the development of new skills.

This situation is further exacerbated by the high rate of undeclared work in the construction industry. Blue-collar professionals face unfair competition from workers who often don't even have the required licenses to perform the tasks they undertake. Citizens, most of the time, choose a craftsman based on the lowest bid price without having the ability to evaluate beforehand, or even afterward, the quality of the services provided. This very ignorance of end-users about the importance of the certification of a craftsman in the final result of construction work results in the undervaluation of these certifications, given that they do not offer any added value to professionals.

The formation of this situation is significantly influenced by the inadequate implementation or/or the absence of the existing legal framework. Insufficient checks on the professional competence of craftsmen employed in the construction industry and the non-compliance (or late compliance) of the state with the current European Directives (e.g., Article 14 of Directive 2009/28/EC, according to which member states were obligated to be prepared by the end of 2012 for the training and certification of small-scale RES system installers) promote the employment of inadequately trained and unlicensed craftsmen in construction activities, to the detriment of craftsmen who have the licenses prescribed by law to practice the profession.

Furthermore, even in state-subsidized programs for energy upgrading of buildings, there is no requirement for the craftsmen who will undertake the implementation of the interventions to have relevant licensing, let alone proper qualification certification. Possibly, a provision for the operation of craftsmen who have qualification certifications could initially cause delays in the implementation of subsidized programs. However, it would provide ample incentive for the development of relevant certification schemes and, ultimately, the training and certification of craftsmen in the construction industry.

From what has been mentioned earlier, it is obvious that the creation of an educational program for acquiring new skills in the construction sector involves a significant sustainability risk for most educational institutions. It should be clarified that technical training requires not only theory but also appropriate practical exercise, which in turn requires suitable infrastructure, consumable materials, equipment, etc., significantly increasing the cost of training. A cost that blue-collar professionals cannot fully bear and, unless there are changes in the institutional framework and, consequently, in the market, it will have no added value for them.

8.2 Barriers to access to training for “white collar” workers

Similarly to the methodology developed for the “blue collar” workers, to identify barriers concerning the training of Engineers (i.e. part of “white collar” workers of the sector) working in the building construction sector, and for the new essential skills required to achieve the energy goals of 2030, questionnaires were developed and sent out for completion to the members of the NQP. From the consultation that took place, the following ‘main’ barriers were identified and included in the questionnaire, while there was the opportunity for any interested party to list any other additional barrier they deemed significant.

The barriers contained in the questionnaire are as follows:

B.1. Cost of training
B.2. Lack of incentives / Difficulty of small businesses accessing training programs
B.3. Lack of time to participate in training programs
B.4. Inadequate institutional framework
B.5. Lack of appropriate training programs
B.6. Lack of interest from professionals in the construction sector
B.7. Lack of certification schemes
B.8. Ignorance of the end-users regarding the certification of qualifications, resulting in no added value being attributed to them
B.9. Informal (unreported) labour in the construction sector
B.10. Lack of relevant information
B.11. Broader sense of devaluation of the engineering profession

Then, the relevant stakeholders were asked to specify which barriers they believe pertain to the sector they represent, as well as to rate their significance on a scale from 1 (not at all significant) to 5 (very significant). The following graph (shown in Figure 8.3) presents the results of processing the answers provided.

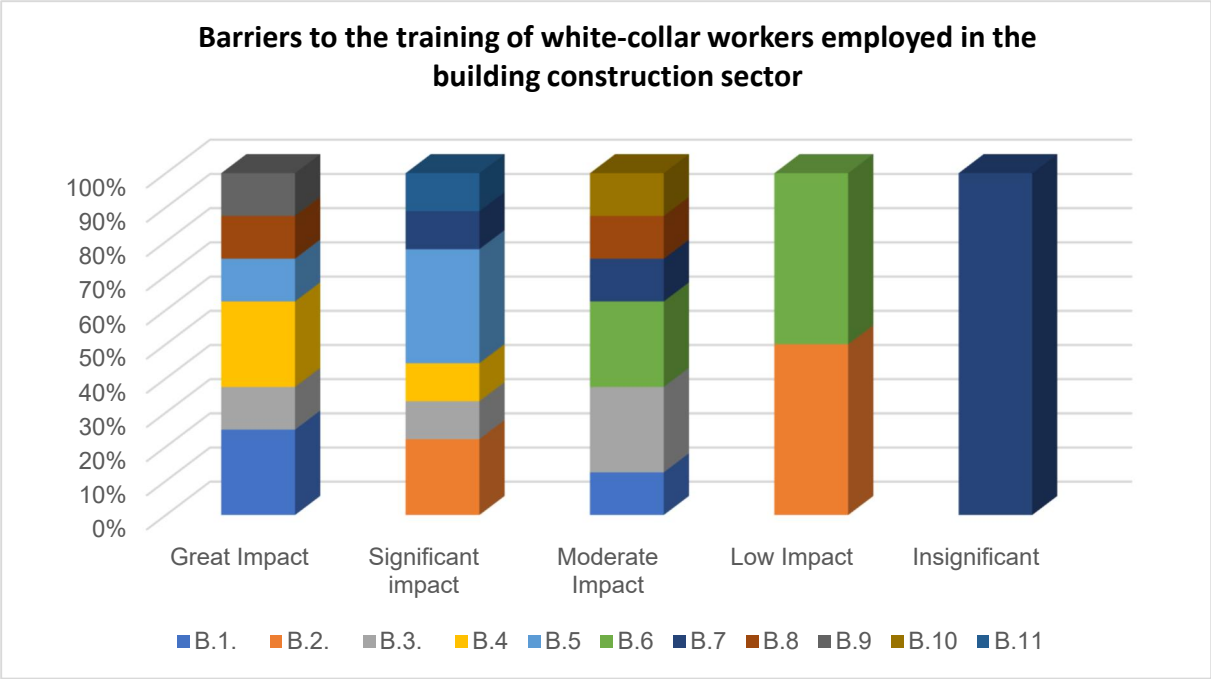

Figure 8.3: Barriers to the training of "white collar" workers employed in the building construction sector

In order to have a comprehensive evaluation of the barriers and their significance, the answers provided by the members of the National Qualifications Platform were weighted based on the respective rating of the significance of each barrier. In this way, the evaluation that is presented in the following graph emerged concerning the significance of each barrier for the entirety of the different specialties in the building construction sector.

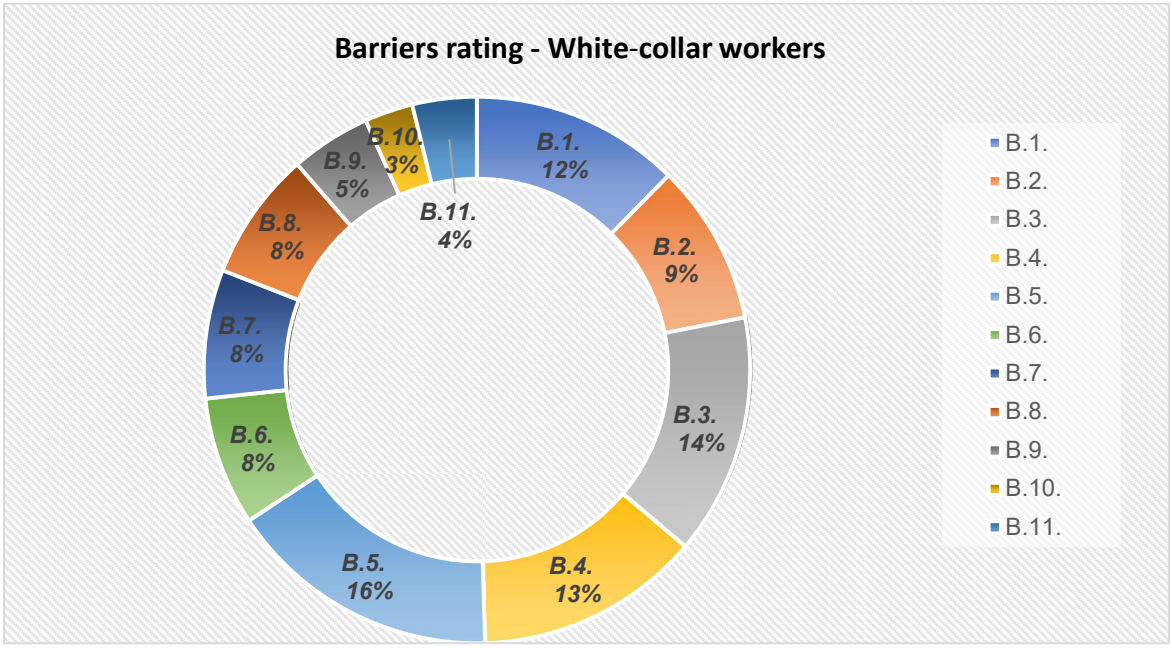

Figure 8.4: Evaluation of the significance of barriers in the training of "white collar" workers employed in the building construction sector

From the above analysis, it emerged that "white collar" professionals who are employed in the building construction sector identified four primary barriers that almost equally limit their access to educational programs through which they would have the opportunity to acquire the new skills required to achieve the energy goals by 2030. These barriers relate to the lack of appropriate training programs, the lack of

time for the Engineers to participate in training programs, the inadequate institutional framework, and the cost of training.

As deduced from the analysis conducted in Chapter 7.3, “white collar” professionals recognized the most significant skills they need to acquire as those related to the implementation of energy efficiency improvement measures and the integration of renewable energy sources in buildings, as well as the skills related to the carbon footprint over the lifespan of a material/system, circular construction, and efficient resource use. Although there are available educational programs for the first category of skills, they are believed to focus more on the activity of the energy auditor and do not provide participants with the specialized knowledge they would desire in order to acquire the necessary skills to achieve the goals set for the building sector by 2030. In contrast, there are no available training programmes for acquiring skills related to the carbon footprint in the life cycle of a material/system.

At the same time, the reduced activity in the building construction sector, as a result of the prolonged economic crisis that the country experienced during the previous period, significantly squeezed the earnings of engineers, the vast majority of whom operate as self-employed or as employees in very small businesses with very few staff members. This situation pushed many engineers towards more bureaucratic tasks (e.g., regularization of illegal constructions, certifications, electronic property identity, issuance of Energy Performance Certificates, etc.), with the result being that they neither have the required time to participate in a specialized training program, nor the ability to self-fund it.

Additionally to the barriers mentioned above, there is also the inadequate institutional framework that allows all engineers, without exception (e.g. with regard to their specialization), to perform the activities of an energy auditor and, by extension, essentially that of an energy consultant, without truly assessing their qualifications in shaping and dimensioning energy saving proposals and the exploitation of RES in the building sector. This often results in the selection and dimensioning of these proposals being made by the consumer and the technician who will implement them, with the engineer formally validating them within the context of a subsidized program.

9. Conclusions

The building sector significantly contributes to the energy consumption in both the European Union and, particularly, in Greece, representing 40% and 43% of the total consumption, respectively. One of the main reasons that explains why Greek buildings consume so much energy (considering the country's climatic conditions, Greek buildings are – possibly – the most energy-intensive in Europe) is the age of the buildings and the lack of modern embedded technologies, due to the absence of relevant legislation over the last 30 years.

To achieve the goals of energy efficiency and reduction of greenhouse gas emissions, improving the energy efficiency of buildings is of vital importance. Specific actions are promoted on national and/or local level to exploit the significant potential for energy savings in buildings, while the use of renewable energy sources contributes to enhancing energy supply security and technological development. Moreover, reducing energy consumption in buildings will bring additional long-term benefits for the environment, the economy, and society.

Thus, improving the energy efficiency of the country's building stock is a key priority of the National Energy and Climate Plan (NECP). The national energy strategic objectives for 2030 regarding the country's building stock include the improvement of the energy efficiency of building infrastructure, the penetration of RES and new energy-saving technologies, as well as the reduction of GHG emissions in the building sector. To promote energy efficiency, national plans are drawn up for the construction of nearly zero-energy buildings (nZEB). These efforts are vital for enhancing the sustainability of the building sector and achieving the climate goals set.

According to the aforementioned plan, the 12-15% of buildings and/or building units are projected to undergo energy upgrading during the decade 2021-2030. Through targeted incentives and policy measures, the aim is to promote the renovation of the private building stock. Overall, it is expected that improving the energy efficiency of the building stock will lead to an increase in domestic added value and the creation and maintenance of many new jobs. Lastly, there is a long-term goal for further reducing energy consumption in buildings by 2050, which concerns both the residential stock and service buildings, to contribute to achieving a more sustainable and responsible energy consumption in the country.

On the other hand, one of the main pillars of the Greek economy, the construction sector, suffered in the past decade due to the economic recession, while in recent years it shows significant signs of recovery. The construction industry has been on an upward trajectory in recent years, from the beginning of the pandemic period, and is one of the most dynamic sectors due to various factors such as short-term leasing, demand for modern homes and buildings, stabilization of the Greek economy, decrease in the percentage of homeownership, etc. The Greek market has a housing shortage, especially in the city of Athens, a factor that has contributed to the increase in rental and purchase prices in most areas. The energy renovation of the significant available building stock and the new Nearly Zero Energy Buildings (nZEBs) prospects seem to be the "solution" to this huge problem.

In this framework, existing strategic planning documents and action plans were reviewed, the objectives and corresponding legislative provisions adopted by the State were presented, and an analysis of data and information concerning the building stock, energy, human resources, and the vocational education and training system was conducted. The skill needs related to a specialized blue and white-collar workforce (craftsmen, technicians, installers, engineers) of the building sector were also identified, as well as the gaps and barriers to achieving the national goals for 2030. All of the above are presented in detail (and in accordance with the provided guidelines) in the preceding chapters of the report.

Although the activity of the construction sector has not yet reached the levels before the Greek economic recession, the sector is on the rise and remains, and should continue to be, a significant sector in terms of employment, as a notable number of employees are employed in it. More specifically, a large number

of workers from the EU or third countries are employed in this sector, especially those involved in technical work. As a severe and direct consequence of the previous prolonged recession in the construction sector, there has been a significant lack of workforce in recent years.

Some of the key factors expected to influence the construction sector in the coming years are the development of both the Greek and global economies, borrowing costs and the ability of banks to ensure financing for investors/private individuals, external demand, energy costs, material costs, the preparation of an incentive program for development, the rationalization of taxation, the simplification of urban planning and building permit issuance processes, as well as land costs in Greece..

What is most anticipated in light of market trends is a shift towards higher quality in the design and construction of buildings, as well as the selection of areas for construction that will present comparative advantages. Additionally, even more of the existing buildings are expected to be renovated and energy upgraded since, as previously mentioned, a notably large percentage of the building stock was constructed before 1970. On the other hand, although national targets are set by the enhanced goals of the EU, according to the “European Green Deal for 2030”, and are binding in their implementation, there is uncertainty in achieving them due to the repercussions of the unstable international economic environment after the pandemic period and the Russian invasion in Ukraine.

The flexibility and adaptability of the Vocational Education and Training System are critical to identify the challenges that may arise. Currently, there is a significant lack of appropriate training courses on RES (Renewable Energy Sources) and EE (Energy Efficiency) regarding the building sector. The limited number of employment profiles related to EE and RES in the construction sector or/and outdated or missing information about the area of "green skills" currently represents a disadvantage concerning the development of specialized labour in the construction sector. New skills are required, including those related to new technologies/equipment and updated qualification frameworks.

The vast dispersion of blue-collar workers in the construction industry across various specialties and the heterogeneity of their skill levels present a significant challenge for designing their effective training. In any case, worker training should address the needs of both the unskilled and the respective retraining needs of experienced craftsmen in new skills of every specialty, as well as horizontal skills common to all specialties. Moreover, white-collar professionals, apart from the required new skills for designing more efficient energy-saving interventions, should also acquire skills related to the practical application of their proposals in order to be able to guide technical staff in their proper implementation.

Thus, the continuous review and upgrade of existing programs, or even the addition of new ones, in line with currently emerging technologies, and most importantly, training the trainers so that they can enrich their existing knowledge, skills and competences, combined with creating incentives for young people to pursue technical professions, is of critical importance. The overall employment needs in Greece, related to the technical professions associated with the BUS-REGRoUP project, are expected to significantly increase during the coming years up to 2030. Additionally, analysing the current situation contributed to identifying significant skills needs associated with the most critical technologies for their achievement by 2030.

Training of professionals in the building construction sector (both “blue” and “white collar”) requires the establishment of “specialized” training centres. These centres should provide both theoretical and practical education and be evenly distributed throughout the Greek territory to facilitate workers with transportation and maintain their homogeneity. Additionally, particular emphasis should be placed on ensuring their ongoing and repetitive nature at regular intervals (depending on the type of skill involved) and to be staffed with the appropriate trainers, the number of which is close to 1,300. Concurrently, the training of professionals should be combined with the certification of their qualifications and with the creation of suitable mechanisms to monitor the evolving needs of the building construction sector (both in terms of workforce needs and education/training needs).

For the effective implementation of education, barriers such as participation costs, lack of time, absence of suitable educational programs, insufficient institutional framework, inadequate market oversight, and the creation of added value should be addressed first, as they hinder the access of professionals in the building construction sector. The state should develop suitable educational programs combined with financial support programs for training so that every professional can access them. At the same time, a series of incentives should be developed to acquire the necessary new skills by creating added value for both blue and white-collar professionals, ensuring their interest in participating in the educational programs.

It should be noted that to achieve the national goals, the needs of businesses in the construction sector must be continuously monitored, and in any case, the necessary measures should be taken to satisfy these needs. Ultimately, the groundwork is laid for the next phase of the project, which is the preparation of a “National Roadmap” with a completion horizon set for 2030. The National Roadmap is expected to include the fundamental policies and actions required for determining and establishing the successful vocational education and training framework for the construction sector and other related sectors. This is so that a specialized workforce can be ensured concerning Energy Efficiency and Renewable Energy Sources for the active contribution to the achievement of the national goals for 2030.

10. Authors/contributors

The following list of people (groups of partners from the consortium of BUS-REGRoUP project partners) worked on the completion of this report:

Dr Charalampos Malamatenios, Ms. Georgia Veziryianni, from CRES Training Department / Division for Energy Policy and Planning (coordination and writing of Chapters 0, 1, 2, 3, 4, 6 and 9) and lead partner of WP3, in elaborating the report.

Prof. Ioannis Psarras, Dr Ioanna Makarouni, Georgios Konstantopoulos, Nikolaos Vourgidis, Christos Konstas, from the Decision Systems and Management Laboratory, School of Electrical and Computer Engineering, National Technical University of Athens (coordination and writing of Chapters 5, 7 and 8).

Also, special mention should be made to the valuable contribution of Mr. Iakovos Karatrasoglou (INE GSEE) and Ms. Georgia Michalopoulou (IME GSEVEE), by providing valuable data and views/opinions in various parts of the report.

11. References

- ✓ “National Plan to increase the number of buildings with almost zero energy consumption (Article 9 of Directive 2010/31/EU on the Energy Performance of Buildings)”, available at: http://www.opengov.gr/minenv/wp-content/uploads/2018/09/ethniko_sxedio_KSMKE.pdf
- ✓ “Long-term Building Renovation Strategy until 2050”, available at: https://energy.ec.europa.eu/document/download/10946cc8-3dd9-4204-a92e-04f60b4ea1dd_en?filename=cy_2020_ltrs.pdf
- ✓ “Report on the annual distribution of energy consumption of households in end uses for submission to EUROSTAT for the year 2020”, CRES [Deliverable D2.6 of the NSRF project with MIS Code: 5021536]
- ✓ https://ec.europa.eu/commission/presscorner/detail/el/qanda_21_6686
- ✓ http://iobe.gr/research_dtl.asp?RID=233
- ✓ http://iobe.gr/research_dtl.asp?RID=270
- ✓ http://iobe.gr/research_dtl.asp?RID=264
- ✓ https://news.b2green.gr/27425/%CE%B5%CE%BB%CF%83%CF%84%CE%B1%CF%84-%CE%B5%CF%84%CE%AE%CF%83%CE%B9%CE%B1-%CE%B1%CF%8D%CE%BE%CE%B7%CF%83%CE%B7-207-%CF%83%CE%B7%CE%BC%CE%B5%CE%AF%CF%89%CF%83%CE%B5-%CE%B7-%CF%80%CE%B1%CF%81%CE%B1
- ✓ https://www.ot.gr/2023/04/27/oikonomia/akinita/elstat-anodos-212-stis-oikodomikes-adeies-ton-ianouario/
- ✓ http://iobe.gr/docs/research/RES_05_F_21072021_REP_GR.pdf
- ✓ https://www.newmoney.gr/roh/palmos-oikonomias/ellada/psachnoun-alla-den-vriskoun-lipoun-280-000-ergazomeni-apo-tis-ikodomes-pics/
- ✓ https://www.oryktosploutos.net/2023/03/%CE%B3%CE%B5%CF%89%CE%B8%CE%B5%CF%81%CE%BC%CE%AF%CE%B1-%CF%83%CF%84%CE%B7%CE%BD-%CE%B5%CE%BB%CE%BB%CE%AC%CE%B4%CE%B1-country-profile-2022/

12. Glossary

Adult Training Centres	KEE
Association of Greek Contracting Companies	SATE
Centre for Renewable Energy Sources and Saving	CRES
Centre of Distance Lifelong Education	KEDVMAP
Continuing Vocational Education & Training	CVET
Continuous Vocational Training	CVT
Energy Efficiency	EE
Energy Performance of Buildings Directive	EPBD
Energy Performance of Buildings Regulation	KENAK
European Qualifications Framework	EQF
Energy Services Directive	ESD
General Secretariat for Adult Education	GSAE
General Secretariat of Lifelong Learning	GSLLL
Greek General Confederation of Labour	GSEE
Greek Manpower Employment Organisation	OAED
Hellenic Accreditation System	ESYD
Hellenic Confederation of Professionals, Craftsmen and Merchants	GSEVEE
Hellenic Qualifications Framework	HQF
Hellenic Statistical Authority	ELSTAT
Initial Vocational Education & Training	IVET
Institute of Adult Lifelong Education	IDEKE
International Standard Classification of Education	ISCED
International Standard Classification of Occupations	ISCO
Lifelong Learning	LLL
Lifelong Learning Centre	KDVM
Ministry of Education and Religious Affairs, Culture and Sports (formerly the Ministry for Education, Lifelong Learning and Religious)	MERACS (former MELLR)
Ministry of Environment and Energy	MEEN (former YPEKA)
Ministry of Labour, Social Security and Welfare	MLSSW
National Organisation for the Certification of Qualifications and Vocational Guidance	EOPPEP
National Energy Efficiency Action Plan	NEEAP
National Institute of Labour and Human Resources	EIEAD
National Qualifications Framework	NQF
National Reform Programme	NRP

National Renewable Energy Action Plan	NREAP
National Strategic Reference Framework	NSRF
National System for linking Vocational Education and Training to Employment	ESSEEKA
Organization for Vocational Education and Training	OEEK
Renewable Energy Sources	RES
Second Chance Schools	SDE
Second Level Vocational High School	EPAL
Vocational Education Training School	EPAS
Vocational Training Institute	IEK
Vocational Training Centre	KEK
Youth and Lifelong Learning Foundation	INEDIVIM

ANNEXES

Annex I. Indicative list of courses, informative webinars and non-formal training programs

Table A1: List of indicative informal courses on the EE and renewable technologies

Training Provider	*Title*	*Date conduct*	*Duration (Hours)*	*Objective / Key Modules*	*Target group*
KNAUF	*WEBINAR ROOF INSULATION TECHNIQUES*	*2021 2022*	*1,5*	*The roof as a key structural element of the building Regulatory requirements and new SAVE Directly on the floor of unused roof/attic Inaccessible lofts and attics At the level of beams - complete solutions for thermal insulation, waterproofing and water vapor management. Exchange of views / discussion*	*Thermal insulation installers Architects Engineers and designers Energy auditors Homeowners*
KNAUF	*WEBINAR SUSTAINABILITY IN BUILDING DESIGN - INTERNATIONAL SUSTAINABLE BUILDING SYSTEMS & THERMAL INSULATION*	*2021 2022*	*1,5*	*The need for sustainability in buildings The value that sustainable design brings to the building - Voluntary Environmental Assessment and Certification Schemes, LEED, BREEAM, DGNB, WELL Sustainability tools and Knauf Insulation credentials Working case for product specification suitable for LEED v4.1 project Leading the way in sustainability with ECOSE Technology Exchange of views / discussion*	*Architects Scholars Sustainable construction consultants Manufacturers Executives in the field of real estate development and management*
KNAUF	*WEBINAR DESIGNING FLEXIBLE AND SUSTAINABLE URBANSCAPE GREEN ROOF SYSTEMS BY KNAUF INSULATION*	*2021 2022*	*1,5*	*The challenges of urbanisation and sustainable design Urbanscape Green Solutions Green roof systems – the Urbanscape approach Comparative advantages - disadvantages Urbanscape and LEED, BREEAM, DGNB certifications Reference works Exchange of views / discussion*	*Landscape architects Sustainable construction consultants Agronomists Rooftop / horizontal roof construction professionals Executives in the field of real estate development and management*
VITEX E-ACADEMY	*WEBINAR- COLOR COMBINATIONS IN ARCHITECTURE*	*2022*	*1*	*Color combinations in architecture*	*Building professionals*

VITEX E-ACADEMY	*WEBINAR- THERMAL INSULATION*	*2022*	*1*	*Advice, solutions and practices for installing a thermal insulation system*	*Insulation professionals*
FIBRAN	*INNOVATIVE EXTERNAL THERMAL INSULATION SYSTEM FOR THE ENERGY AND SEISMIC UPGRADE AND PROTECTION OF THE BUILDING ENVELOPE (ON-SITE TRAINING IN VARIOUS CITIES OF GREECE)*	*2021* *2022* *2023*	*2*	*External thermal façade and "Saving – Autonomy" tips, solutions and practices for installing a thermal insulation system*	*Thermal insulation installers* *Architects* *Engineers and designers* *Energy auditors* *Homeowners*
FIBRAN	*WEBINAR: OPTIMAL CHOICES OF THERMAL INSULATION MATERIALS IN THE ENERGY UPGRADE OF BUILDINGS*	*2020*	*2*	*Optimal choices of thermal insulation materials in the energy upgrade of buildings: The FIBRAN toolbox* *Fibrous thermal insulation materials, their categories and differences* *FIBRANskin membrane moisture management systems* *Dry building systems: Thermal insulation – Sound insulation – Fire protection of installations* *Facade decoration systems VISAGE-CERESIT*	*Thermal insulation installers* *Architects* *Engineers and designers* *Energy inspectors* *Homeowners*
SaintGobain	*EDUCATIONAL PROGRAM CRAFTSMEN CERTIFICATION EXTERNAL THERMAL INSULATION SYSTEMS (S.E.T.)*	*2020* *2021* *2022*	*9*	*General principles of thermal insulation of buildings* *Steps for proper implementation of ICS* *PROPER APPLICATION OF SETH practices*	*Energy auditors* *Architects Graduates of Higher Schools* *Civil Engineers* *Mechanical Engineers •* *Electricians* *Chemical Engineers* *Environmental Engineers* *Technological Education Engineers* *Design and technical offices of building projects* *Professional fitters and insulation companies*

KTIRIO PUBLICATIONS	*MODERN SOLUTIONS & NEW MATERIALS*	*2021*	*1*	*The invisible air conditioning system, Optimal solutions for roof thermal insulation, Paints with appropriate technology for "green buildings", Innovative system for masonry cladding with aluminum, Single coverage system for heating - air conditioning needs - Z.N.X.*	*Architects Designers - Engineers Energy auditors Manufacturers Executives in the field of real estate development and management*
PEEGEP	*INTRODUCTION TO PLANTED ROOFS, CONSTRUCTION AND BENEFITS*	*2021*	*1*	*Introduction to Green Roofs, Construction and Benefits*	*Architects Designers - Engineers Energy auditors Manufacturers Executives in the field of real estate development and management*
Kafkas Institute	*INTRODUCTION TO KNX AND PROGRAMMING WITH ETS6*	*2020- today*	*6*	*KNX system, basic principles, operating logic, advantages and points of differentiation compared to other building automation systems (smart home), as well as get acquainted with the ETS6 project through practical examples.*	*Electrical engineers, Designers, Supervisors dealing with building installations, Electrical installers, Technical education teachers and Automation engineers.*
TUV AUSTRIA	*THERMAL INSULATION OF ROOFS & ROOFS ACCORDING TO NATIONAL TECHNICAL SPECIFICATIONS ELOT IT & DIN 4108*	*2022*	*8*	*Conventional methodologies for thermal insulation of roofs and roofs in new and existing buildings, construction practices to avoid or solve problems of building pathology that include a number of technical details and special requirements*	*Civil Engineers Mechanical Engineers Electricians Chemical Engineers Environmental Engineers Technological Education Engineers Professional fitters and insulation companies*

ALUMIL	*INSTALLATION OF WEBINAR FRAMES*	*2021*	*1*	*Through practical methods, participants will be informed about ways of proper construction, the use of appropriate waterproofing, insulation or support materials, as well as the pitfalls they must avoid in each new project they undertake. Condensed all the key points of the profession for a better result that will satisfy every future customer of a frame manufacturer.*	*Manufacturers – Installers of aluminum frames.*
ALUMIL	*INSTALLATION OF FRAMES FOR RENOVATIONS AND NEARLY ZERO CONSUMPTION BUILDINGS | WEBINAR*	*2021*	*2*	*It focuses on all steps during the design and construction of the building envelope based on its high thermal insulation performance. Participants will be able to evolve their way of working in the architectural study and the construction site, utilize new waterproofing / insulation materials and finally proceed to the right selection of frames for the building, in order for their projects to have a thermal performance certificate type B+.*	*Engineers and Architects*
ALUMIL	*INSTALLATION OF FRAMES - LEGISLATIVE CHANGES, CONSEQUENCES ON CONSTRUCTION AND INSTALLATION OF ALUMINUM CONSTRUCTION | WEBINAR*	*2021*	*2*	*It focuses on all steps during the design and construction of the building envelope based on its high thermal insulation performance. Participants will be able to evolve their way of working in the architectural study and the construction site, utilize new waterproofing / insulation materials and finally proceed to the right selection of frames for the building, in order for their projects to have a thermal performance certificate type B+.*	*Engineers and Architects*

Table A2: List of indicative informal training programmes on the EE and RES technologies

Training Provider	*Title*	*Date conduct*	*Duration (Hours)*	*Objective / Key Modules*	*Target group*
IME GSEVEE	*GEOTHERMAL ENERGY – HELIOTHERMIA - ENERGY SAVING TECHNIQUES*	*2015*	*50*	*The main purpose of the program is to provide participants with an understanding of the technical principles, design and installation of geothermal heat pumps (GHPs) and solar thermal systems (STSs). It also provides the required knowledge and information to assist the plumber in the selection and use of energy and water saving techniques and technologies.* *SEMINAR CONTENTS* *¬ Geothermal – Geothermal Heat Pumps (GHP)* *¬ Solar heat – Thermal Solar Systems (STS)* *¬ Energy saving techniques*	*PLUMBING TECHNICIANS*
SaintGobain	*EDUCATIONAL PROGRAM CRAFTSMEN CERTIFICATION EXTERNAL THERMAL INSULATION SYSTEMS (S.E.T.)*	*2020* *2021* *2022*	*9*	*General principles of thermal insulation of buildings* *Steps for proper implementation of ICS* *GOOD APPLICATION OF SETH practices*	*Energy auditors* *Architects Graduates of Higher Schools* *Civil Engineers* *Mechanical Engineers* *Electricians* *Chemical Engineers* *Environmental Engineers* *Technological Education Engineers* *Design and technical offices of building projects* *Professional fitters and insulation companies*

Kafkas Institute	*INTRODUCTION TO KNX AND PROGRAMMING WITH ETS6*	*2020- today*	*6*	*KNX system, basic principles, operating logic, advantages and points of differentiation compared to other building automation systems (smart home), as well as get acquainted with the ETS6 project through practical examples.*	*Electrical engineers, Designers, Supervisors dealing with building installations, Electrical installers, Technical education teachers and Automation engineers.*
TUV AUSTRIA	*INSULATION WORKSHOP SUPERVISOR ACCORDING TO GREEK TECHNICAL SPECIFICATIONS ELOT IT & KENAK ACCORDING TO EN ISO 17024*	*2022- today*	*16*	*Conventional insulation, waterproofing & dry building methodologies, to achieve rational energy behaviour, in new and existing buildings in accordance with Greek Technical Standards and regulations, construction practices to avoid or solve building pathology problems involving a multitude of technical details and special requirements, unknown to the majority of the technical world, but critical for success, the functionality and safety of the structure;*	*Energy auditors* *Architects Graduates of Higher Schools* *Civil Engineers* *Mechanical Engineers* *Electricians* *Chemical Engineers* *Environmental Engineers* *Technological Education Engineers* *Design and technical offices of building projects* *Professional fitters and insulation companies*
TUV AUSTRIA	*THERMAL INSULATION OF EXTERNAL WALLS & THERMAL FAÇADE ACCORDING TO NATIONAL TECHNICAL SPECIFICATIONS ELOT IT & ETAG 004*	*2022*	*8*	*Conventional methodologies for thermal insulation of external walls, as well as the application of Complex External Thermal Insulation Systems, to achieve rational energy behaviour, in new and existing buildings, a number of technical details and special requirements, unknown to the majority of the technical world*	*Civil Engineers* *Mechanical Engineers* *Electricians* *Chemical Engineers* *Environmental Engineers* *Technological Education Engineers* *Professional fitters and insulation companies*

TUV AUSTRIA	*THERMAL INSULATION OF ROOFS & ROOFS ACCORDING TO NATIONAL TECHNICAL SPECIFICATIONS ELOT IT & DIN 4108*	*2022*	*8*	*Conventional methodologies for thermal insulation of roofs and roofs in new and existing buildings, construction practices to avoid or solve problems of building pathology that include a number of technical details and special requirements*	*Civil Engineers* *Mechanical Engineers* *Electricians* *Chemical Engineers* *Environmental Engineers* *Technological Education Engineers* *Professional fitters and insulation companies*
E-LEARNING GP - Engineering Webinars	*CALCULATIONS OF ELECTRICAL CHARACTERISTICS OF ELECTRICAL INSTALLATION LINES ACCORDING TO ELOT 60364 – ANALYSIS AND JUSTIFICATION IN THE NEW REQUIRED MATERIALS*	*2022* *2023*	*12*	*The subject of the seminar covers the basic and required knowledge – at all levels – from the basic theoretical background, the level of Design, the Calculation process of the various power lines to the stage of Selection of the Appropriate Protection Materials according to the purpose for which the Electrical Installation is intended.*	*Electricians of all levels of education, professionals and students, Electrical Installations Maintenance Executives, Technical Department of bodies*
E-LEARNING GP - Engineering Webinars	*PRINCIPLES OF DESIGN AND CONSTRUCTION OF WATERPROOFING OF BUILDING ENVELOPE*	*2022-*	*12*	*The seminar covers the basic theoretical background on hygrothermal insulation, highlighting the phenomena from which the building envelope must be protected and the causes that create them and analyses common applications and problems that arise at the level of study and application.*	*Civil Engineers* *Mechanical Engineers* *Electricians* *Chemical Engineers* *Environmental Engineers* *Technological Education Engineers* *Professional fitters and insulation companies*

E-LEARNING GP - Engineering Webinars	*BASIC DESIGN PRINCIPLES OF PASSIVE AND NZEB BUILDINGS*	*2022-*	*10*	*The 10-hour seminar explains the basic design principles of passive and nZEB buildings and their comparison with the current Greek regulation. It also covers the history of energy efficient buildings in Greece and the world, offers examples of good practices and makes a first approach to the economy of construction of buildings with high environmental performance. The seminar is a recognized part of the overall training one should receive for the Passive House Designer certification.*	*Civil Engineers* *Mechanical Engineers* *Electricians* *Chemical Engineers* *Environmental Engineers* *Technological Education Engineers*
E-LEARNING GP - Engineering Webinars	*PASSIVE & ACTIVE FIRE PROTECTION OF BUILDINGS – PREPARATION OF A STUDY WITH THE CURRENT REGULATIONS (2023)*	*2023*	*9*	*Passive and Active Fire Protection of Buildings with a subject focused on the preparation of the required studies based on the current regulations (update 2023).*	*Mechanical engineers* *Civil engineers* *Architects*
E-LEARNING GP - Engineering Webinars	*PLANTED ROOFS – PRINCIPLES OF DESIGN AND CONSTRUCTION*	*2022-*	*14*	*Green Roofs at Design and Construction level. Categories, Specifications, Design, Vegetation cover, Principles of construction and hygrothermal design, Construction Design in 3D*	*Mechanical engineers* *Civil engineers* *Architects*
E-LEARNING GP - Engineering Webinars	*MECHANICAL VENTILATION SYSTEMS WITH HEAT RECOVERY*	*2022-*	*6*	*Basic principles of design, implementation and final adjustment of a mechanical ventilation system with heat recovery in a house, fresh air supply requirements, dimensioning methods*	*Engineers of all specialties* *Manufacturers* *Heating and air conditioning technicians* *Ventilation Technicians* *Traders of construction materials* *Homeowners* *Students*

E-LEARNING GP - Engineering Webinars	*PHOTOVOLTAIC SYSTEMS – DESIGN, LICENSING AND TECHNICAL IMPLEMENTATION*	*2022-*	*20*	*Basic knowledge at all levels, from the basic theoretical background, the level of Design, the Licensing process to the stage of Technical Implementation and Maintenance.*	*Engineers (professionals and students) of all specialties with relevant activity with the design and / or installation of photovoltaic systems*
Federation of Professional Plumbers of Greece – OBYE	*ENHANCEMENT OF EMPLOYEES' KNOWLEDGE AND SKILLS IN THEMATIC SUBJECTS OF ENERGY SAVING OF BUILDINGS THROUGH PROJECT MANAGEMENT, PLUMBING AND INSULATION*	*2022*	*150*	*Management of Energy Saving, Energy Performance Improvement and Building Energy Upgrade Projects* *Plumbing Installations of Heating, Cooling, Ventilation Systems using Natural Gas and Renewable Energy Sources (Solar Thermal Energy, etc.)* *Energy Efficiency and Energy Saving in Building Insulation*	*employees of enterprises in the private sector of the economy*
Federation of Electricians of Greece	*ENHANCING THE KNOWLEDGE AND SKILLS OF EMPLOYEES IN THEMATIC SUBJECTS OF ENERGY SAVING IN BUILDINGS THROUGH APPROPRIATE INSTALLATIONS AND BUILDING MATERIALS AND APPLICATIONS OF RENEWABLE ENERGY SOURCES"*	*2022*	*150*	*Techniques for the Promotion and Sale of Energy Economic Building Products and Energy Upgrading Systems for Buildings (Green Marketing)* *Energy Saving & Energy Efficiency Improvement of Building Facilities* *Applications of RES technologies for energy needs of buildings*	*employees of enterprises in the private sector of the economy*
VTC MASTER	*ELECTROMECHANICAL STUDIES*	*2018-*	*28*	*Parameters for the proper preparation of electromechanical studies* *Making optimal decisions to save resources* *Important points and legislation / type of study* *Elaboration of studies in practice in appropriate case studies using the best design and computational programs*	*engineers or electromechanical designers*

VTC MASTER	*MODERN METHODS FOR EFFECTIVE ENERGY MANAGEMENT:*	*2018-*	*15*	*Introduction to Energy, Energy Management Policy, Systematic Energy Management Actions, Legal Framework, Mapping of energy consumption, Opportunities for improving energy efficiency The Role of the Human Factor, Human issues The Role of Conservation, Energy Efficiency Assurance Measures, Methodology for the execution of Energy Management Audits, Corrective and Preventive Actions Ways of evaluation and improvement decisions*	*engineers or electromechanical designers*
VTC MASTER	*(NEAR) ZERO ENERGY BUILDING :*	*2018-*	*20*	*Requirements, characteristics and categorization of Minimum Energy Needs Buildings Existing institutional framework for energy requirements for buildings Components affecting the energy performance of the building Building materials and their developments, in terms of their thermal properties, energy efficiency and construction techniques Passive house – characteristics, behavior and mode of operation Renewable energy sources with efficient application in buildings Energy efficient building E/M installations and appliances – listing the latest technological and institutional developments.*	*Design Engineers, Constructors, Energy auditors of Buildings, Building Managers, Executives of Public Organizations, Engineers Heads of Public Organizations – Design Departments*
VTC MASTER	*Training of Energy auditors*	*2018-*	*80*	*regulatory framework for energy inspections of buildings, presentation of the relevant regulation (KENAK), sizes that affect the energy identity of a building, use of the TEE-KENAK application, examples of energy audit and methodology for calculating energy performance*	*Qualified engineers, members of the Technical Chamber of Greece (TEE) or graduates of Technological Education engineers or engineers who have obtained recognition of professional qualifications in our country*

BACK COVER