Energy Service

Ministry of Energy, Commerce, Industry and Tourism

Strategy for mobilising investment in the field of building renovation

In accordance with Article 4 of Directive 2012/27/EU on energy efficiency

April 2017

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Contents

1. Introduction

In accordance with Article 4 of Directive 2012/27/EU on energy efficiency, Member States shall establish a long-term strategy for mobilising investment in the renovation of the national building stock (European Parliament and European Council, 2012). The strategy shall encompass at least the following:

i. an overview of the national building stock based, as appropriate, on statistical sampling;
ii. identification of cost-effective approaches to renovations relevant to the building type and climatic zone;
iii. policies and measures to stimulate cost-effective deep renovations, including staged renovations;
iv. a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions;
v. an evidence-based estimate of expected energy savings and broader benefits.

Homes in Cyprus are estimated to account for 18 % of the final energy consumption, whereas commerce, hotels and services, i.e. mostly office buildings, account for another 11 % (Energy Service of Ministry of Energy, Commerce, Industry and Tourism, 2017). The different political, economic and social conditions that prevailed for many years did not favour the implementation of energy-saving measures in building construction. The first organised effort to implement energy-saving measures in buildings was made in 2004 through the aid schemes of the Special Fund for Renewable Energy Sources (RES) and Energy Savings (ES), whereas the implementation of mandatory measures in new buildings and large buildings undergoing major renovation started in 2007 upon adoption of the Regulation on the Energy Performance of Buildings (Minimum energy performance requirements) Decree of 2007. As a result, we now have a particularly energy-intensive building stock, which has a negative economic and environmental impact. Also, the absence of sufficient thermal insulation measures and the excessive exposure to sunlight in many buildings are detrimental to people’s health, reduce employee productivity and downgrade the overall quality of life. Major renovation of buildings is a chance to tackle many of those problems.

This publication uses quantitative and qualitative indicators to stress the problems caused by the energy status of the building stock to date, as well as the opportunities offered by increased mobilisation in investment in major renovation. It identifies the parties involved, the obstacles they come across and how these can be overcome. Speeding up the rate of implementation of renovation and the increase in the energy-saving measures applied in renovation are in line with the energy and environmental targets of Cyprus. **The aim is to ensure the energy upgrading of the building stock in cost-optimal ways for the owner, while at the same time maximising economic, environmental and social benefits for Cyprus.**

The strategy for mobilising investment in the renovation of buildings was drawn up following consultation with the stakeholders. The consultation was carried out through the statutory Advisory Committee for Monitoring the Application of the Regulation on the Energy Performance of Buildings Laws, comprising 22 organisations and bodies, including engineers, architects, building contractors, technical building system installers, land developers, universities, consumer associations and public sector departments involved in the building sector. There were also individual meetings held on the energy upgrading of buildings with employers' associations, financial institutions and private organisations whose primary objective is to carry out research and provide information in the energy sector. The exchange of views between the Ministry of Energy, Commerce, Industry and Tourism and the parties involved in building renovation was in itself an opportunity to exchange knowledge and come up with new ideas.

2. Review of the national building stock and trends concerning its development up until 2030

The building stock of Cyprus is relatively new, as most buildings were constructed in or after the 1980s. As a result of the absence of any policy measures for the construction of these buildings, most of the existing buildings have a low energy efficiency rating. This is reflected in the final energy consumption of buildings, which rose dramatically from the late 1990s onwards, with a slight drop in 2013 due to the economic crisis. It is therefore true that there is great unused potential for energy savings in buildings. The review of the existing building stock is broken down into homes (residential buildings), non-residential buildings and public buildings and is based on statistics available from the Statistical Service of Cyprus and the technical report entitled ‘Building Stock in Cyprus and Trends to 2030’, as prepared by the Joint Research Institute (JRC) for the Ministry of Energy, Commerce, Industry and Tourism. This chapter also cites estimates of the expected development of the existing building stock up until 2030.

2.1 Homes

There are almost 300 thousand homes used as permanent dwellings. Approximately another 78 thousand homes are used as country or tourist dwellings, meaning that they are typically used for shorter periods of time, thus consuming less energy. There are also another 54 thousand empty homes, meaning that they are available for sale or rent or that some of them are abandoned (Statistical Service of the Ministry of Finance, 2011).

Table 1: Homes per type of building and type of occupancy (Statistical Service of the Ministry of Finance, 2011)

ΤΥΠΟΣ ΚΤΙΡΙΟΥ ΣΤΟ ΟΠΟΙΟ ΒΡΙΣΚΕΤΑΙ Η ΚΑΤΟΙΚΙΑ	ΚΑΘΕΣΤΩΣ ΚΑΤΟΙΚΗΣΗΣ					
	Σύνολο	Κατοικημένη ως συνήθης τόπος διαμονής	Κενή κατοικία	Χρησιμοποιείται ως εξοχική/δεύτερη κατοικία	Χρησιμοποιείται ως τουριστικό διαμέρισμα/ κατοικία	Για κατεδάφιση/ Άλλη χρήση
Σύνολο	**431.059**	**297.122**	**54.651**	**71.942**	**6.146**	**1.198**
Μονοκατοικία	172.944	129.268	12.949	28.090	1.959	678
Διπλοκατοικία	59.050	48.743	4.597	5.344	247	119
Σπίτια σε συνεχή δόμηση	32.893	18.004	4.883	8.922	859	225
Βοηθητικό σπίτι	8.993	6.457	1.809	679	2	46
Πολυκατοικία	123.557	72.072	24.254	24.729	2.418	84
Κατοικία σε κτίριο μεικτής χρήσεως	32.530	22.215	6.066	3.589	618	42
Κτίριο άλλου τύπου	1.092	363	93	589	43	4

Πηγή : Στατιστική Υπηρεσία Κύπρου

TYPE OF OCCUPANCY

TYPE OF BUILDING IN WHICH THE HOME IS LOCATED	Total	Occupied as a usual place of residence	Empty home	Used as country/ second home	Used as tourist apartment/ home	Intended for demolition/ other use
Total	**431 059**	**297 122**	**54 651**	**71 942**	**6 146**	**1 198**
Single-family house	172 944	129 268	12 949	28 090	1 959	678
Two-family house	59 050	48 743	4 597	5 344	247	119
Terraced houses	32 893	18 004	4 883	8 922	859	225
Auxiliary house	8 993	6 457	1 809	679	2	46
Multi-apartment building	123 557	72 072	24 254	24 729	2 418	84
Home in a mixed-use building	32 530	22 215	6 066	3 589	618	42
Other type of building	1 092	363	93	589	43	4

Source: Statistical Service of Cyprus

Most homes that are used as permanent dwellings are single-family houses, i.e. approximately 130 thousand, followed by approximately 110 thousand apartments and 65 thousand terraced houses or two-family houses. There are another 8 thousand homes that are designated as ‘other types of homes’, which cannot be classified under the above categories.

Sixty eight per cent (68 %) of the homes are located in urban areas. There are great differences between urban and rural homes. The number of single-family houses is approximately the same in urban and rural areas, whereas most of the apartments (90 %) and two-family houses or terraced houses (62 %) are located in urban areas (Zangheri, 2016). Furthermore, it should be stressed in relation to the geographical distribution of homes that 78 % of them are located in seaside and lowland areas (Zangheri, 2016).

As regards ownership, 67 % of the homes are used by their owners.

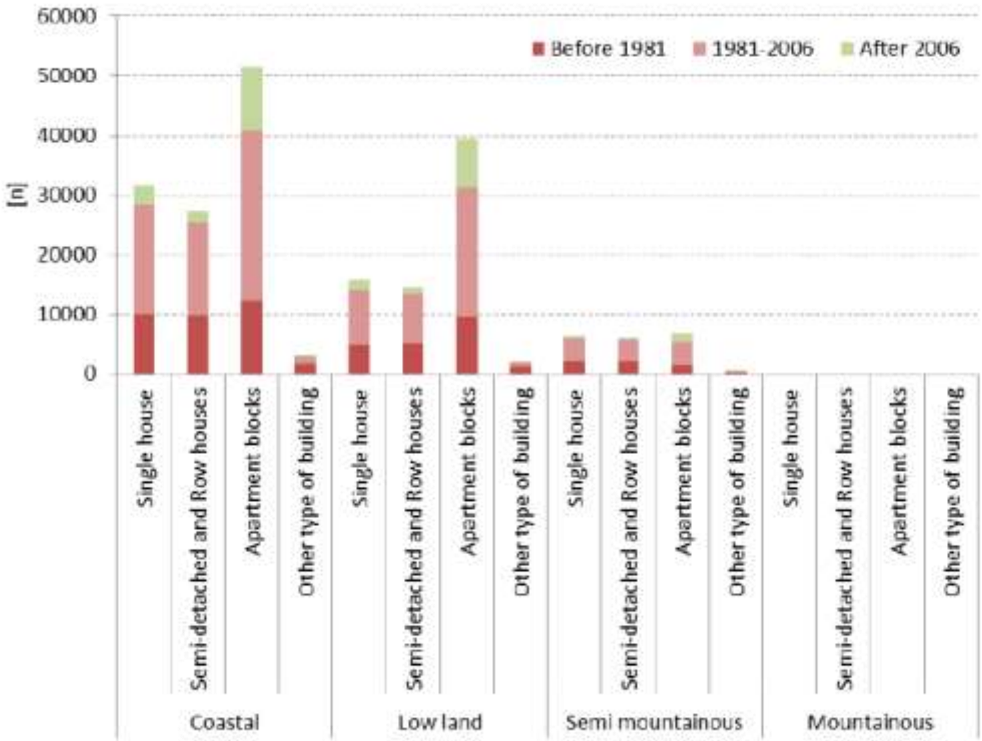
The size of the homes constructed tends to change in the course to time. The average floor area of single-family houses and terraced houses constructed after 2006 is larger than that of the ones constructed before 1981, whereas the exact opposite is true for apartments.

Table 2: Average floor area of homes per type and year of construction (Zangheri, 2016)

	Type of home	Year of construction	Average floor area (m^2)
Urban areas	Single-family house	Before 1981	95
		1981 - 2006	177
		After 2006	191
	Two-family houses and terraced houses	Before 1981	105
		1981 - 2006	125
		After 2006	132
	Apartments	Before 1981	92
		1981 - 2006	95
		After 2006	79
	Other types of houses	Before 1981	59
		1981 - 2006	44
		After 2006	44
Rural areas	Single-family house	Before 1981	105
		1981 - 2006	156
		After 2006	169
	Two-family houses and terraced houses	Before 1981	105
		1981 - 2006	127
		After 2006	133
	Apartments	Before 1981	76
		1981 - 2006	77
		After 2006	63
	Other types of houses	Before 1981	59
		1981 - 2006	51
		After 2006	58

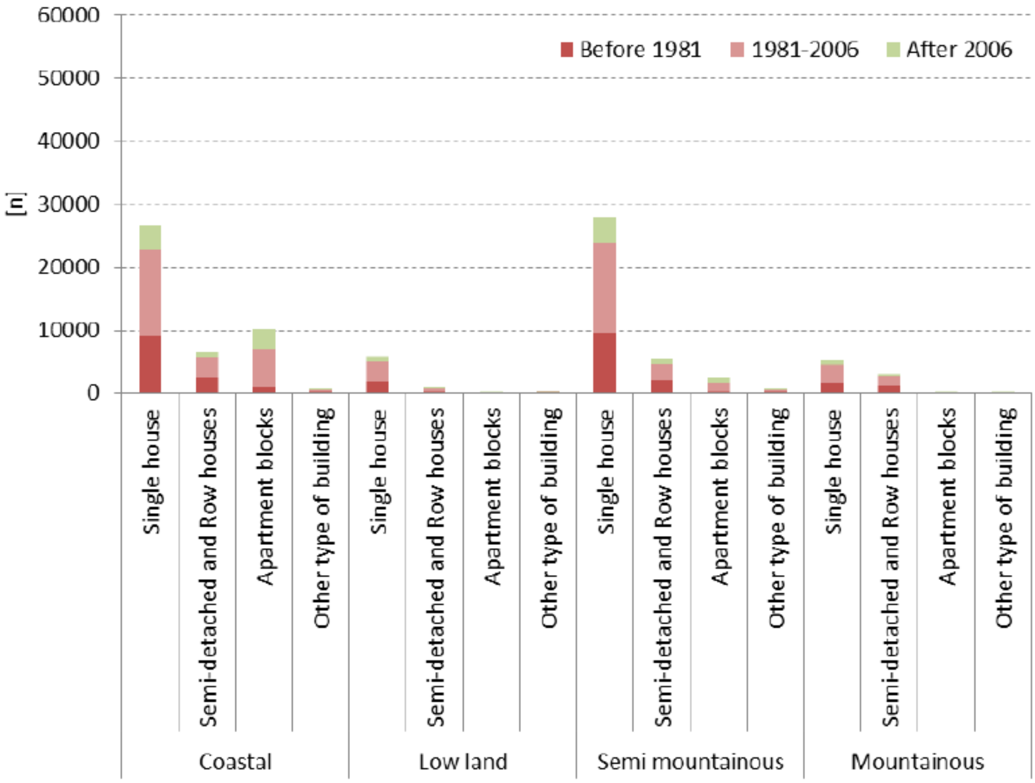
Forty per cent (40 %) of homes in Cyprus were erected before 1981 and 54 % of them were erected between 1981 and 2006. That is, the vast majority of homes were constructed when there were no minimum energy performance requirements in force. Therefore, a poor to medium energy efficiency rating can be assigned to most homes, as the building owners did not take any measures in the construction of the building, while some home owners took energy-saving measures afterwards, taking advantage mostly of the relevant aid schemes implemented by the Special Fund for RES and ES. Based on available statistics, no energy-saving measures have been taken in 49 % of the homes, and some form of thermal insulation has been used on the building envelope only in 12 % of the homes. The situation is a bit better in terms of door and window frames, where 38 % of the homes have double glazing (Statistical Service of the Ministry of Finance, 2009).

Graph 1: Number of houses per type of house, per year of construction and meteorological zone - urban areas (Zangheri, 2016)

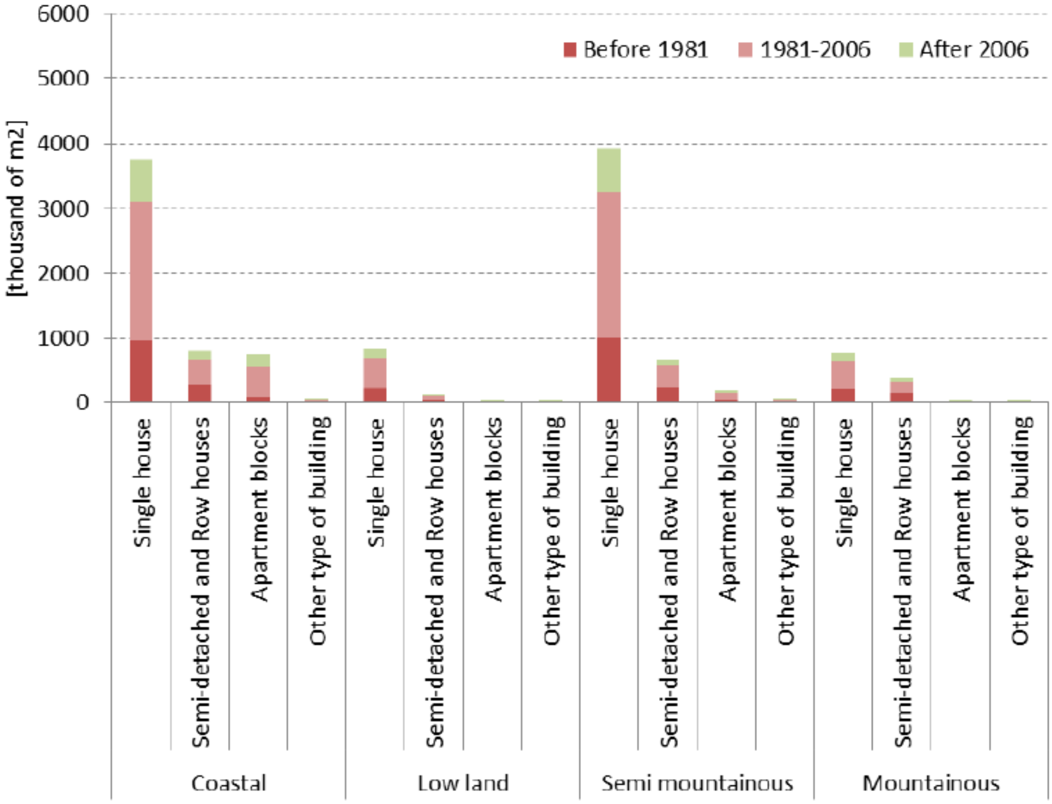


Graph 2: Total floor area per type of house, per year of construction and meteorological zone - urban areas (Zangheri, 2016)

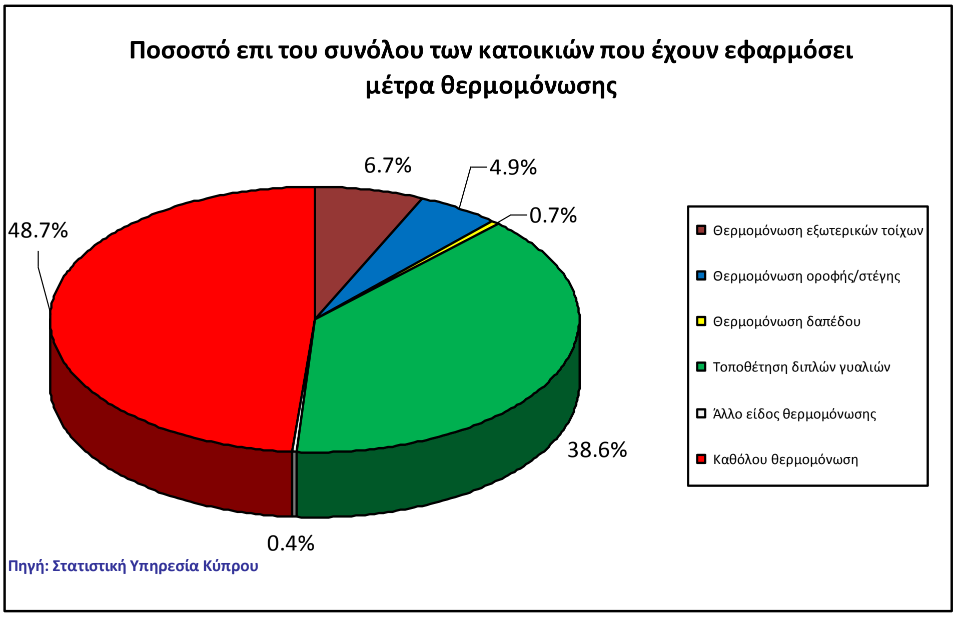
Graph 3: Number of houses per type of house, per year of construction and meteorological zone - rural areas (Zangheri, 2016)



Graph 4: Total floor area per type of house, per year of construction and meteorological zone - rural areas (Zangheri, 2016)



Graph 5: Ratio of homes with thermal insulation measures



Ratio of homes, out of the total number of homes, with thermal insulation measures

Thermal insulation on exterior walls

Thermal insulation on ceiling/ roof

Thermal insulation on floor

Double glazing installed

Other type of thermal insulation

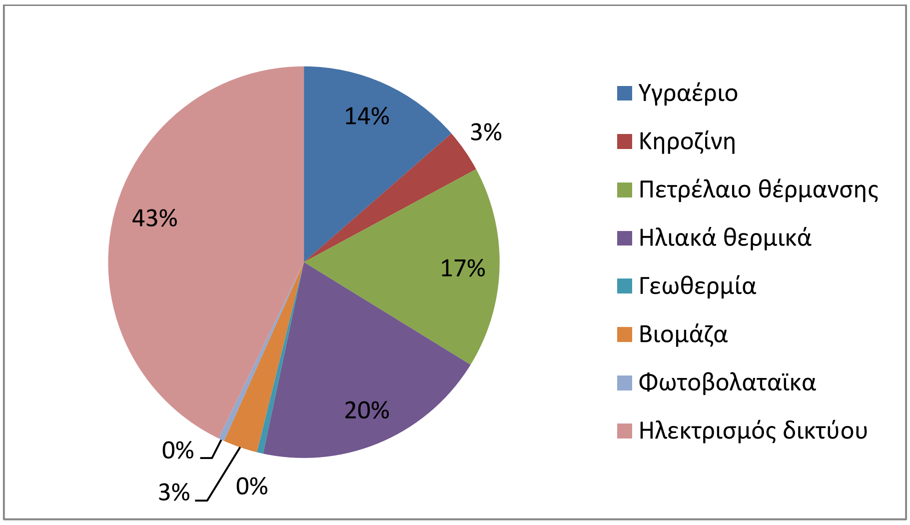
No thermal insulation

Source: Statistical Service of Cyprus

The primary energy product used in the residential sector is grid electricity, as this accounts for almost half of the final energy consumption, followed by heating oil and liquefied gas, which are the most important energy products after electricity.

As regards renewable energy systems in homes, solar energy for hot water production is the most widely used system, as it represents 20 % of the final energy consumption. This is primarily due to the fact that there are solar water heaters installed for hot water production in 91 % of homes (Statistical Service of the Ministry of Finance, 2009). However, there is no information available on the age or performance levels of these systems. Photovoltaic systems have been installed on homes since 2004, initially with subsidised rates for the electricity generated and then by offsetting the electricity consumed against that generated. There are currently more than 11 000 photovoltaic systems installed on homes. However, photovoltaics and other RES systems, such as geothermal heat pumps and biomass systems, have a very small share in the final energy consumption of the residential sector, of the order of 4 % (Energy Service of Ministry of Energy, Commerce, Industry and Tourism, 2017).

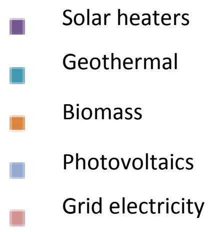
Graph 6: Ratio of energy product used in the residential sector



Liquefied gas

Kerosene

Heating oil



In a typical home, most of the energy is consumed by the air conditioning and heating systems, provided that thermal comfort conditions are ensured in the home (Ministry of Energy, Commerce, Industry and Tourism, 2013). The most widespread heating system in single-family houses is a central heating system with an oil boiler, as opposed to apartments, in which independent air conditioners are used for heating. Independent air conditioners are the most common air conditioning system used in summer months in all types of homes. However, half of the homes do not have any central heating system installed, and 18 % of the homes do not have an air conditioning system installed, which means that a large part of the households have settled for average to poor thermal comfort conditions (Zangheri, 2016).

Table 3: Type of heating system per type of home in urban areas, and in rural areas in parentheses (Zangheri, 2016)

Heating system	Fuel	Single-family house	Two-family houses and terraced houses	Apartments	Other types of houses
Central heating system with an oil boiler	Oil	41 % (27 %)	35 % (25 %)	17 % (5 %)	23 % (9 %)
Central heating system with a condensing boiler	Oil or liquefied gas	0 % (0 %)	0 % (0 %)	0 % (0 %)	0 % (0 %)
Oil stove	Oil	2 % (2 %)	2 % (2 %)	2 % (1 %)	1 % (2 %)
Central heating system with a liquefied gas boiler	Liquefied gas	3 % (3 %)	1 % (2 %)	0 % (1 %)	0 % (1 %)
Liquefied gas heater	Liquefied gas	11 % (17 %)	11 % (19 %)	9 % (13 %)	28 % (21 %)
Heat pump	Electricity	4 % (3 %)	4 % (2 %)	5 % (2 %)	0 % (2 %)
Heat pump with a ground source	Electricity	0 % (0 %)	0 % (0 %)	0 % (0 %)	0 % (0 %)

heat exchanger					
Independent air conditioners	Electricity	17 % (17 %)	23 % (19 %)	35 % (42 %)	14 % (19 %)
Independent high efficiency air conditioners	Electricity	4 % (4 %)	6 % (5 %)	9 % (11 %)	4 % (5 %)
Electric heater	Electricity	8 % (10 %)	9 % (12 %)	11 % (15 %)	20 % (29 %)
EAC storage heaters	Electricity	2 % (1 %)	3 % (1 %)	6 % (1 %)	0 % (0 %)
Fireplace	Biomass	4 % (13 %)	3 % (12 %)	1 % (2 %)	1 % (3 %)
No or other heating equipment	N/A	3 % (2 %)	2 % (2 %)	5 % (8 %)	7 % (9 %)

Table 4: Type of air conditioning system per type of home in urban areas, and in rural areas in parentheses (Zangheri, 2016)

Air conditioning system	Fuel	Single-family house	Two-family houses and terraced houses	Apartments	Other types of houses
Central system with a heat pump	Electricity	4 % (4 %)	4 % (4 %)	5 % (5 %)	0 % (0 %)
Central system with a ground source heat exchanger	Electricity	0 % (0 %)	0 % (0 %)	0 % (0 %)	0 % (0 %)
Independent air conditioners	Electricity	62 % (62 %)	62 % (62 %)	61 % (61 %)	65 % (65 %)
Independent high efficiency air conditioners	Electricity	16 % (16 %)	16 % (16 %)	15 % (15 %)	16 % (16 %)
No or other air conditioning equipment	N/A	18 % (18%)	18 % (18%)	18 % (18%)	18 % (18%)

Table 5 shows the estimated energy demand per type of home and construction period. As energy demand takes no account of the technical system used to meet the building occupants' needs, this table indicates how efficient the building envelope is in reducing energy consumption.

Table 5: Energy demand per type of home and year of construction **(Zangheri, 2016)**

	Year of construction	Space heating **(kWh / m^2 / year)**	Space cooling **(kWh / m^2 / year)**	Hot water **(kWh / m^2 / year)**
Single-family house	Before 1981	54	72	23
	1981 - 2006	40	54	18
	After 2006	36	50	15
Two-family houses and terraced houses	Before 1981	59	58	23
	1981 - 2006	43	44	18
	After 2006	39	40	15
Apartments	Before 1981	45	105	23
	1981 - 2006	33	84	18
	After 2006	30	76	15
Other types of houses	Before 1981	56	53	23
	1981 - 2006	41	41	28
	After 2006	37	38	15

2.2 Non-residential buildings

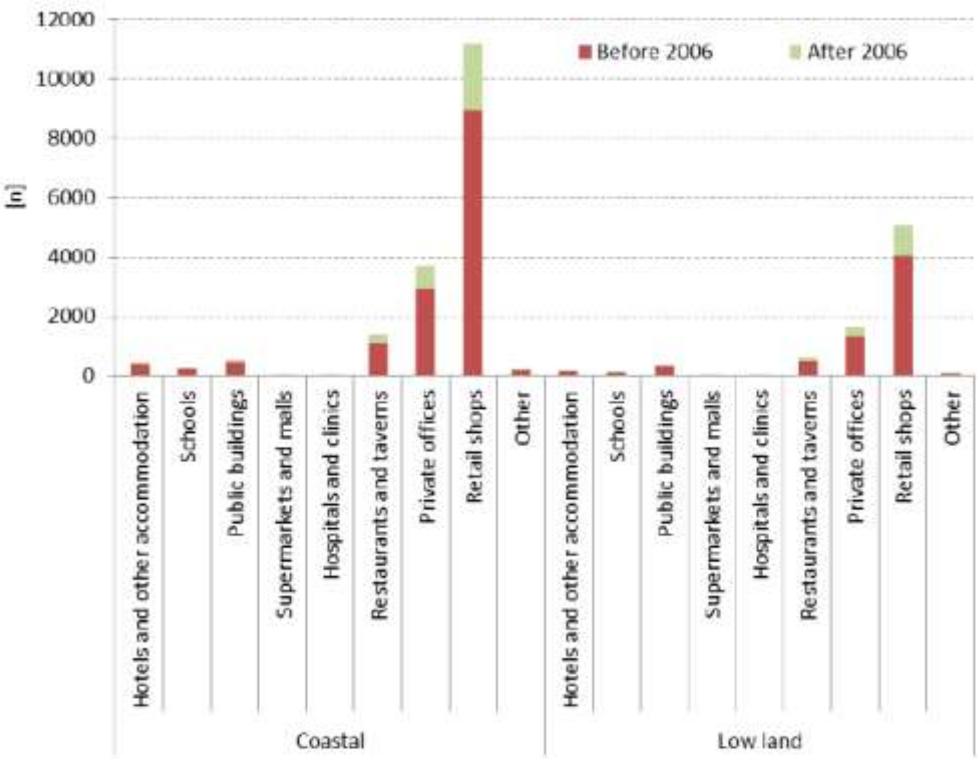
There are 30 thousand tertiary sector buildings in Cyprus, with a total floor area of 9 million square metres (Zangheri, 2016). Non-residential buildings include different types of buildings, notably offices, retail sales facilities and dining establishments. However, the largest category of buildings in terms of floor area is that of hotels and accommodation facilities, with 2 million square metres (Economidou, Report on the current status of the energy services market and proposals for mesaures to promote EPC in the public and private sector- JRC Technical Reports, 2016). Table 8 shows the total number and floor area of non-residential buildings.

Table 6: Total number and floor area of the most important types of non-residential buildings **(Economidou, Report on the current status of the energy services market and proposals for mesaures to promote EPC in the public and private sector- JRC Technical Reports, 2016)**

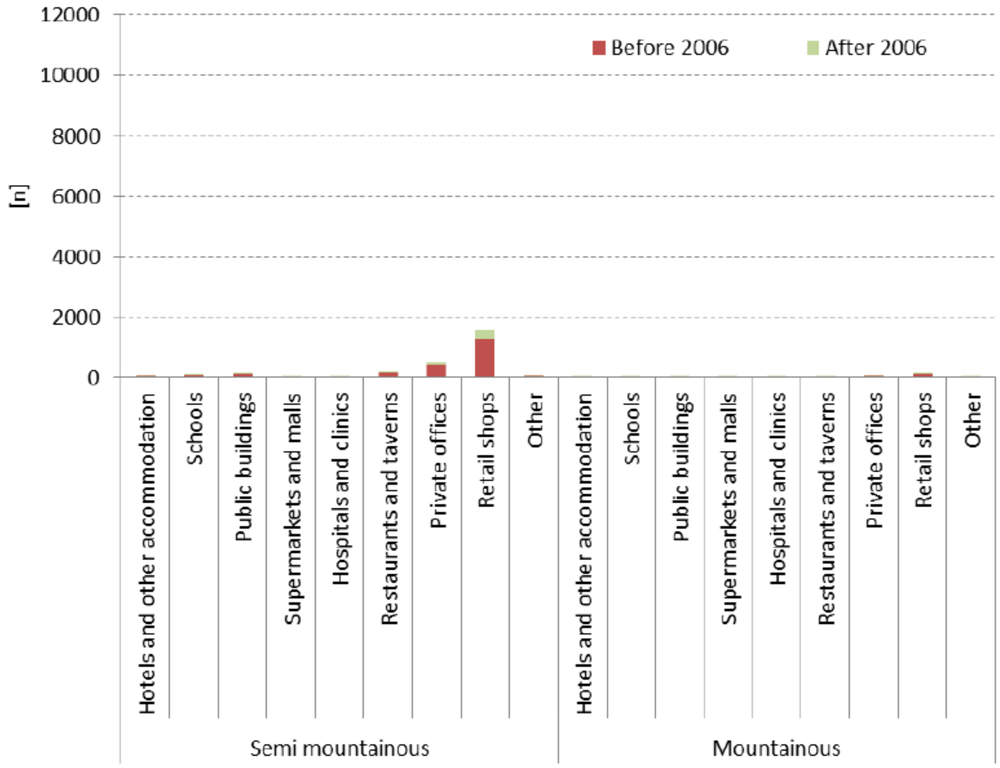
	Total floor area (m2)	Number of accommodation facilities	Average floor area (m2)
Hotels	2 094 134	766	2 734
Private offices	1 665 000	11 100	150
Retail sales facilities (stores)	1 080 000	18 000	60
Hospitals and clinics	485 898	83	17 354
Hypermarkets and compartment stores	280 396	67	4 185
Restaurants	179 360	2 242	80
Airports	119 600	2	59 800

Just like in the residential sector, 83 % of the buildings used for the provision of services or other business purposes were constructed before adopting any minimum energy performance requirements. The vast majority of non-residential buildings are located in coastal and lowland areas in Cyprus (meteorological zones 1 and 2).

Graph 7: Number of non-residential buildings per type in meteorological zones 1 and 2 **(Zangheri, 2016)**

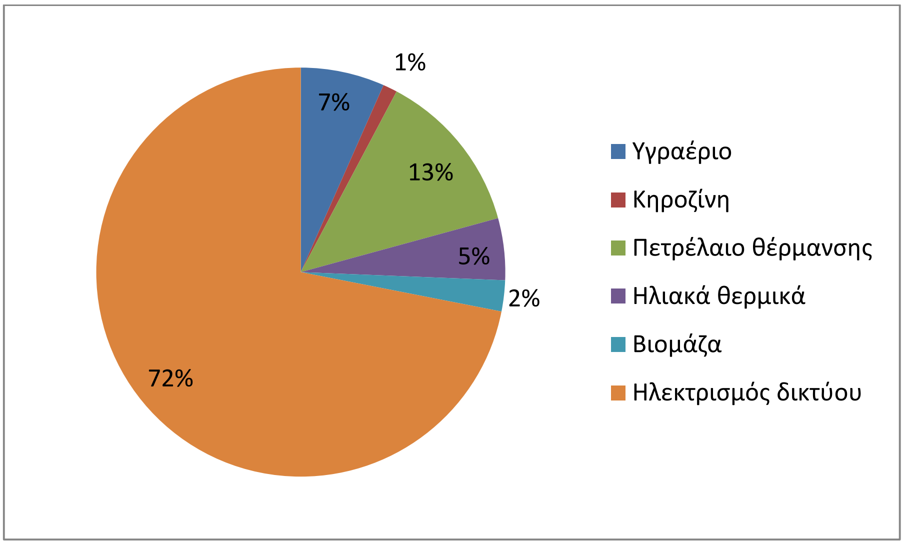


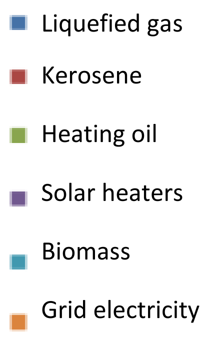
Graph 8: Number of non-residential buildings per type in meteorological zones 3 and 4 (Zangheri, 2016)



Two thirds of the total final energy consumption in non-residential buildings is covered by the use of grid electricity, where the use of RES in 2015 represented 7 % (Energy Service of Ministry of Energy, Commerce, Industry and Tourism, 2017). The level of RES penetration in certain types of buildings is higher than the average level in tertiary sector buildings, i.e. in hotels, where 95 % of the buildings use solar energy for hot water production.

Graph 9: Ratio of the energy product used in the non-residential sector





The technical systems installed in tertiary sector buildings are different depending on the type of building. The most common heating system used in hotels is a central heating system with a boiler; in offices, stores and hypermarkets it is a central heating system with a heat pump. As regards air conditioning, most of the buildings examined used a central air conditioning system.

Table 7: Type of heating system per type of building (Zangheri, 2016)

	Fuel	Hotels	Private offices	Retail sales facilities (stores)	Hospitals and clinics	Hypermarkets and compartment stores	Restaurants
Central heating system with an oil boiler	Oil	43 %	41 %	12 %	31 %	11 %	28 %
Central heating system with a condensing boiler	Oil or liquefied gas	2 %	1 %	0 %	1 %	1 %	0 %
Central heating system with a liquefied gas boiler	Liquefied gas	10 %	4 %	2 %	4 %	1 %	3 %
Heat pump	Electricity	40 %	44 %	75 %	61 %	81 %	36 %
Heat pump with a ground source	Electricity	0 %	1 %	0 %	1 %	2 %	0 %

heat exchanger							
Independent air conditioners	Electricity	3 %	6 %	8 %	0 %	8 %	18 %
Independent high efficiency air conditioners	Electricity	1 %	1 %	1 %	0 %	1 %	5 %
No or other heating equipment	N/A	1 %	0 %	0 %	0 %	0 %	0 %

Table 8: Type of air conditioning system per type of building (Zangheri, 2016)

	Fuel	Hotels	Private offices	Retail sales facilities (stores)	Hospitals and clinics	Hypermarkets and compartment stores	Restaurants
Central system with a heat pump	Electricity	62 %	54 %	75 %	68 %	88 %	42 %
Central system with a ground source heat exchanger	Electricity	0 %	1 %	0 %	1 %	2 %	0 %
Independent air conditioners	Electricity	24 %	22 %	8 %	9 %	0 %	28 %
Independent high efficiency air conditioners	Electricity	4 %	3 %	1 %	2 %	0 %	5 %
No or other air conditioning equipment	N/A	10 %	20 %	16 %	20 %	10 %	25 %

Table 9 shows the estimated energy demand per type of building.

Table 9: Energy demand per type of building and year of construction (Zangheri, 2016)

	Year of construction	**Space heating (kWh / m^2 / year)**	**Space cooling (kWh / m^2 / year)**	**Hot water (kWh / m^2 / year)**	**Lighting (kWh / m^2 / year)**
Hotels	Before 2006	65	268	40	55
	After 2006	45	183	28	50
Private offices	Before 2006	87	203	5	45
	After 2006	59	138	4	40
Retail sales facilities (stores)	Before 2006	41	194	5	105
	After 2006	28	132	4	95
Hypermarkets and compartment stores	Before 2006	33	470	1	105
	After 2006	23	321	1	95
Restaurants	Before 2006	142	285	214	85
	After 2006	97	194	146	80

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2.3 Public buildings

'Public buildings' means buildings used by:

I. central government authorities, such as ministries, the police and the Attorney General's office;

II. local authorities, such as municipalities and communities;

III. public schools, public universities and other educational establishments;

IV. the army.

‘Central government authorities’ means all administrative authorities whose jurisdiction covers the entire territory of the Republic of Cyprus and listed in Annex IV of the Coordination of Procedures for the Award of Certain Works Contracts, Supply Contracts and Service Contracts and Relevant Matters Law of 2006. The buildings used by central government authorities typically have a low energy efficiency rating, as most of these buildings are classified under categories C to H in accordance with the energy performance certificates already issued (Ministry of Energy, Commerce, Industry and Tourism, 2015).

Local authorities in the free areas of the Republic of Cyprus include 39 municipalities, 9 of them being occupied, and 350 communities. Most of the municipalities and larger communities only have one building used for administrative purposes and events. Larger municipalities, however, own several buildings intended for providing services to the general public, as well as other types of buildings, such as libraries and sports centres.

There are more than 800 public primary and secondary schools in Cyprus. The responsibility for the implementation of projects consisting in the construction of new schools and the maintenance and expansion of existing ones lies with the technical departments of the Ministry of Education and Culture. Most schools were erected before 2006. Almost all schools use a central heating system with a boiler for heating in winter, and there is no air conditioning in most classrooms (Zangheri, 2016).

As regards public universities, the University of Cyprus, which is the largest public university, owns the highest number of buildings, most of which were erected in the campus in recent years. The Cyprus University of Technology is housed mainly in historic buildings and rented ones in downtown Limassol, whereas the Open University of Cyprus is housed in a building in Nicosia. Public universities operate technical departments that are responsible for the maintenance and smooth functioning of their building facilities.

Table 10: Total number and floor area of public buildings (Zangheri, 2016)

	Total floor area (m2)	Number of accommodation	Average floor area (m2)

		facilities	
Public buildings	1 886 370	1 087	1 735
Primary schools	453 755	325	1 396
Junior and senior high schools and technical schools	613 546	144	4 261
Child care centres	96 376	419	230
Higher education	222 404	N/A	N/A

Table 11: Energy demand per type of building and year of construction **(Zangheri, 2016)**

	Year of construction	**Space heating (kWh / m^2 / year)**	**Space cooling (kWh / m^2 / year)**	**Hot water (kWh / m^2 / year)**	**Lighting (kWh / m^2 / year)**
Public buildings	Before 2006	49	44	5	42
	After 2006	34	30	4	37
Schools	Before 2006	35	55	7	35
	After 2006	24	37	5	30

2.4 Trends concerning the development of the building stock up until 2030

The technical report entitled 'Building Stock in Cyprus and Trends to 2030', as prepared by the JRC for the Ministry of Energy, Commerce, Industry and Tourism**,** provides an estimate of the development of the building stock in Cyprus up until 2030 unless there are policy changes made regarding the energy performance of buildings. This estimate is based on assumptions regarding:

I. the gross domestic product (GDP) increase,

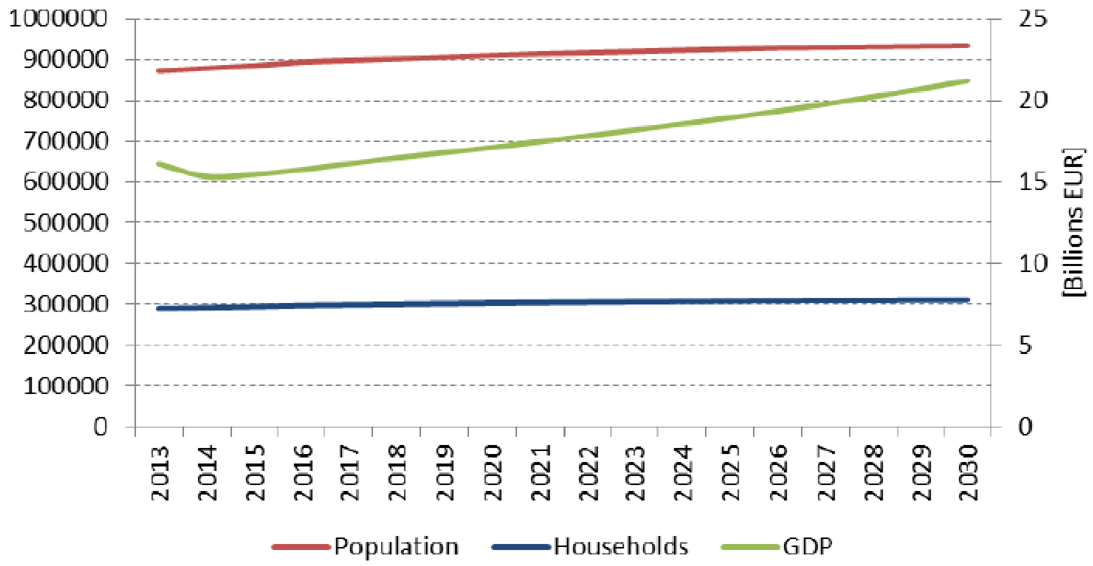
II. the population increase,

III. the number of new buildings erected annually,

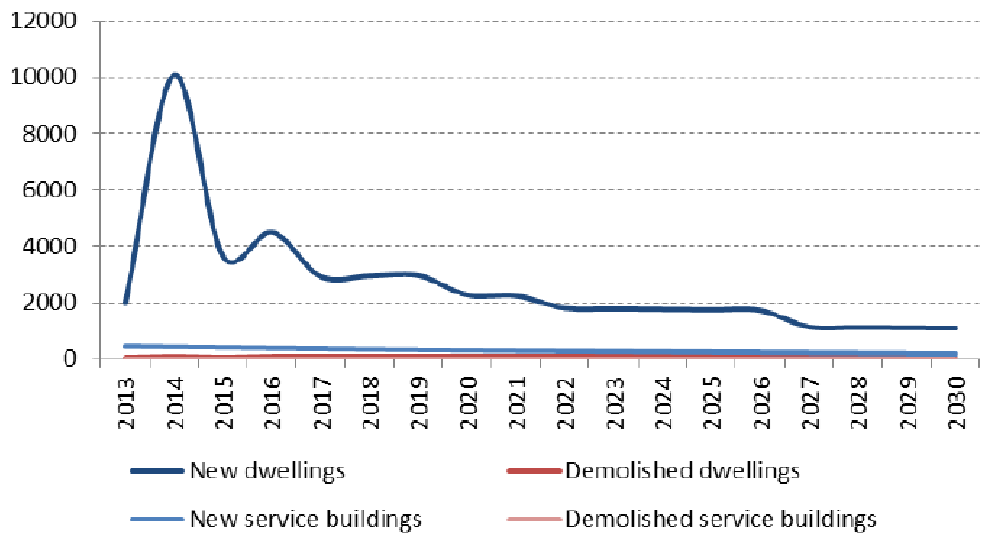
IV. the number of existing buildings demolished annually,

as shown in the following graphs.

Graph 10: Estimated increase in population, GDP and number of households by 2030 (Zangheri, 2016)

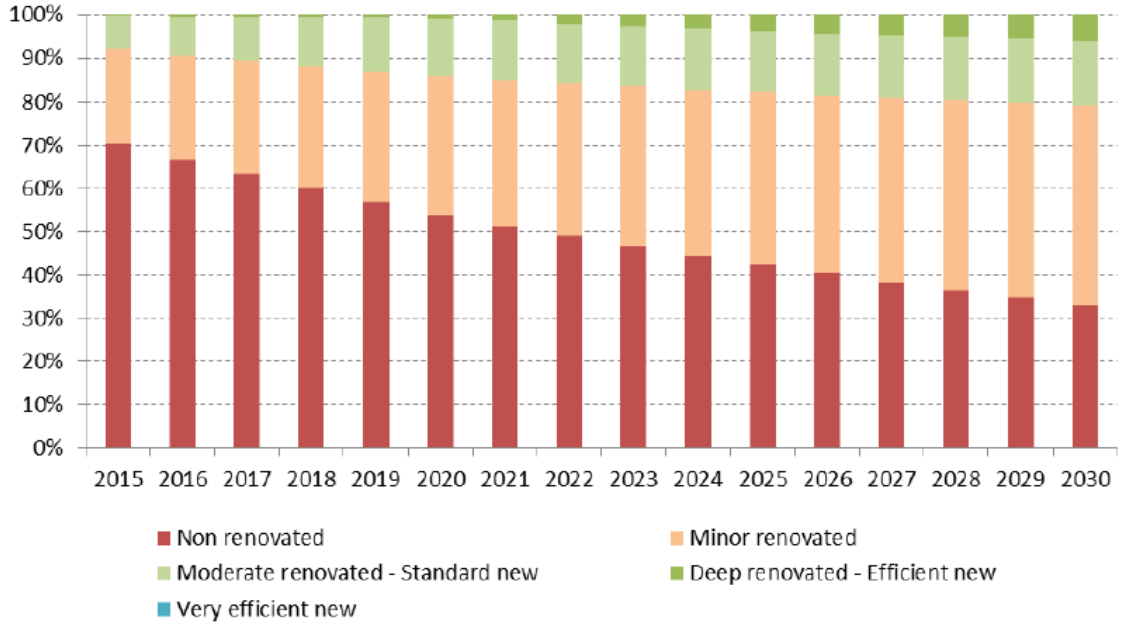


Graph 11: Estimated numbers of new buildings erected and of existing ones demolished by 2030 (Zangheri, 2016)

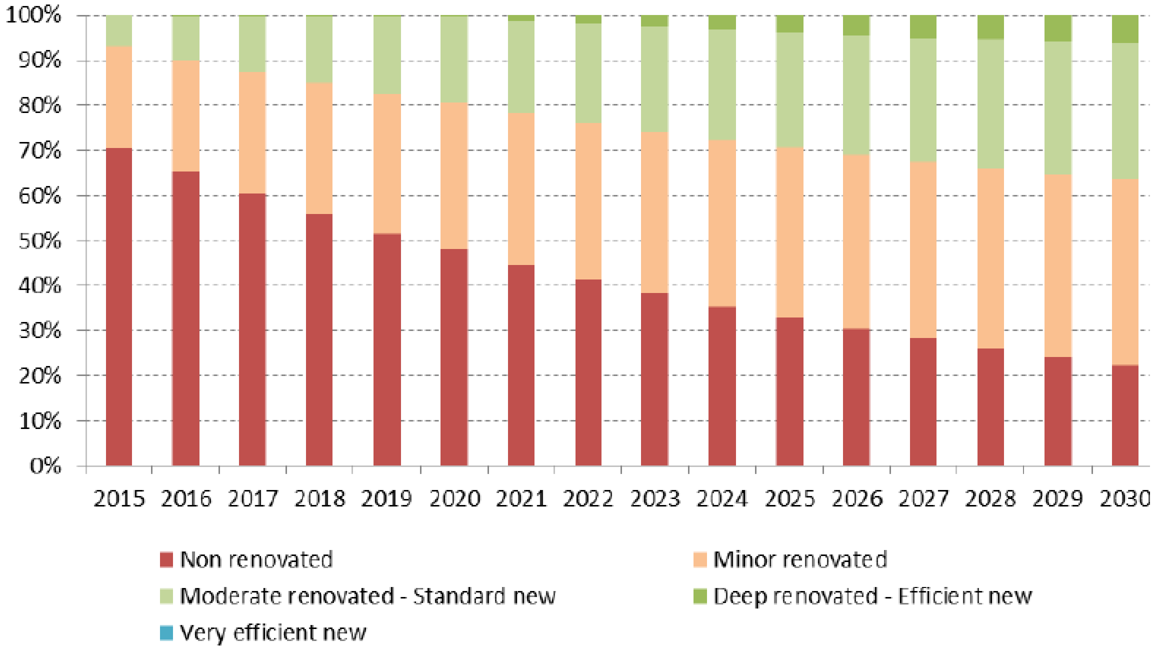


In view of the above, a baseline scenario was created regarding the development of the building stock up until 2030 in terms of energy performance. According to that scenario, up until 2030, a little more than 20 % of homes and 35 % of non-residential buildings will have a good energy efficiency rating, and a very small ratio of buildings will have a high energy efficiency rating.

Graph 12: Estimated ratio of homes to be renovated by 2030 - baseline scenarios (Zangheri, 2016)



Graph 13: Estimated ratio of tertiary sector buildings to be renovated by 2030 - baseline scenarios (Zangheri, 2016)



3. Cost-optimal approaches to renovation

The calculation of cost-optimal levels of minimum energy performance requirements for buildings, as made under Article 5 of Directive 2010/31/EU on the energy performance of buildings (recast), offered an opportunity to look into the cost-optimal building renovation methods, also taking into account the initial capital expenditure and the operating cost over the lifecycle of the building. Moreover, in recent years there have been recorded data on the energy upgrading of buildings which was carried out through such financing programmes as the 'Save & Upgrade' programme and the 'ENERGEIN' project. This chapter sets out cost-effective and technically practical measures for improving the energy performance of buildings, whether calculated or applied in practice.

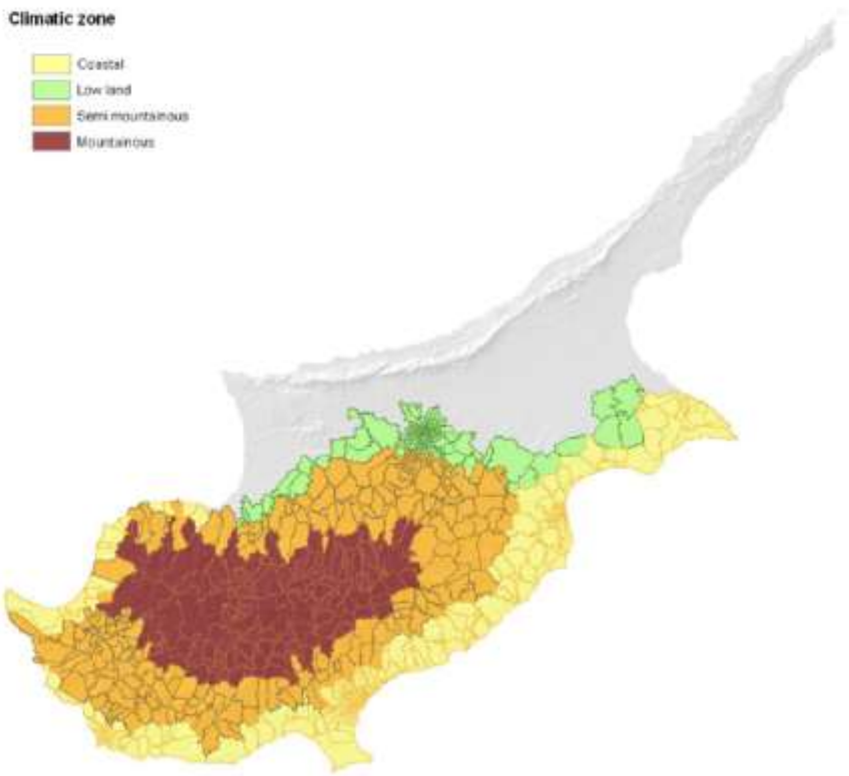
3.1 Calculation of cost-optimal levels of minimum energy performance requirements

To make possible the calculation of cost-optimal levels of minimum energy performance requirements for existing buildings, seven reference buildings were created: two single-family houses, two multi-apartment buildings, two office buildings and a retail sales facility. The aim was for these buildings to be most representative of the typical and average existing building stock. These are virtual buildings and are based on available statistics and on the views of architects, engineers, contractors and other professionals in the sector, as obtained by the preceding consultation.

The calculations were made for meteorological zone 2, as defined in the 'Calculation Methodology of the Energy Efficiency of Buildings'. The methodology breaks down the territory of Cyprus into four meteorological zones. Zones 1, 2 and 3 have similar climatic characteristics and, therefore, similar energy consumption levels[1]. Zone 4 (areas with an altitude of more than 600 m) is very different from the other zones, as the energy needs for heating in the same home are three times higher and the air conditioning needs are 70 % lower than in the other zones (Exergia S.A. , 2012). However, there are only 24 289 homes and only 3 % of the population lives in zone 4 (Statistical Service of the Ministry of Finance, 2011).

[1] Zone 1 includes coastal areas, zone 2 includes lowland areas, zone 3 includes semi-mountainous areas, and zone 4 includes mountainous areas.

Graph 14: The climatic zones of Cyprus for the purpose of calculating the energy performance of buildings **(Zangheri, 2016)**



Following are examples of cost-optimal, over the lifecycle of a building, combinations of energy-saving measures that can be implemented as part of a major renovation, based on the results of the calculations concerned. Please note that these examples reflect the cost of energy and materials at the time when the calculations were made, i.e. in 2013, and the energy consumption level reflects the average potential use. Therefore, the examples give a general picture, as the energy-saving interventions and the installation of RES systems in buildings must be looked into in relation to the data of each case. Moreover, the implementation of the measures listed below may achieve other objectives too, which are unrelated to energy savings, such as the beautification of facades, the replacement of building elements whose lifecycle has ended, etc. It is estimated that, by implementing the energy-saving measures in the context of a scheduled large-scale renovation, the initial capital expenditure required only for energy purposes must be considered as being 30 % lower than the cost referred to below.

(1) One-floor single-family house with a floor area of 193 m2, with a level roof (typical home in the 80s)

Description of construction prior to any intervention:

- Roof: Concrete, no thermal insulation (U=4.27W/m^2K)
- Pillars/ beams: Concrete, no thermal insulation (U=3.33W/m^2K)
- Walls: Typical 20 cm brick (U=1.38W/m^2K)
- Frames: Aluminium frames with single glazing, no thermal break system (U=6W/m^2K)
- Shading: External moving shades
- Heating system: Central heating system with radiators and an oil boiler with an efficiency rating of 80 %
- Air conditioning system: Independent air conditioners with a cooling efficiency rating of 2.5
- Hot water system: The same oil boiler as that used for heating, and solar panels
- Lighting: Compact fluorescent lamps
- Energy efficiency class in the energy performance certificate: H

One-floor single-family house with a floor area of 193 m2, with a level roof (typical home in the 80s) - energy consumption and costs before renovation			
	Electricity (kWh)	Oil (litres)	Total energy costs over the lifecycle of the building, current values (€)
Heating	-	1 930	115 277
Air-conditioning	10 576	-	
Hot water	-	185	
Lighting	3 686	-	
Total	14 262	2 115	

Energy-saving measures and initial cost:

- ✓ Installation of 8 cm thick thermal insulation on the roof (U=0.34W/m^2K) €6 347
- ✓ Installation of 7 cm thick thermal insulation on the walls, pillars and beams (U=0.34W/m^2K) €7 604

- ✓ Replacement of boiler with a liquefied gas condensing boiler €1 900
- ✓ Replacement of air conditioners with high efficiency ones €2 012
- ✓ New energy efficiency class in the energy performance certificate: B
- ✓ Total initial cost = €17 863

One-floor single-family house with a floor area of 193 m2, with a level roof (typical home in the 80s) - energy consumption and costs after renovation			
	Electricity (kWh)	Liquefied gas (kg)	Total energy costs over the lifecycle of the building, current values (€)
Heating	-	498	40 467
Air-conditioning	1 351	-	
Hot water	-	117	
Lighting	3 686	-	
Total	5 034	615	

(2) Two-floor single-family house with a floor area of 195 m2, with a pitched tile roof (typical home in the 1990s)

Description of construction prior to any intervention:

- Pitched tile roof, no thermal insulation ($U=1.72W/m^2K$)
- Pillars/ beams: Concrete, no thermal insulation ($U=3.33W/m^2K$)
- Walls: Typical 20 cm brick ($U=1.38W/m^2K$)
- Frames: Aluminium frames with single glazing, no thermal break system ($U=6W/m^2K$)
- Shading: No external shades
- Heating system: Central heating system with radiators and an oil boiler with an efficiency rating of 80 %
- Air conditioning system: Independent air conditioners with a cooling efficiency rating of 3.2
- Hot water system: The same oil boiler as that used for heating, and solar panels
- Lighting: Compact fluorescent lamps
- Energy efficiency class in the energy performance certificate: D

Two-floor single-family house with a floor area of 195 m2, with a pitched tile roof (typical home in the 90s) - energy consumption and costs before renovation			
	Electricity (kWh)	Oil (litres)	Total energy costs over the lifecycle of the building, current values (€)
Heating	-	1 342	66 997
Air-conditioning	4 192	-	
Hot water	-	177	
Lighting	3 042	-	
Total	7 234	1 519	

Energy-saving measures implemented:

- ✓ Installation of 8 cm thick thermal insulation on the roof ($U=0.31W/m^2K$) €4 091
- ✓ Installation of 7 cm thick thermal insulation on the walls, pillars and beams ($U=0.34W/m^2K$) €8 510
- ✓ Replacement of boiler with a liquefied gas condensing boiler €1 900
- ✓ Installation of a photovoltaic system with a capacity of 2kW €3 400
- ✓ New energy efficiency class in the energy performance certificate: B+
- ✓ Total initial cost = <u>€17 901</u>
- ✓

Two-floor single-family house with a floor area of 195 m2, with a pitched tile roof (typical home in the 90s) - energy consumption and costs after renovation			
	Electricity (kWh)	Liquefied gas (kg)	Total energy costs over the lifecycle of the building, current values (€)
Heating	-	520	30 940
Air-conditioning	2 145	-	
Hot water	-	111	
Lighting	3 032	-	
RES-based electricity generation	-3 744	-	
Total	1 433	631	

(3) Office building with a floor area of 1 448 m2

Description of construction prior to any intervention:

- Roof: Concrete, no thermal insulation (U=1.99W/m^{2}K)
- Pillars/ beams: Concrete, no thermal insulation (U=1.1W/m^{2}K)
- Walls: Typical 20 cm brick (U=W/m^{2}K)
- Frames: Aluminium frames with double glazing, no thermal break system (U=3.8W/m^{2}K)
- Shading: No external shades
- Heating and air conditioning system: Independent air conditioners with a cooling efficiency rating of 2.2 for heating and 2 for cooling
- Hot water system: Instantaneous hot water, no storage
- Lighting: Compact fluorescent lamps
- Energy efficiency class in the energy performance certificate: G

Office building with a floor area of 1 448 m2 - energy consumption and costs before renovation			
	Electricity (kWh)	Oil (litres)	Total energy costs over the lifecycle of the building, current values (€)
Heating	36 489	-	706 693
Air-conditioning	52 852	-	
Hot water	4 199	-	
Lighting	80 074	-	
Ventilation	-	-	
Total	173 614	-	

Energy-saving measures implemented:

- ✓ Installation of 12 cm thick thermal insulation on the roof (U=0.22W/m^{2}K) €15 693
- ✓ Installation of 12 cm thick thermal insulation on the walls, pillars and beams

  (U=0.20W/m^{2}K) €36 930
- ✓ Installation of frames with double glazing and a panel with an increased thermal efficiency rating (U=2.25W/m^{2}K) €62 478
- ✓ Installation of fixed shades on the frames with a south and east orientation €17 282
- ✓ Replacement of air conditioners with high efficiency ones €43 000

- ✓ Installation of energy efficient lamps €2 750
- ✓ Installation of a photovoltaic system with a capacity of 10kW €17 000
- ✓ New energy efficiency class in the energy performance certificate: B
- ✓ Total initial cost = €195 133

Office building with a floor area of 1 448 m2 - energy consumption and costs after renovation		
	Electricity (kWh)	Total energy costs over the lifecycle of the building, current values (€)
Heating	11 873	32 2590
Air-conditioning	17 810	
Hot water	4 199	
Lighting	55 748	
RES-based electricity generation	-18 824	
Total	70 806	

3.2 Examples of buildings whose energy performance was improved

The programme 'Energy Efficiency in Low Income Housing in the Mediterranean' (ELI-MED) aims to identify cost-optimal approaches to the energy upgrading of buildings through pilot applications and focuses on low-income households in the Mediterranean area. In the context of that project, 25 pilot applications were implemented in homes in Cyprus after assessing their energy efficiency rating, and energy-saving measures were then implemented. Smart meters were installed in the buildings to allow for assessing the results and comparing the estimated energy savings (ELI-MED Project). The results to date indicate savings levels between 30 % and 40 %. There are three different types of homes listed below as examples of gradual renovations which, if implemented in a targeted fashion, can yield great results in terms of energy and money savings.

1) Single-family house with a floor area of 150 m2 in Dali (climatic zone 2)

Year or construction: 1985
Energy efficiency class in the energy performance certificate: E
Energy-savings measures implemented:

- ✓ Installation of 7 cm thick thermal insulation on the roof €7 530
- ✓ Replacement of air conditioners with high efficiency ones €1 770
- ✓ Total initial cost = €9 300

New energy efficiency class in the energy performance certificate: C

Estimated energy savings: 43 %

2) Terraced house with a floor area of 128 m2 in Aradippou (climatic zone 1)

Year or construction: 1992
Energy efficiency class in the energy performance certificate: E
Energy-savings measures implemented:

- ✓ Installation of 7 cm thick thermal insulation on the roof €6 669
- ✓ Replacement of solar water heater €1 400
- ✓ Total initial cost = €8 069

New energy efficiency class in the energy performance certificate: C

Estimated energy savings: 35 %

3) Apartment with a floor area of 94 m2 in Agios Athanasios (climatic zone 1)

Year or construction: 2007
Energy efficiency class in the energy performance certificate: G
Energy-saving measures implemented:

- ✓ Replacement of ordinary fireplace with an energy efficient one €5 000
- ✓ Replacement of incandescent lamps with compact fluorescent lamps €100
- ✓ Total initial cost = €5 100

New energy efficiency class in the energy performance certificate: E

Estimated energy savings: 29 %

An example of good practice for commercial buildings is the Hellenic Bank, which converted 10 branches into ‘energy-friendly branches’, as it calls them. The measures implemented in these branches included the installation of thermal insulation on the roof, thermally insulated glazing, new class A air conditioners, as well as LED lamps and illuminated signs. Thanks to these measures, the amounts of energy consumed in these branches dropped by 50 % to 60 %. Also, the actions taken by the Bank and its staff in other buildings ensured savings of €416 000 (or 18 %) in 2013 compared to 2012.

The costs of the energy upgrading works carried out in the 10 branches, the State aid requested and the pay-off period are as follows:

- Total cost of energy upgrading works: €663 404

- Additional cost of energy upgrading works compared to typical cost: €270 854
- State aid requested: €163 532
- Pay-off period: 1.5-2.5 years.

Following is a detailed list of the works and costs for a branch:

1. Cost of energy interventions
    - Thermal insulation on roof: €6 750
    - Thermally insulated front windows and aluminium frames €10 396
    - Air conditioners with a high energy efficiency rating €14 107
    - State aid requested: €8 522
2. Energy savings: 63 %
3. Pay-off period: 1-2 years.

Companies and organisations with similar activities and/or similar buildings could reduce their energy consumption levels and operating costs by resorting to similar approaches.

Good practice examples for public sector buildings can be found in the context of the SERPENTE project, aimed at the energy upgrading of various types of public sector buildings. The Cyprus Energy Agency, whose partners include local authority bodies, is the project coordinator in Cyprus. Following are two examples of applications implemented in Cyprus:

1) Municipal library of Strovolos (climatic zone 2)

The building was constructed in 1915 and has been designated as a listed historic building. The building was first used as a school, then as a slaughterhouse and finally as the City Hall of Strovolos up until 1993, when it was abandoned. In 2011-2012, the building was renovated, and the energy-saving measures implemented included installing 5 cm thick thermal insulation on the roof, interior thermal insulation on the walls, double glazing on the north and east sides, sunlight blocking films on the west-oriented window panes, a geothermal heat pump for heating and cooling, and an electronic energy management system. The total cost of the measures stood at €290 000 and the pay-off period is estimated at 4 years.

2) Olympic swimming facility 'Tassos Papadopoulos' in the Municipality of Geroskipou (climatic zone 1)

The sports facility was constructed in 2004 and, despite the thermal insulation measures implemented in the building, no heating and air conditioning efficiency measures were taken in designing it. The rise in energy prices brought about a significant increase in the cost incurred for heating the swimming pool, thus putting at risk the sustainability of the swimming facility. Solar panels and a geothermal pump were installed in 2008, to reduce the amounts of energy derived from conventional fuels. As a result, the consumption of heating oil dropped by 20 % (30 000 to 40 000 litres per year). The cost of the project stood at €132 000 and the pay-off period is estimated at 4 years.

4. Policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations.

The policies and measures to stimulate the mobilisation of investment in the renovation of existing buildings can be broken down into legislative measures, incentives, training measures and information measures. An analysis of the current state of play is provided below, and the relevant obstacles along how to overcome them are identified.

4.1 Legislative measures

The most important legislative measures for the energy upgrading of existing buildings relate to the provisions of the Regulation on the Energy Performance of Buildings Laws of 2006 to 2017 and the regulatory and administrative acts adopted on the basis thereof. The minimum energy performance requirements include requirements for existing buildings. The first decree on the minimum energy performance requirements, as adopted in 2007, provided for the mandatory energy upgrading only of buildings with a floor area of more than 1 000 m2 undergoing major renovation, as it required that the same level of thermal insulation should be installed on the building envelope elements as that required for a new building. The minimum requirements were amended in 2009, adding the requirement for issuing energy performance certificates with a minimum class B for buildings with a floor area of more than 1 000 m2 undergoing major renovation. A new decree was adopted in December 2013, reducing the U-values by 15 % both for buildings with a floor area of more than 1 000 m2 undergoing major renovation and for the building elements that are installed subsequently or are replaced irrespective of the size of the building. As of 1 January 2017, all buildings undergoing major renovation must be classified under energy efficiency class B. If the energy upgrading to that minimum level is not technically and/or financially feasible, a study should be prepared to explain why.

Table 12: Minimum energy performance requirements for existing buildings

		Minimum energy performance requirements Decree of 2007 (RAA 568/2007) In force since 21/12/2007	**Minimum energy performance requirements Decree of 2009 (RAA 446/2009)** In force since 1/1/2010	**Minimum energy performance requirements Decree of 2013 (RAA 432/2013)** In force since 11/12/2013	**Minimum energy performance requirements Decree of 2016 (RAA 119/2016)** In force since 1/1/2017
Major renovation	**Walls and load-carrying structure**	0.85 W / m^2 K only for buildings with a floor area of more than 1 000 m2	0.85 W / m^2 K only for buildings with a floor area of more than 1 000 m2	0.72 W / m^2 K only for buildings with a floor area of more than 1 000 m2	-
	Ceiling and exposed floors	0.75 W / m^2 K only for buildings with a floor area of more than 1 000 m2	0.75 W / m^2 K only for buildings with a floor area of more than 1 000 m2	0.63 W / m^2 K only for buildings with a floor area of more than 1 000 m2	-
	Overlying floors in closed non-air conditioned spaces	2.0 W / m^2 K only for buildings with a floor area of more than 1 000 m2	2.0 W / m^2 K only for buildings with a floor area of more than 1 000 m2	2.0 W / m^2 K only for buildings with a floor area of more than 1 000 m2	-
	Frames	3.8 W / m^2 K	3.8 W / m^2 K only for buildings with a floor area of more than 1 000 m2	3.23 W / m^2 K only for buildings with a floor area of more than 1 000 m2	-
	Maximum shade factor for frames	-	-	0.63 only for buildings with a floor area of more than 1 000 m2	-
	Minimum energy efficiency class in the energy performance certificate	-	B only for buildings with a floor area of more than 1 000 m2	B only for buildings with a floor area of more than 1 000 m2	B for all buildings
Building elements that are replaced or installed	**Walls and load-carrying structure**	-	-	0.72 W / m^2 K for all buildings	0.4 W / m^2 K for all buildings
	Ceiling and exposed floors	-	-	0.63 W / m^2 K for all buildings	0.4 W / m^2 K for all buildings

subsequently	**Overlying floors in closed non-air conditioned spaces**	-	-	2.0 W / m^2 K only for buildings with a floor area of more than 1 000 m2	-
	Frames	-	-	3.23 W / m^2 K for all buildings	2.9 W / m^2 K for all buildings
	Maximum shade factor for frames	-	-	0.63 for all buildings	-
	Minimum energy efficiency class in the energy performance certificate	-	-	-	-

Under the law, to sell and rent buildings and building units, an energy performance certificate is required and a copy thereof must be provided to the new tenant or buyer. Also, the energy efficiency class of a building must be indicated in commercial advertisements when the building is offered for renting or sale. Energy performance certificates have been issued to date for approximately 34 thousand buildings and building units. However, the issuance of energy performance certificates for the purposes of sale or renting is low. This can be attributed to the following reasons:

i. no legislation in force to associate the energy performance certificate with the deed of sale or rental;
ii. no information on the energy performance certificate provided to would-be buyers or tenants of buildings;
iii. would-be buyers or tenants of buildings, owners and real estate professionals find it difficult to 'translate' the data shown on the energy performance certificate into building operating costs;
iv. relatively low value added to the selling or rental price that the building owner can secure due to its high energy efficiency rating.

The above obstacles have not allowed the energy performance certificate to gain full momentum as an indicator that affects the value of properties and, ultimately, fostering the energy upgrading of existing buildings. The situation has improved since 2015, primarily due to associating financing incentives with the issuance of an energy performance certificate, such as in the case of the 'Save & Upgrade' programme, and secondarily due to a step-up in controlling compliance with the legislation and imposing administrative fines on the part of the Ministry of Energy, Commerce, Industry and Tourism. For example, 27 % of all the energy performance certificates issued in 2015 related to existing buildings, as opposed to 7 % in previous years.

The gradual deep renovation of existing buildings and the enhancement of energy efficiency tends to cut down on operating costs in the following years. There is an additional incentive for implementing energy-saving measures in buildings offered for sale or renting, as this can make them stand out in the real estate market and give them a comparative advantage. Issuing an energy performance certificate is a reliable way to evidence the energy upgrade. The economic crisis that affected the real estate market was added to the problems referred to above in respect of getting the energy performance certificate established among consumers. The large number of available buildings and the drop in family income has encouraged the market to focus on reducing selling and rental prices, while ignoring operating costs. The emerging change in the economic environment and the creation of a more competitive market in terms of property sales and rentals are expected to increase the importance of energy efficiency.

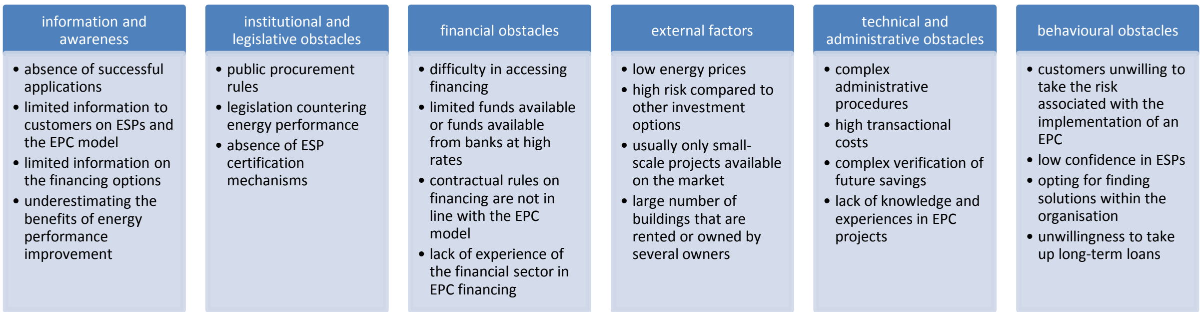
The mandatory periodic inspection of air conditioning and heating systems is yet another measure that can contribute towards the energy upgrading of existing buildings. Inspection is mandatory for heating systems with a boiler with a rated output of more than 20kW and air conditioning systems with a rated output of more than 12kW, or in buildings with an aggregate rated output of more than 50kW. Inspection is carried out by air conditioning system inspectors or heating system inspectors, as the case may be. Inspection aims to detect problems relating to the dimensioning, maintenance and functioning of the system that tend to waste energy, and make technical and economic recommendations for energy savings. These recommendations are recorded in the inspection report delivered by the inspector to the building tenant.

A provision was adopted in 2015 and 2013, respectively, for the periodic checking, adjustment and functioning of these systems, as a complement to the inspection of air conditioning and heating systems. Two guides that have been issued for each system describe the works and controls to be carried out by the technical staff. Also, to further enhance the energy efficiency of technical systems installed or upgraded in existing buildings, energy performance requirements were adopted in 2016 by the Energy Service both for these systems and their individual components. The requirements relate, in addition to air conditioning and heating systems, to hot water and large ventilation systems insofar as this is technically, functionally and financially feasible.

Energy auditing of buildings, as carried out by authorised energy auditors, offers a more holistic approach than that offered by the three other independent experts in the field of the energy performance of buildings (qualified experts, air-conditioning system inspectors and heating system inspectors), as it must be based on updated and measurable operating data regarding energy consumption in the building and must include a detailed overview of the characteristics of that consumption. The training and authorisation of energy auditors started in the second half of 2013. Periodic energy audits are mandatory for large undertakings, as an energy audit must be carried out by 5 December 2015 and must be repeated every four years thereafter. The regulations on energy service providers (ESPs) were adopted in April 2014, to increase confidence in energy audits among stakeholders, as well as in the alternative ways of financing energy-saving measures resulting from energy audits, by means of energy performance contracting (EPC). To date, there are 60 energy auditors for buildings and 24 ESPs.

The level of activity of energy auditors and ESPs is very low. This may be due to a lack of confidence on the part of end users in the process and to a lack of know-how and experience on the part of ESPs. Moreover, the relatively small size of the market, the high interest rates, the lack of access to financing, under the current financial conditions in particular, are also important factors that prevent the market from growing. Graph 15 summarises the general obstacles relating to the energy services market. These are broken down into the following themes: information and awareness, institutional and legislative obstacles, financial obstacles, market-related and external obstacles, technical and administrative obstacles, and behavioural obstacles.

Graph 15: Obstacles to the development of the energy services sector relating to the energy performance of buildings (Economidou, Report on the current status of the energy services market and proposals for mesaures to promote EPC in the public and private sector- JRC Technical Reports, 2016)



The technical ‘Report on the current status of the EPC market and proposal for measures that will promote EPC in the public and private sector’, as prepared by the JRC for the Ministry of Energy, Commerce, Industry and Tourism, has proposed a number of measures for the growth of the services market. The measures are summarised below:

i. strengthening the current legal and institutional framework, such as by removing obstacles to public procurement and making the recording of energy consumption in public buildings mandatory;

ii. promoting training and information by creating standard EPC forms and setting up an information platform for ESPs;

iii. improving access to financing by creating new financing products.

As regards energy consumption measurement, the energy savings officers are currently an important source of information on the energy efficiency rating of government buildings through the annual reports they prepare (see more information on energy savings officers in par. 4.5). To ensure more accurate energy consumption measurements, the Department of Electrical and Mechanical Services has installed smart meters in buildings in which EPCs will be implemented and is making plans for the installation of smart meters in another one hundred public buildings. Moreover, the Department of Electrical and Mechanical Services is making plans, through the structural programmes, for installing energy management systems in 15 buildings and interconnecting them centrally with a view to monitoring, adjusting and controlling the operating parameters of electrical and mechanical equipment.

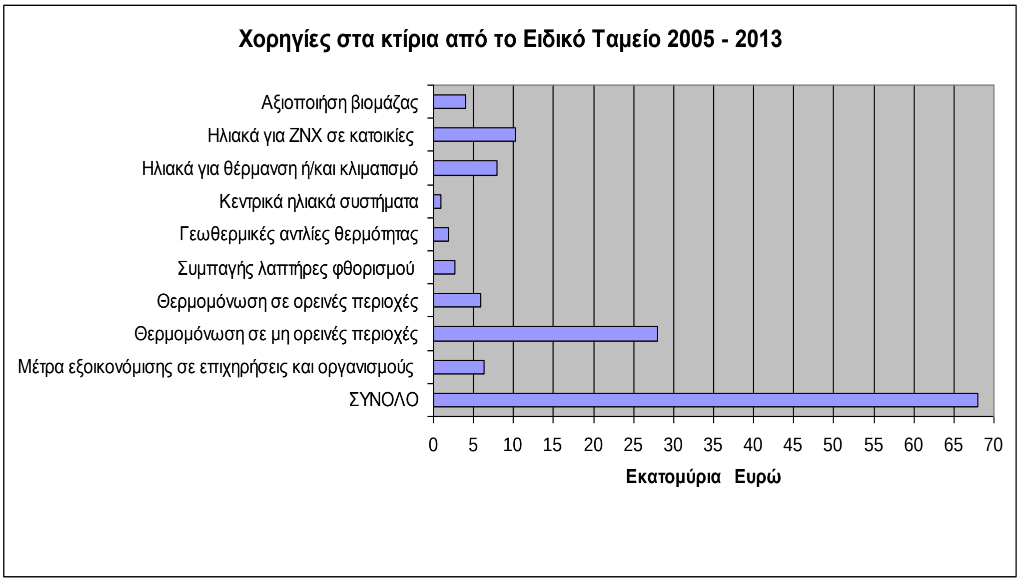
To further enhance energy efficiency in companies, and private and public organisations, the Energy Service of the Ministry of Energy, Commerce, Industry and Tourism is promoting the institution of ‘energy manager’. A decree adopted in 2016 has defined the training and duties of energy mangers. An energy manager’s duties include, among other things, proposing actions and making recommendations to an organisation’s management for reducing energy consumption. This helps promote increased energy efficiency on a voluntary basis through a company’s, organisation’s or government authority’s own procedures too.

The penetration of RES systems is also part of the upgrading of existing buildings. To promote the use of renewable energy, a certification system has been established for installers of small-scale RES systems carrying out the installation and/or maintenance of small-scale biomass boilers and heaters and/or photovoltaic and solar thermal systems and/or shallow geothermal systems and heat pumps. To date, a training provider for photovoltaic system installers and another one for installers of small-scale biomass boilers and heaters have been authorised. In addition to that, the Energy Service has, following consultation with the stakeholders, prepared draft regulations setting out the qualifications and obligations of installers of heating, air conditioning, major ventilation and hot water production systems.

4.2 Incentives

The aid schemes of the Special Fund for RES and ES were put in place from February 2004 to the end of 2013 and a total or €100 million was granted for investments implemented by natural and legal persons and public sector bodies engaging in economic activity. An estimated €67 million was granted as an economic incentive for the implementation of RES and ES measures in buildings, such as thermal insulation, door and window frames, energy efficient lighting, heat recovery, automation and RES systems in air conditioning and heating. Graph 9 shows a breakdown of the aid granted by the Fund to date[2]. The Fund derives its income from imposing an energy fee per kWh of electricity consumed on all final consumers.

Graph 16: Aid granted by the Special Fund for RES and ES per type of measure implemented



Aid granted to buildings by the Special Fund from 2005 to 2013

Utilising biomass

Solar water heaters for hot water in homes

Solar water heaters for heating and/or air conditioning

Central solar systems

Geothermal heat pumps

[2] The aid granted for the installation of photovoltaic systems in buildings is not included

Compact fluorescent lamps

Thermal insulation in mountainous areas

Thermal insulation in non-mountainous areas

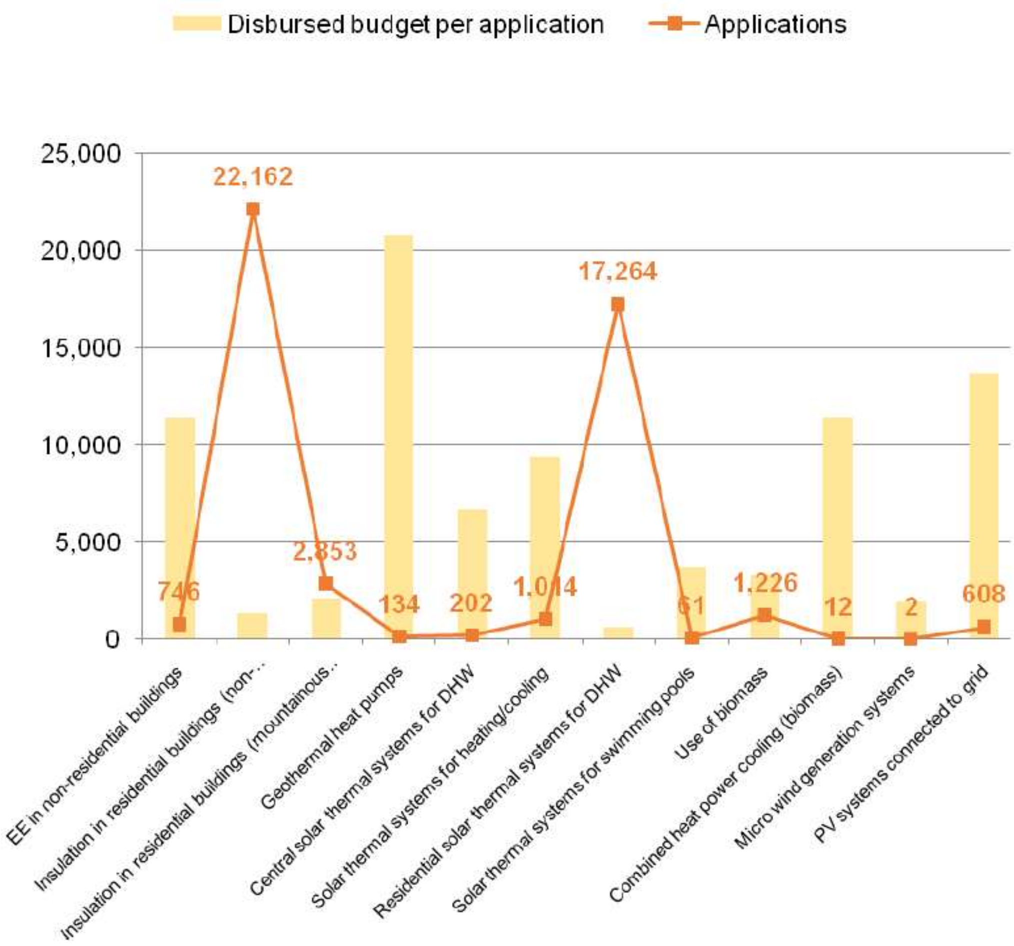
Energy-savings measures in undertakings and organisations

TOTAL

EUR million

Since the minimum energy performance requirements were put in force in 2008, the Fund kept subsidising energy-saving measures only for existing buildings and RES systems intended for heating and cooling in new and existing buildings. The energy savings to be included in the lifecycle of the buildings through the implementation of measures financed by the Special Fund are estimated to reach 1 million tons of oil equivalent (TOE).

Graph 17: Aid granted by the Special Fund for RES and ES in the building sector per number of applications and amount of grant (Economidou, Financing energy efficiency in buildings in Cyprus - JRC Technical Report, 2016)



Upon discontinuation of the aid schemes for the implementation of energy-saving measures in buildings through the Special Fund for RES and ES in 2013, a new aid scheme was put in place in 2014 to encourage households and small and medium-sized enterprises (SMEs) to adopt energy efficiency and renewable energy measures. The 'Save & Upgrade' programme finances major renovation of homes and buildings owned or used by SMEs, which had requested a building permit before 21 December 2007, i.e. before the entry into force of the initial minimum energy performance requirements. The programme has a budget of €15.3 million for the period 2014-2020 for SMEs and €16.5 million for households and is co-financed by the European Regional Development Fund (ERDF) for SMEs or by the Union's Cohesion Fund (CF) for households.

As opposed to the previous aid scheme for individual intervention measures, the new scheme provides financial support for a set of measures aimed to upgrade the building to a minimum increased energy efficiency level. This minimum level means that a building should, after the measures are implemented, be classified under class B in the energy performance certificate or should have achieved a 40 % reduction in primary energy consumption in accordance with the energy performance certificate. Higher aid is granted for buildings that are renovated into nearly zero-energy buildings (NZEBs). Higher aid is granted to vulnerable consumers wishing to upgrade to energy efficiency class B or to achieve a 40 % reduction in primary energy consumption, and they are also entitled to individual aid measures, such as thermal insulation on the roof and changing door and window frames. An estimated 1 138 homes and 164 SME buildings will undergo energy upgrading as of the 1st call issued in the context of the 'Save & Upgrade' programme. On the basis of the assessment of results to be made by the Directorate-General for European Programmes, Coordination and Development, the plan will be revised and a 2nd call will follow.

Another incentive is Order No 1 of 2014, as issued by the Minister for Interior on the basis of the Town and Country Planning Law. In accordance with the Order, in the case of new buildings and buildings undergoing renovation, it is possible to increase the building rate by 5% for energy class A buildings, and at least 25% of their total energy needs will be covered from renewable energy sources, i.e. at least two of the criteria laid down for NZEBs must be met.

The installation of photovoltaic systems in buildings started in 2005 with aid granted by the Special Fund against the installation cost and the energy generated. Reduced photovoltaic prices and increased electricity tariffs have turned the development model for these systems to methods associating production with consumption, which is expected to foster also the installation of smart meters and power accumulators. The 'Solar energy for all' programme started in 2013, aiming to promote photovoltaic installations for meeting own electricity needs. Up until the end of 2015, it was possible to install a photovoltaic system only in homes with a maximum capacity of 3kW. In December 2015, the programme was revised to include all types of buildings and to increase the maximum permissible capacity of the photovoltaic system to 5kW. Where these systems are installed, the electricity consumed by the building is offset against that generated by the photovoltaic system (net metering). It is also possible to install larger photovoltaic systems (10kW to 10MW), in which case offsetting takes place every 20 minutes. To date, more than 11 000 photovoltaic systems have been installed in buildings using the net metering method, and the aim is to have another 70MW installed by 2020, which corresponds to 15 000 buildings.

The current financial support policy for improving the energy performance of existing buildings largely depends on State subsidisation for households, undertakings and the public sector. Please note that certain deficiencies in the previous aid scheme of the Special Fund for RES and ES are addressed in the 'Save & Upgrade' programme. For example, the 'Save & Upgrade' programme provides for major renovation financing, meaning that the buildings falling under the current scheme are not at risk of 'blocking' the entire energy-saving potential of the building. Furthermore, the provision for participation of the qualified experts and energy auditors in the scheme boosts the market in the energy efficiency and promotes a holistic and cost-effective approach when measures are chosen for intervention in each building (Economidou, Financing energy efficiency in buildings in Cyprus - JRC Technical Report, 2016).

Table 13: Average investment and average aid granted in the context of the 'Save & Upgrade' programme for homes (Economidou, Financing energy efficiency in buildings in Cyprus - JRC Technical Report, 2016)

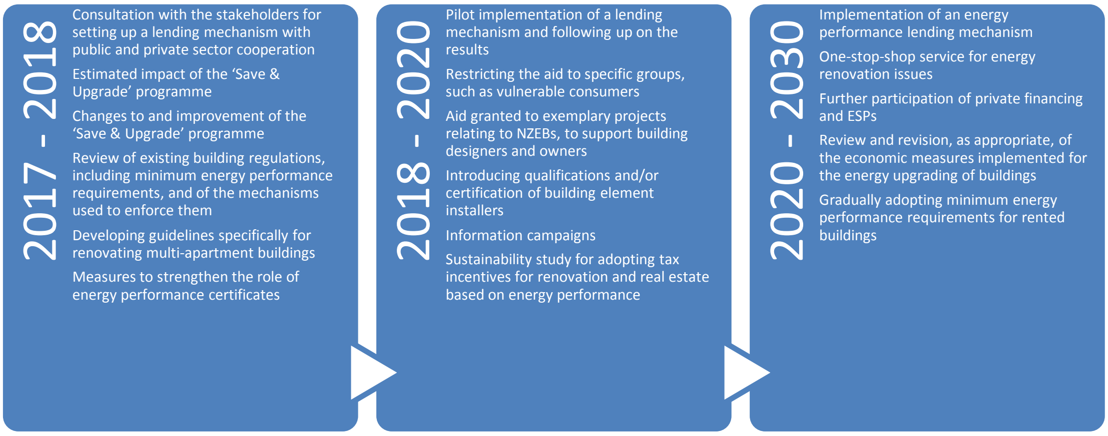
Type of energy	Average	Average aid (€)

upgrading	investment (€)	
NZEBs	39 633	21 800
Energy efficiency class B	23 773	9 595
At least 40 % energy savings	20 857	8 505
Individual measures	4 081	1 887

However, ensuring maximum investment requires a higher share of private financing and solutions that are based on market mechanisms. Therefore, energy upgrading projects must meet the different criteria that are mandatory for financing from the financial sector, and the banking sector must also become acquainted with the concept of energy upgrading of existing buildings. The technical report entitled ‘Financing energy efficiency in buildings in Cyprus’, as prepared by the JRC for the Ministry of Energy, Commerce, Industry and Tourism provides an analysis of the existing incentives and an assessment of their cost and energy effectiveness, also proposing a roadmap for a transition to financing measures that are more based on market mechanisms. Greater mobilisation of private capital is very important, in accordance with the report, and proposals for improving the situation are being made. This parameter will be reconsidered in the impending restructuring of the ‘Save & Upgrade’ programme in view of the 2nd call to be issued.

Events were also organised, where commercial banks were informed of matters relating to the energy performance of buildings, both by the Energy Service of the Ministry of Energy, Commerce, Industry and Tourism and by professionals in the field. The aim is to intensify these contacts and the exchange of views in order to find solutions satisfying all stakeholders, including building owners.

Graph 18: Measures considered for enhancing financing incentives by 2030 (Economidou, Financing energy efficiency in buildings in Cyprus - JRC Technical Report, 2016)



4.3 Training measures

The training of all professionals involved in the energy performance of buildings, in the energy upgrading of existing buildings in particular, is a fundamental measure for fostering investments in this sector. Professionals engaging primarily in the design of buildings and of technical building systems, including RES systems, and the persons responsible for the installation of building elements that affect energy performance are the most important players.

Designating qualified experts as the parties responsible for calculating the energy efficiency rating of buildings and issuing energy performance certificates and making recommendations in 2009 was an opportunity for providing architects as well as civil, mechanical and electrical engineers with training on the energy performance of buildings. Despite the absence of any provision on training in the qualifications for qualified experts, the Energy Service organised dozens of training seminars to prepare the parties concerned for the relevant examination. The seminars intended for qualified experts concerning homes lasted for 16 hours and covered topics relating to legislation, energy efficiency calculation and cost-optimal measures for improving the energy performance of buildings. In the period 2009-2013, a total of 1 074 persons attended these seminars, only 220 of them being qualified experts, which shows that a large number of engineers and architects used them for purely educational purposes. Building energy inspectors must necessarily attend and successfully complete, following an examination, an 80-hour long theoretical and practical training session. Training sessions are conducted by organisations authorised by the Energy Service. These organisations include a partnership between the University of Cyprus and the Cyprus Energy Agency, as well as the Frederick University. The training provided to engineers and architects is enhanced by numerous laboratories, workshops and discourses organised by universities, the Cyprus Scientific and Technical Chamber (ETEK), professional associations and other organisations focusing on buildings and energy.

The training sessions are necessary for setting up a critical pool of professionals to foster the energy performance of buildings, also taking into account that many technical university schools attended by today's engineers did not include the energy performance of buildings in their curricula. Universities in Cyprus have taken important steps towards including this knowledge in their curricula, to better prepare new scientists intended to work in the construction industry. Some typical examples include the course 'Energy resources and energy performance of buildings' offered to undergraduate students of engineering at the Cyprus University of Technology and the MSc in 'Energy systems and the Built Environment' offered by the School of Engineering and Applied Sciences of the Fredrick University. However, academic programmes and training sessions focusing on the energy upgrading of existing buildings are rarely offered. The effort made by the Energy Service of the Ministry of Energy, Commerce, Industry and Tourism, through its cooperation with universities, aims to offer better training opportunities at an academic and professional level concerning the energy upgrading of existing buildings, including technical, environmental and economic parameters, in the years to come.

As regards building element installers, professional education and training is provided to them through initial and ongoing training programmes. The average technical and professional training provided by technical schools also includes branches directly associated with the energy performance of buildings, such as mechanical engineering, electrical engineering and construction. The training courses that are related to the energy performance of buildings have followed a slightly upward trend in recent years, while the ratios of graduates engaging in related professional activities have also been on the rise. However, the ratio of enrolments in secondary and technical vocational training is still one of the lowest ones in the European Union (Build up skills Cyprus, 2012).

Training for the construction industry is also provided to technical staff by the apprenticeship system, the new modern apprenticeship system and the post-secondary institutes for technical and vocational education and training (MIEEKs). The apprenticeship system is a two-year programme offered to young people who have not successfully completed secondary education and wish to be employed in technical occupations. The occupations for which the apprenticeship system provides training are specified each year in accordance with the number of classrooms and trainers available. The new modern apprenticeship system, which has been fully implemented since 2015, aims to address the needs of the economy by increasing the number of qualified workers. The MIEEKs, which were put in operation in 2012, offer a one- or two-year initial training programme for young people wishing to acquire or improve or upgrade their professional skills. The occupations for which training is provided by the MIEEKs also include some relating to the energy performance of buildings, such as home automation technician and photovoltaic installation and maintenance technician. Also, the Human Resource Development Authority of Cyprus offers short initial training programmes, for 21 to 25 weeks, including theoretical and practical training through the training establishment for occupations in which there is a significant shortage in the labour market. These programmes give priority to the long-term unemployed. These programmes include training for construction workers, plumbers, aluminium frame technicians and electrical installers.

Ongoing education and training is offered to building elements installers through the evening and night departments of technical schools. Adult professionals are given a chance to attend one-year programmes leading to the acquisition of a certificate of competence, or three-year long programmes leading to the acquisition of a certificate equivalent to that offered by technical schools. Also, public and private training organisations offer a number of specialised training programmes for technicians in the building sector. These programmes are authorised and financed by the Human Resource Development Authority of Cyprus, and the participants are given a certificate of attendance.

According to the roadmap developed in the context of the ‘Build up skills – Pillar I’ initiative, there is a need to provide ‘green’ training to at least 4 500 workers for 13 different skills until 2020, to achieve the national targets for the energy performance of buildings. Following ‘Build Up Skills - Pillar I’, the bodies responsible for the implementation of the project ‘WE-Qualify: Improve skills and qualifications in the building workforce relating to the energy performance of buildings’, taking into account the ‘roadmap’, completed the integrated planning and trial implementation of five training courses for three different skills: (i) installation of thermal insulation, (ii) installation of frames and sunlight protection systems, and (iii) installation of biomass boilers and heaters. The main objective of the WE-Qualify project was to assist the construction sector in Cyprus to address the lack of skills among the workforce in relation to the construction of energy-efficient buildings, as well as to contribute towards the attainment of the targets for promoting renewable energy technologies.

The most significant obstacles to the quantitative and qualitative improvement of installers and the methods used to address them are listed below:

i. Absence of regulation of technical occupations: Until recently, the only regulated technical occupations in the building sector were those of electrical installer and cooling technician. The regulations already in force for installers of small-scale RES systems and the promotion of regulations for installers of heating, air conditioning and hot water systems referred to in par. 4.1 are expected to tackle the issue of insufficient regulation. The standard professional qualifications established by the Human Resource Development Authority of Cyprus for the construction industry are helpful in this respect. The standard professional qualifications lay down the skills and knowledge that installers must have. Examinations are held to grant professional qualification certification to those wishing to take such an examination. Please note that the standard professional qualifications also cover installers of thermal insulation and door and window frames, for which there is no legislative regulation at all.

ii. Financing: The companies active in the construction industry have been seriously affected by the ongoing economic crisis, thus being unable to spend any resources on training. There have been considerable layoffs in the industry, thus creating a climate of employment uncertainty that makes any effort for improvement and/or acquisition of knowledge and skills untimely. Moreover, a number of installers are self-employed and do not pay contributions to the Human Resource Development Fund, thus not being entitled to financing for the vocational training seminars authorised by the Human Resource Development Authority of Cyprus. One of the measures adopted by the Ministry of Labour and Social Insurance in cooperation with the Human Resource Development Authority of Cyprus to address the situation consists in implementing a number of programmes financed with Community and national funds. These programmes aim to provide the unemployed with training through short programmes or through temporary employment with employers participating in the programme, in economic sectors which appear to be in need of qualified staff.

iii. Infrastructure for vocational education and training, and trainers: Trainers and training facilities must be in line with the technological advancements in respect of the energy performance of buildings and market demands. Trainers must keep increasing their knowledge of new technologies, and nobody knows how many trainers have specialised building renovation knowledge and to what extent. In certain cases, the laboratory infrastructure of public and private sector training bodies is outdated and needs to be assessed and upgraded as appropriate. This problem was partly addressed by the implementation of the ‘WE-Qualify’ project, as its deliverables include training materials and guides for installer trainers.

Also, the implementation of pilot training programmes has helped upgrade the laboratory infrastructure of participating bodies.

4. 4.Information measures

The energy status of buildings concerns all people in Cyprus, as they all use buildings either for residential purposes or as workplaces or to provide and receive services. The general public's knowledge of issues relating to the energy performance of buildings appears to be improving in the course of time by the implementation of financing incentives and legislative measures, whereas the dramatic increase in energy prices has been pivotal in that improvement. However, many people are unaware of the energy consumption level of their building and of the resulting costs. Even where these facts are known, it is still hard to assess, let alone to detect, the cause of the irrational waste of energy, in order to determine the optimal solutions to the problem.

An energy performance certificate aims to inform the parties concerned of the energy efficiency rating of their building. However, issuing that certificate is mandatory only when buildings are constructed, sold or rented. Thus, a large part of the building stock – e.g. homes, which are mostly privately owned – is excluded. Also, although it is mandatory to produce an energy performance certificate when a building is sold or rented, many would-be buyers and tenants are unaware of this requirement, thus obtaining it only following completion of the sale and purchase agreement or not obtaining it at all. The Ministry of Energy, Commerce, Industry and Tourism organises information campaigns on the energy performance certificate. It has been recognised, though, that the relevant effort must be ongoing and intensified, as it takes time for the general public to become acquainted with the fact that producing an energy performance certificate is necessary and advantageous when selling or renting property. The provision of information on the energy performance certificate must include all the parties involved, i.e. building owners, tenants, would-be buyers, real estate agents and property evaluators. Experience from previous years has shown that the information efforts should focus particularly on would-be buyers and tenants as, of all the parties involved, they are the ones to bear the energy costs, and the energy performance certificate is the only reliable source of information for them.

Moreover, the Energy Service has issued dozens of information leaflets for the general public, both in hard copy and electronic format, concerning the energy performance certificates, energy audits, NZEBs and other important topics relating to the energy performance of buildings. To ensure more effective communication with the public, the Energy Service has used social media, and a new website is currently under construction. It also organises and participates in one-day information workshops.

In recognition of the fact that more can be done in terms of providing information, the Ministry of Energy, Commerce, Industry and Tourism has secured technical assistance from the Gesellschaft für Internationale Zusammenarbeit (GIZ) for planning an energy performance information campaign. The aim is to provide appropriate and timely information, adapted to each specific target group, such as households, undertakings, local authorities, etc. The results of the study will be used as a criterion for the information measures to be implemented afterwards.

A measure that is expected to increase the energy consumption information available to building occupants (tenants and owners) is promoting smart meters. The Electricity Authority of Cyprus (EAC), i.e. the sole electricity provider in Cyprus, promotes the installation of such meters, also including in the invoices issued to consumers such information as a comparison of the amount of electricity consumed in the same period last year and energy-saving tips.

Information on energy consumption and the resulting costs is undoubtedly a first step for encouraging building owners to take energy-saving measures. A second step is to identify the technical solutions that are cost-optimal. Chapter 3 gives some examples, but each building has its own specific characteristics and needs to be examined separately. Due to lack of information, building owners often turn for solutions to suppliers of energy-saving materials and technologies and RES systems. However, it is hard for these suppliers to be objective, given their capacity. The problem is worse in existing buildings in which individual measures are implemented, usually without obtaining the services of a consultant/design engineer. An energy auditor aims to fill this gap by giving an independent and substantiated opinion to the building owner.

Qualified experts also play the same role by issuing energy performance certificates and making recommendations for existing buildings, without, however, requiring the same extent of analysis, which may allow for easier adjustment in the event of limited funds. As regards air conditioning and heating systems the inspectors serve as independent experts giving advice.

In the case of buildings used as business premises, the persons employed therein need to be informed in order to use energy rationally and to be more receptive to the implementation of energy efficiency measures. This is fostered in the public sector through the appointment by the management of an employee as energy savings officer, i.e. the person responsible for promoting energy efficiency in the building in which he is employed. The Ministry of Energy, Commerce, Industry and Tourism provides energy savings officers with information and guidance, as well as information material for distribution among their colleagues. A similar measure is implemented in local authorities and private companies. The measure is expected to be further strengthened by the establishment of energy managers. Information measures at the workplace have a multiplying effect, as the knowledge obtained by employees is transferred to their homes, and they become information hubs in their environment.

4. 5 Exemplary role of the public sector

In accordance with Article 5 of Directive 2012/27/EU on energy efficiency, each Member State shall ensure that, as of 1st January 2014, 3 % of the total floor area of the buildings owned and occupied by its central government is renovated each year to meet at least the minimum energy performance requirements. Member States may opt for an alternative approach to the requirement to have 3 % of the total floor area of the buildings owned and occupied by its central government renovated each year, whereby they take other cost-effective energy-saving measures in selected privately-owned public buildings (including deep renovations and measures for behavioural change of occupants) to achieve, by 2020, an amount of energy savings that is at least equivalent. Cyprus has opted for the alternative approach, as it allows for more flexibility in implementing cost-optimal energy-saving measures as appropriate. The measures planned for buildings used by the central government are recorded in a relevant report.

Energy upgrade works have started since 2013 in buildings owned and used by the central government under the ‘ENERGEIN’ project. The project included the major renovation of two buildings and the implementation of individual energy-saving and renewable energy measures in another two buildings.

By virtue of the Decision of the Council of Ministers of 14 April 2016, a Committee was set up for upgrading the energy performance of buildings used by central government authorities, comprising representatives of the Department of Public Works, the Department of Electrical and Mechanical Services, the Directorate of Control of the Ministry of Transport, Communications and Works and the Energy Service of the Ministry of Energy, Commerce, Industry and Tourism. The relevant working group has been appointed to schedule the energy-saving measures based on the relevant technical data and the funds available. The working group also looks into the different financing methods. Financing of €16 million has already been secured from the European and Structural Funds for the period 2014-2020 with a view to implementing energy upgrading projects in buildings owned and used by the central public administration. Also, the Department of Electrical and Mechanical Services has prepared standard energy performance contracting (EPC) forms for implementing energy-saving measures in privately-owned public buildings. These forms can be adjusted in each case and are also expected to trigger the interest of energy service providers (ESPs). The committee should prepare an annual report to inform the Minister for Transport, Communications and Works and the Minister for Energy, Commerce, Industry and Tourism on the progress made in achieving the national target for energy savings in public buildings.

The Cypriot State acting as tenant of buildings has an opportunity to give an example by applying Article 6 of Directive 2012/27/EU on energy efficiency, as it has to rent only buildings that conform at least to the minimum energy performance requirements. If central government authorities decide to rent a non-high energy efficiency performance building, this must be justified by them in terms of cost-effectiveness, economical feasibility, wider sustainability and technical suitability.

Local authorities in Cyprus have taken the lead by stressing the role of local authorities in new technological challenges and environmental issues, such as addressing climate change and adapting to its impact. With support from the Cyprus Energy Agency, local authorities have endorsed the Covenant of Mayors or the Covenant of Islands, or have been accredited by the 'European Energy Prize'. The key obligations under these initiatives include the development of local sustainable energy action plans, with a view to reducing carbon dioxide emissions by more than 20 % by 2020. The action plans include, among other things, actions for improving the energy efficiency of buildings used by local authorities as well as actions for promoting measures relating to the energy upgrading of existing buildings or the construction of new ones with a high energy efficiency rating in the residential and tertiary sectors, to contribute towards energy savings. To date, 23 sustainable energy action plans have been prepared by the Cyprus Energy Agency and approved by the Secretariat of the Covenant of Mayors in Brussels for local authorities in Cyprus.

Several local authorities have expressed an interest in extending their action up until 2030, with more ambitious targets for reducing carbon dioxide emissions by more than 40 %. They are also ready to make a commitment for studying their vulnerability to the impact of climate change and implement measures for adapting to it. They are also joining forces with other insular local authorities in Europe, in support of the 'Smart Islands' initiative, which aims to stress the specificities of insular areas and mobilise targeted financing for RES, energy efficiency and sustainable transport projects on the islands.

A total of 23 sustainable energy action plans are estimated to ensure a reduction of approximately 600 000 tons of carbon dioxide (35 % lower emissions compared to 2009, i.e. the reference year), an increase in the amount of RES energy to 90 000 MWh/year, as well as energy savings of more than 2 000 000 MWh/year by 2020.

As a matter of fact, local authorities have difficulties in implementing, or securing funds for, actions intended for residential and tertiary sector buildings. This is due to their limited energy-related powers, as such issues are regulated mostly at a central government level. However, the municipalities and communities which have undertaken binding targets may adopt incentives and measures for significantly increasing mobilisation of energy investments within their boundaries, such as faster authorisation procedures, reduced real estate duties and taxes, or even setting up local energy upgrade support plans.

Consideration could also be given to setting up a feedback fund to support such investments, which could be funded from the savings resulting from the implementation of sustainable energy action plans, from grants, even from a fee imposed on the people living and undertakings operating in the municipality concerned. Naturally, each local authority should look into the measures in accordance with the financial, human and other resources at its disposal. The implementation of certain measures and incentives may also contradict the legislative framework on the functioning of local authorities, whereupon amendment to legislation or alternatives should be considered.

4. 6 Breakdown of incentives for the energy upgrading of buildings rented or owned by several owners

As regards a certain percentage of the building stock, the parties involved are discouraged from making energy performance investments as all or part of the resulting benefits will not be enjoyed by the party bearing the initial investment costs. Buildings usually have this problem when (Economidou, Split incentive and energy efficiency in Cyprus , 2016):

I. The final energy user bears energy costs, but cannot decide to implement energy efficiency improvement measures, e.g. in rented homes and commercial premises.

II. The final energy user does not bear the energy costs, and therefore has no economic incentive to reduce consumption, e.g. hotel guests.

III. There are several owners or tenants and it is necessary to obtain consent from all of them to implement energy upgrading measures, e.g. in multi-apartment buildings.

IV. The building's uses and/or users keep changing either due to its type or due to its location, such as stores on commercial roads whose tenants change often or homes that are rented out on a temporary basis. In these cases, the duration of the use of the building is not long enough or is uncertain, thus not securing the pay-off of the initial capital expenditure.

Approximately 60 % of all homes in Cyprus may fall under one of the above cases or a combination thereof. The tenants and/or owners of apartments are a category representing a large percentage of the building stock and are very likely to face these challenges. This is mainly due to:

I. the different levels of understanding of the benefits of energy efficiency between joint owners;

II. the different incentives and priorities between joint owners;

III. the different levels of credit rating and income between joint owners;

IV. organisational issues associated with the collective decision-making process.

Rented homes represent 24 % of all homes. The implementation of energy upgrading measures in these homes may be prevented by the fact that the investment cost borne by the building owner results in benefits for the tenant alone. There is a similar problem with tertiary sector buildings. Despite the data from the commercial sector being insufficient, we do know that the renting of buildings as offices, points of sales of products and dining facilities constitutes a widespread practice in Cyprus.

Table 14: Ratio of homes that are used by their owners or rented out **(Economidou, Split incentive and energy efficiency in Cyprus , 2016)**

	Used by owners	Rented out	Other
Single-family houses	35.9 %	6.9 %	2.9 %
Apartments, two-family houses, mixed use buildings	33.1 %	17.5 %	3.7 %
Other types of	0 %	0.1 %	0 %

houses			

The technical report entitled ‘Split incentives and energy efficiency in Cyprus’, as prepared by the JRC for the Ministry of Energy, Commerce, Industry and Tourism, provides an analysis of the roadblocks to the energy upgrading of buildings due to the current structure of the real estate market. To overcome the roadblocks, the technical report cites examples of successful policies and measures implemented in other countries, as well as proposals for measures that can be implemented in Cyprus. The most important measures proposed are:

i. strengthening the application of the legislation on the issuance of energy performance certificates when buildings are rented;
ii. fostering the installation of energy meters in each apartment;
iii. fostering policies for simplifying the decision making process for buildings owned by several owners.

The 1st call issued in the context of the ‘Save & Upgrade’ programme attempted to give solutions to the obstacles that prevent the energy upgrading of buildings rented and those owned by several owners. Buildings that were rented could also be included in the plans. In the case of SMEs, the SME that was using the rented building or owned it and rented it out to another party was the applicant and beneficiary. In the case of homes, rented buildings could also be included, but the application could be filed only by the owner. Moreover, there was special provision made for including a multi-apartment building in the plan, whereby a management committee was the applicant and beneficiary of the aid. However, the number of such buildings in the ‘Save & Upgrade’ programme was limited.

In view of the above and with the involvement of the parties concerned, the incentives granted to owners of buildings that are rented and buildings owned by several owners, which are compatible with the social and financial situation in Cyprus, are reviewed.

4.7 Research in the field of the energy upgrading of existing buildings

Significant work has been carried out in recent years by universities and other research institutions in the field of the energy upgrading of existing buildings. The

Energy Service of the Ministry of Energy, Commerce, Industry and Tourism supports such initiatives, mainly by issuing opinions on the policy implemented by the Republic of Cyprus in the energy sector, as well as on the dissemination of the results. Moreover, the results of these projects are also used as feedback to improve the existing arrangements and incentives relating to the energy upgrading of existing buildings. Following are some of these research projects, while we should also stress that other research programmes relating to the energy performance of buildings in general are being, or have been, implemented. Efforts to secure research programmes are still being made by stakeholder organisations, and additional research projects may be implemented by 2020.

The European research project 'Energy Performance Indicator Tracking Schemes for the Continuous Optimization of Refurbishment Processes in European Housing Stocks' (EPISCOPE) aims to consider the most effective methods for the energy upgrading of residential buildings, including scenarios for major renovation into NZEBs. Seventeen (17) Member States take part in the project, including Cyprus, its partner being the University of Cyprus.

The project 'Nearly Zero-Energy Sports Facilities – n0e Sport Facilities' aims to assess the current state of play in terms of energy in 18 sports facilities in the EU and to determine and implement innovative technological solutions for energy savings, aiming to save more than 50 % of the current energy consumption. As a result, the 'n0e sport facilities' project promotes the creation of nearly zero-energy sports facilities through the design and promotion of an integrated renovation package for sports facilities, including all the available energy-saving methods/measures and utilising renewable energy technologies. Three or four pilot sports facilities have been chosen in each country participating in the programme, to propose and implement energy efficiency improvement measures. The municipal swimming pool in Aglandjia, the sports facilities of the Chalkanoras Idaliou Club, the municipal swimming pool of Nicosia and the Sports Centre of Kition in Larnaca were chosen in Cyprus. The project is implemented in Cyprus by the Cyprus Energy Agency.

The Cyprus Institute is a partner in the QUALICHECK programme, aiming to review the credibility of the energy performance certificates issued and the quality of the construction works carried out. In nine countries, including Cyprus, there are certain issues reviewed and problems identified regarding the current procedures used to issue energy performance certificates and install such building elements as thermal insulation and passive cooling systems.

EUROFUND is a tool to be used to estimate the energy upgrading capacity of a building, just like a bank would assess the credit rating of a client. The tool will be based on a methodology to be developed on the basis of a number of energy performance parameters, such as the data included in the energy performance certificate, the number of available certified installers, the State aid schemes in force, etc. The programme is financed by the Horizon 2020 programme and is coordinated by the Cyprus University of Technology.

The Cyprus Energy Agency is a partner in the 'VIOLET' (preserVe tradItiOnal buiLdings through Energy reducTion) project, which is co-financed by the ERDF and has a duration of 5 years (2017-2021). More specifically, the project aims to foster and develop policies for strengthening the energy performance of traditional buildings, also including parallel actions for reducing carbon dioxide emissions and preserving their cultural heritage. VIOLET encourages the application of integrated design for the energy upgrading and protection of traditional buildings, with a view to making sure that they are properly restored and preserved, as they will remain financially viable for ongoing use at reduced energy operating costs. There are 6 partners in the project, from Romania, Germany, Spain, the Netherlands, France and Cyprus, with a total budget of 1.3 million.

The project 'ENERJ - Joint Actions for energy efficiency' supports local authorities in implementing energy efficiency actions in public buildings, as measures taken in the context of their local energy and climatic policy. It fosters cooperation between local authorities concerning joint actions for energy savings. The ENERJ platform facilitates the planning of joint actions and hosts a database for local action plans concerning energy and energy-saving measures. The project is co-financed by the ERDF through the Interreg MED programme and has a duration of 30 months (completion date: 31 April 2019). There are 10 partners in the project from Mediterranean countries. The Cypriot partner is the Cyprus Energy Agency.

5. Prospects for investment decisions of individuals, of the construction industry and of financial institutions.

The rate of renovations and the level of energy savings attained by each upgrading project will depend on the funds invested in this field in the following years. Investments in the renovation of buildings, leading also to reduced energy consumption, are often prevented by the fact that people tend to focus on the initial capital expenditure, ignore the benefits and focus also on the long pay-off periods. Providing investors with timely and substantiated information is necessary to enable them to make decisions for implementing cost-effective renovation projects. The topics of cost-effective approaches to renovation, provision of information and broader benefits are detailed in other parts of this document. However, even if these obstacles are overcome, financing is still the greatest roadblock in most cases. Following are the current and potential investors in the field of the renovation of buildings, as well as their challenges and prospects:

i. Natural persons: The natural persons that use the buildings and have to pay the energy bills take a keen interest in reducing the amounts of energy they consume. The interest in savings is high in homes, where most of the occupants also own the buildings. The reduced income and the difficulty in obtaining loans, however, tend to prevent households from investing in energy-saving measures. The financing difficulties faced by natural persons to date were mitigated to a certain extent by the aid schemes. Alternatively, the owners of small buildings can upgrade them gradually through small-scale targeted interventions that will reduce the initial capital expenditure and achieve short pay-off periods. For example, where the lifecycle of a technical system ends and the system is replaced by another one with a much higher energy efficiency rating, the additional cost consists only in the difference in cost between the more efficient system and the conventional one. Even in gradual upgrading, however, basic financial and technical planning is required to ensure the maximum possible return even on the limited funds invested. Therefore, the owner must always obtain advice from an independent expert. Where the natural person does not have to bear the energy costs, e.g. where he rents out the building, the investment must translate in an increase in the value of the property. Investing in the energy upgrading of a building, if accompanied by proper promotion when renting it out, may ensure economic benefits for the owner. This can be very effective in types of properties and in geographical areas with increased competition. It should also be stressed that an energy efficient building that is rented out ensures reduced energy costs for its tenant, allowing the latter to pay the rent more easily when in dire straits. Households and SMEs facing financial difficulties always choose to pay the electricity bill instead of the rent, as the electricity will be cut off immediately if the bill is not paid, whereas evicting a tenant is difficult.

ii. Companies that own buildings: Buildings used as offices, hotels and private hospitals represent a significant asset for the company that owns them. By investing in energy-saving measures, a company can significantly reduce its operating costs and increase its profit. A common reason why such investments are not realised is that they have to compete against other proposals in a company's budget for investments that may ensure better return. To successfully implement energy-saving investments, it is important to present sufficient and substantiated data to the company's management. The process starts by gathering consumption data, which can be carried out by the organisation's technical department, and/or by appointing certain staff members as energy officers, similar to the energy savings officers appointed by the public sector. The energy status then needs to be assessed, to identify where interventions can be implemented to reduce energy consumption. This can be done either by using the methods available on the market, such as an energy audit and the issuance of an energy performance certificate, or on an in-house basis if possible. This will result in a list of proposed investments, along with their return, to provide the company's management with different options and enable them to set up a plan of energy interventions and savings. Investment in the energy upgrading of buildings can ensure added value to a company if integrated in its social corporate responsibility policy. Given the limited funds, companies have to choose what fields to invest in, just like the case is with other activities. Investing in the energy performance of a company's building will be accompanied by a high energy efficiency rating in the energy performance certificate or a different energy and environmental certification, which will make the company stand out as being environmentally and socially responsible, while at the same time improving the economic viability of the company itself. Corporate social responsibility actions which also add value to the company last longer and are more likely to succeed, as they are implemented by the organisation's executives more zealously and decisively.

iii. Companies active in the building and energy sectors: Construction companies represent the major industry that will implement major renovations in buildings. This requires, however, cooperation from a number of other types of undertakings, such as vendors of building materials and technical elements, producers of building materials and companies engaging in the installation of technical and RES systems. These companies could, by the use of own funds or through easier access to financing, cover the initial capital expenditure themselves, said expenditure being repaid gradually. This will enable companies in the sector to attract customers more easily, as they will relieve them of the effort needed to secure financing and will establish a climate of mutual trust. As easy access to funds is often determined by the size of a company, if a number of companies in the sector pool together, this will make such access easier, while at the same time favouring the development of synergies and know-how. The legislative arrangements for ESPs and EPC, as well as the 'Save & Upgrade' programme aim to create a favourable business environment for partnerships of different types of companies that are involved in the renovation of buildings. ESPs cannot solve the problem of financing, but can make a contribution towards solving it, as there are different ESP models, financing being very important for some of them or totally unimportant for others. Cypriot undertakings can learn from ESPs that have been active in the EU for years or even consider establishing partnerships with them.

iv. Financial institutions: Financial institutions were seriously affected by the economic crisis, thus cutting down on lending, which had a really negative impact on the construction industry. On the other hand, the reduction in the number of new constructions leads to greater interest in renovations. Building renovations lead to a significant drop in operating costs due to reduced energy consumption and can represent reliable investment for financial institutions. Apart from the typical usual banking practice used, a bank that has to make a decision on whether to grant a loan for an investment may, for major renovation, use the results of the energy audit and the energy performance certificate for its assessment. There are financial institutions granting loans on favourable terms for individual energy-saving and RES measures in buildings as well as major renovations. These products could be developed even more through partnerships with ESPs, energy auditors and other independent experts, to grant loans for cost-effective major renovations.

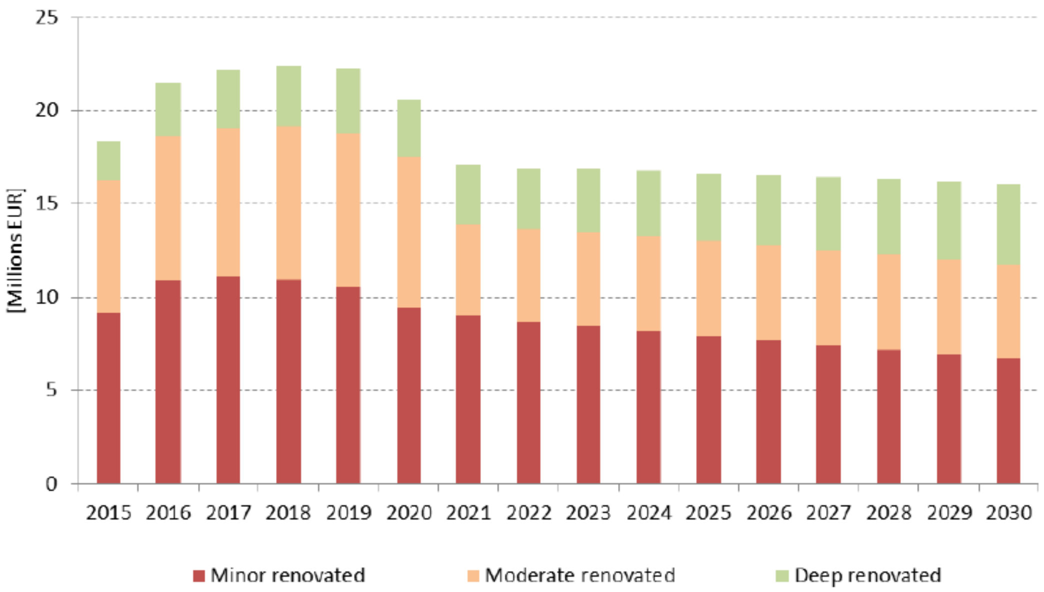
v. Private investment funds: Using investment funds in the field of the renovation of buildings is a promising option. As of the end of 2015, there were 205 Cypriot investment service providers in Cyprus (Cyprus Securities and Exchange Commission). Despite the challenges faced by the economy, the interest in the setup of such undertakings is still vivid. Also, Cyprus has managed to make a reputation as a country that attracts foreign investment funds, thus having accumulated valuable experience in different professional sectors, such as the financial sector, the legal consulting and auditing-accounting sector, whereas the setup of infrastructures for attracting foreign investments, such as CIPA, has helped. Professional groups, undertakings and organisations focusing primarily on utilising private investment funds have started to engage in the hydrocarbon and RES sectors in recent years. The field of building renovation and energy upgrading is almost untouched by large investment funds, and the prospects of such investments must be looked into, as regards large buildings and groups of buildings in particular.

vi. Public funds: Great effort has been made in recent years to reduce budgetary spending, thus leading to a lack of funds available for financing the energy upgrading of buildings. The energy-saving measures implemented to date were financed by the Special Fund for RES and ES. Financing was strengthened by adding resources from the European Structural Funds for the period 2014-2020. Their contribution, however, is expected to be too small for the needs of an ambitious plan for the energy upgrading and major renovation of the existing building stock. Having such projects financed by public funds through large-scale aid schemes would require an increase in existing taxes (including the contribution to the Special Fund) and/or the imposition of new ones, which is not desirable under the current economic situation. The public sector as a source of financing in the following years is expected to settle for its exemplary role, implementing 3 % of the renovation of public buildings and using partnerships with the private sector.

5.1 Investment prospects up until 2030

In accordance with the baseline scenario referred to in par. 2.4 on the development of the building stock up until 2030 and on the basis of the assumption that the policies on new and existing homes will remain the same, an estimated approximate €250 million will be spent on renovation works in the period 2015-2030.

Graph 19: Estimated costs to be incurred by 2030 for the renovation of homes - baseline scenario (Zangheri, 2016)



This amount can be doubled through a change to incentives, as referred to in par. 4.2 and in Graph 18. That is:

i. Migrating gradually to energy renovation lending mechanisms, while at the same time making aid schemes available only to vulnerable groups of people and exemplary energy projects.

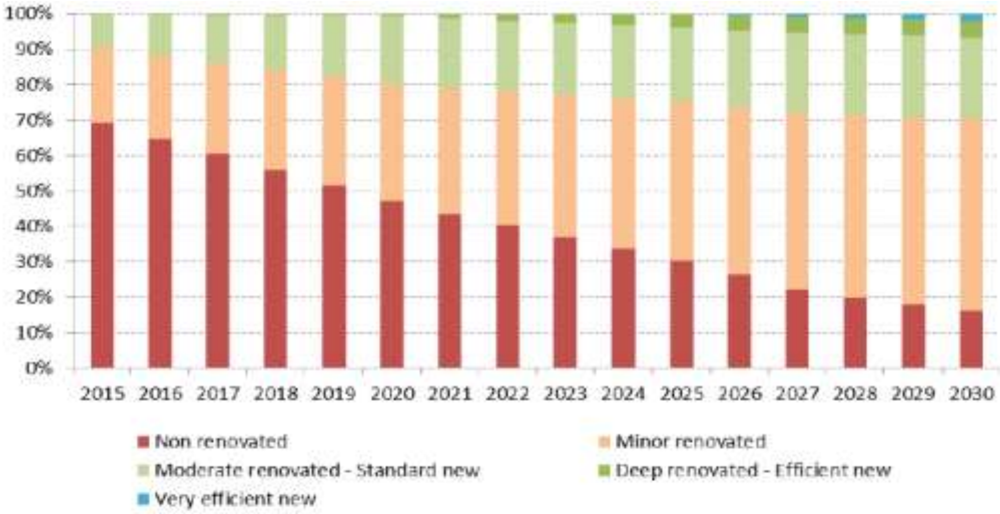
ii. Training and/or certification of technical staff.

iii. Systematic information provided to the public through information campaigns and one-stop shops providing energy renovation services to the public.

According to that scenario up until 2030, approximately 30 % of the homes will have a good energy efficiency rating, as opposed to 20 % under the baseline scenario.

Graph 20: Estimated costs to be incurred by 2030 for the renovation of homes - alternative scenario (Zangheri, 2016)

Graph 21: Estimated ratio of homes to be renovated by 2030 - alternative scenario (Zangheri, 2016)



6. Estimate of expected energy savings and broader benefits.

Renovating the existing building stock will undoubtedly lead to savings in energy and funds for the investor provided that it is implemented in a cost and technically optimal way. However, it is important to assess the benefit of renovation for society in general, e.g. for the competitiveness of the Cypriot economy, employment, social cohesion and the environment. The resulting benefits are dependent upon the quantity and quality of the renovation projects to be implemented in the following years. The relevant benefits are listed below, along with some estimates.

6.1 Economic benefits

In estimating the impact of implementing Directive 2012/27/EU on energy efficiency, the Commission predicted that achieving the energy-saving targets would lead to an additional 2.7 % GDP increase by 2020, compared to the baseline scenario (BPIE, 2013). The effect of the energy upgrading of the existing building stock on the growth of the Cypriot economy has not been estimated, but certain estimates can be made of its positive impact on individual economic sectors.

The cost of fuels in 2015 stood at €1.1 billion, representing 22 % of the total imports of Cyprus (Ministry of Energy, Commerce, Industry and Tourism, 2015). Please note that the total value of Cypriot exports in the same year stood at €1.7 billion. The cost of imported energy has been increasing over time, which is partly due to an increase in the global oil prices, but is primarily due to the fact that the economic growth and improvement of the standard of living in the last 40 years was based on increased energy intensity.

At a household level, the average energy expenditure for the functioning of a building is €1 388 per year,, whereas the average family income is €43 080, i.e. the annual energy costs represent almost a monthly salary in many cases (Statistical Service of the Ministry of Finance, 2009 Household Budget Survey, 2009). It is also foreseen that the costs incurred by households for energy products as a ratio of their income will keep increasing. An increase in the energy efficiency of buildings will release funds for households to purchase other services and products, which will have a multiplying benefit for the economy in general. As regards undertakings, a reduction in energy consumption will significantly improve their viability, which is particularly true for undertakings for which the energy costs of their building facilities represent a large part of the operating costs, e.g. hotels and retail stores. The positive impact of reduced energy consumption is expected to be higher, on a pro rata basis, for SMEs than for larger undertakings.

To achieve the energy upgrading of buildings, investments need to be made by the public, and primarily the private, sector. To attain the renovation of an annual 3 % of the total floor area of buildings owned and operated by the central government, an estimated €18 million will be required in the period 2014-2020, while larger investments will be required for the energy upgrading of private buildings, as estimated in par. 5.1. Given that every €1 million creates 19 jobs, these investments will lead to the creation of thousands of jobs across the production chain of the construction industry, which covers a wide range of occupations (European Commission, 2011).

6.2 Social benefits

Energy poverty is already a significant social problem that takes action to combat. One in seven households in the EU is at risk of poverty, and in Cyprus 59 369 households are designated as vulnerable consumers, 13 981 of which are granted special tariffs by the EAC. There are certain incentives already in place for vulnerable consumers (Chapter 4), but the mobilisation of investments in the renovation of homes leading to the energy upgrading of these homes will eliminate the problem for a number of decades.

Poor thermal comfort conditions in the existing building stock have a negative impact on the quality of life and, in some cases, on the health of the occupants. The World Health Organisation has recognised that the number of deaths caused by defective building design and construction in European countries is higher than the number of deaths caused by road accidents. The number of deaths in the winter is above average in Europe. According to the World Health Organisation, the increase in the number of deaths is linked to heavy winter conditions in each area. However, this link varies as the thermal insulation levels of buildings and their capacity to maintain high indoor temperatures play a major role. For example, the relevant increase in the number of deaths in winter is higher in the UK than in Scandinavian countries, where outdoor temperatures in winter are lower (World Health Organization - Europe , 2011). Also, one's home represents their social status. Inadequate and poor living conditions contribute towards social exclusion, and give rise to constant safety and health concerns. Such concerns affect mental health in the long run. The laws on energy efficiency have not addressed health and safety in buildings. However, the energy upgrading of existing buildings will unavoidably improve the quality of indoor areas, the living conditions and the quality of life.

6.3 Environmental benefits

Greenhouse emissions in Cyprus are almost entirely due to the consumption of energy (European Commission , 2015). Net of transport, those emissions rose by 61 % in 2011 compared to 1990. Consumption in buildings represents one third of the final energy consumption, thus having a significant share in the increase in greenhouse emissions. Only heating and air conditioning represent 6.9 % of all emissions. The energy upgrading of buildings will significantly reduce greenhouse emissions. For example, a home with a floor area of 195 m2 is responsible for the production of 9.7 tons of CO_2 annually, and an office building with a floor area of 1 448 m2 is responsible for the production of 135 tons of CO_2. By implementing measures reducing the consumption of energy by 56 %, CO_2 emissions can be reduced to 5.9 and 70 tons, respectively.

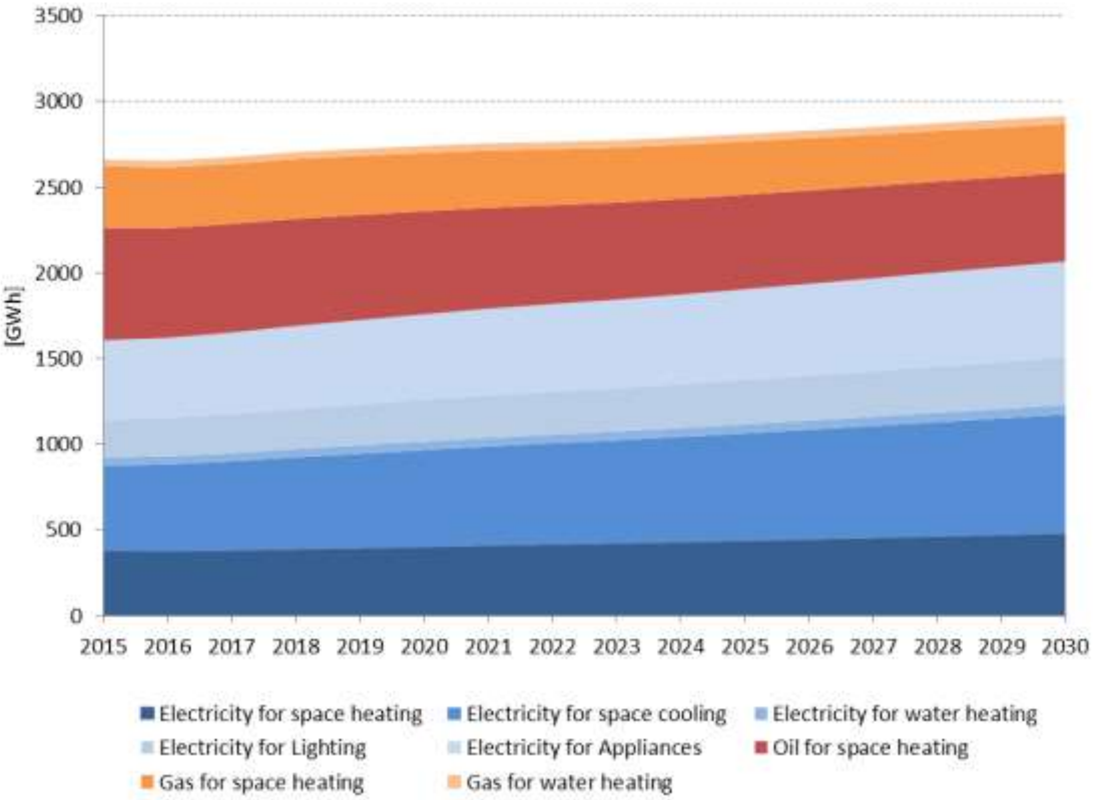
Reduced energy consumption in buildings, apart from its contribution towards combating climate change, also reduces the emissions of other polluting gases, such as SO_2, NO_x and small particles produced by power plants and heating systems. These emissions have a negative impact on the environment and public health.

6.4 Benefits for the energy system of Cyprus

Cyprus has set an indicative target for improving its energy efficiency by 14.3% up until 2020, and based on Article 7 of Directive 2012/27/EU on energy efficiency, an estimated 240 000 TOE must be saved in the period 2014-2020, in addition to the savings resulting from applying the Directives on energy savings. Furthermore, Cyprus must ensure that the share of RES in final energy consumption is at least 13 % by 2020. Directive 2009/28/EC on the promotion of the use of energy from renewable sources states: ‘It will be incumbent upon Member States to make significant improvements in energy efficiency in all sectors in order more easily to achieve their targets for energy from renewable sources.’ Therefore, the energy upgrading of the existing building stock must be considered as necessary for attaining the above targets.

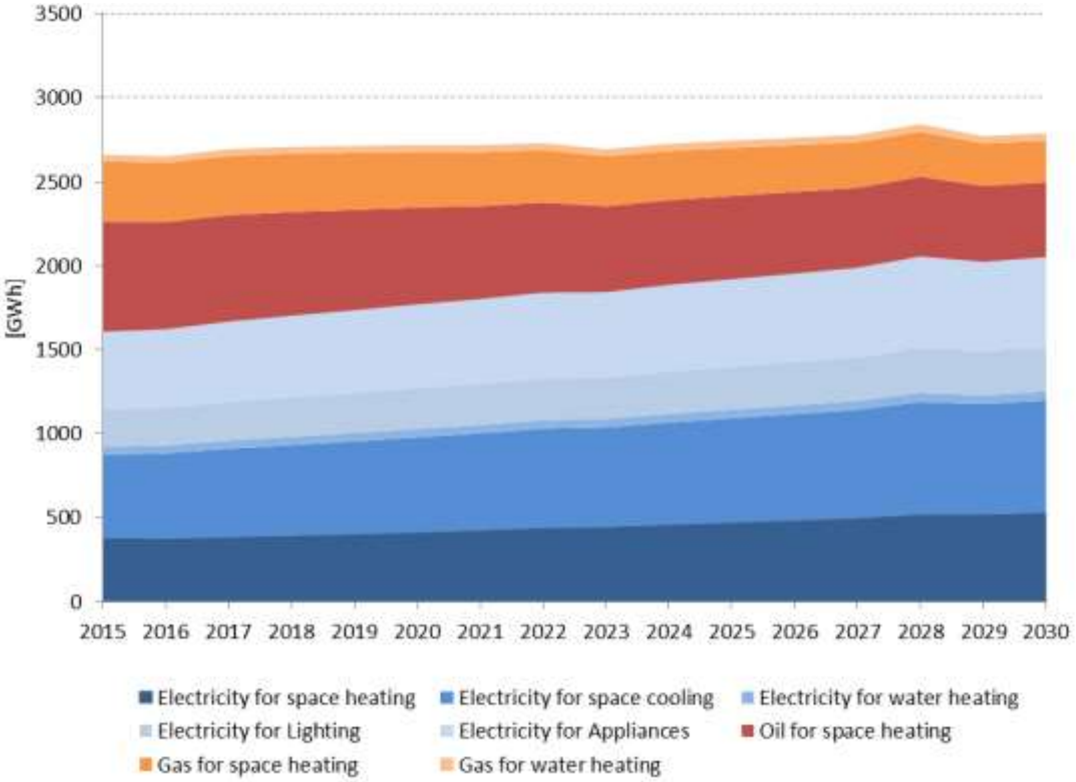
In accordance with the baseline scenario referred to in par. 2.4 and 5.1, continued implementation of the existing policies for homes is estimated to reduce the increase in the total final energy consumption (from non-renewable sources) by households to approximately 10 % in 2030 compared 2015 (Zangheri, 2016).

Graph 22: Estimated final energy consumption from conventional fuels in the residential sector by 2030 - baseline scenario (Zangheri, 2016)



This picture can be improved through a change to incentives, as described in par. 4.2 and 5.1. In accordance with that scenario, the final energy consumption in homes in 2030 will be approximately the same as total consumption in 2015 (Zangheri, 2016).

Graph 23: Estimated final energy consumption from conventional fuels in the residential sector by 2030 - alternative scenario (Zangheri, 2016)



The Commission has recognised that an increase in the rate of renovation of buildings, with a simultaneous enhancement of their energy efficiency, is very important in attaining the target of energy security. Increasing the energy efficiency of buildings will play a major role in increasing the security of energy supply to Cyprus as approximately 30 % of its final energy consumption is due to buildings. The increased dependence of Cyprus on imported fuels intensifies its dependence on external financial and political factors that are beyond its control.

Moreover, reducing energy consumption in buildings will mitigate the impact of the obligation to set up new power plants and to keep oil stocks. In Europe, it is estimated that attaining the target for a 20 % reduction in energy consumption by 2020 will result in avoiding the construction of 1 000 new conventional power plants and the setup of 500 000 wind turbines (BPIE, 2013). Electricity consumption in Cyprus has been increasing in the last ten years at an average annual rate of 6.6 %, thus necessitating the construction of new power generation and distribution infrastructures. In accordance with the Maintenance of Oil Stocks Laws, minimum stocks of crude oil and oil products must be maintained in Cyprus and/or other

Member States. The Cyprus Organisation for Storage and Management of Oil Stocks (KODAP) maintained stocks worth €111 million as of 2014, and the relevant storage and management costs stood at €10 million (PWC, 2015). The construction of infrastructures for power generation and storage of oil products requires high capital expenditure, whereas the nature of these infrastructures is often incompatible with other economic activities, such as tourism, as the land available for development is limited.

7. Conclusions

The renovation of the existing building stock and the upgrading of its energy efficiency is one of the most important tools for Cyprus to comply with its obligations in the energy sector and reduce greenhouse emissions. The need for increasing the number of renovation projects is getting more imperative given the benefits that can be derived for building owners, undertakings, public finances and the labour market.

The field of energy interventions in buildings has grown in recent years. Such growth, however, is lower than the field's potential. Speeding up the rate of renovations and ensuring better enhancement of the energy efficiency of a building following renovation is subject to roadblocks relating primarily to financing and the provision of information. Adopting new statutory measures and incentives and revising existing ones is a way to remove the roadblocks, which is not sufficient though. The reaction of the parties involved in the private sector and their capacity to take advantage of the challenges to emerge in the following years can play a major role.

The drawing up of this publication, which first took place in 2014, and its revision, which resulted in this version, has given an opportunity to discuss and analyse, as far as feasible, the problems faced by each professional sector involved in the energy upgrading of buildings. However, the 'Strategy for mobilising investment in the field of building renovation' should not be seen as a mere recording of the problems and potential of renovations, but as a first step and springboard for helping building owners, investors and professionals in the sector to join forces in an effort that will ensure maximum economic and other benefits for all the parties concerned.

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