Report on the long-term strategy for renovating the stock of public and private buildings and transforming it into a decarbonised and highly energy efficient stock of buildings by 2050, facilitating the cost-effective transformation of existing buildings into nearly zero-energy buildings

(Article 2A of Law 4122/2013)

Athens, March 2021

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1 INTRODUCTION

The long-term strategy for renovating the stock of buildings is a commitment undertaken by the Hellenic Government in application of Law 4122/2013 (Government Gazette, Series I, No 42) transposing Directive 2010/31/EU (OJ L 153) on the energy performance of buildings (EPBD), as amended in 2018 by Directive (EU) 2018/844 (OJ L 156[1]). The long-term strategy places particular emphasis on, and highlights the importance of, the energy upgrading of the stock of residential and non-residential buildings, both public and private, with a view to transforming it into a highly energy efficient and decarbonised building stock by 2050, facilitating the cost-effective transformation of existing buildings into nearly zero-energy buildings.

The long-term renovation strategy is a follow-up to the second long-term strategy report 'Approval of the second edition of the Report on the strategy for renovating the national stock of buildings'[2], prepared and submitted to the Commission in 2018 in application of amended Directive 2012/27/EU on energy efficiency (OJ L 315)[3], transposed by Law 4342/2015 (Government Gazette, Series I, No 143). The new long-term renovation strategy has replaced the previous two editions and is submitted together with the national energy and climate plan[4] (NECP), in accordance with Regulation (EU) 2018/1999[5] (OJ L 320).

Given that the share of buildings in final energy consumption now stands almost at 40 %, the major and intensive renovation of the existing stock of buildings and the construction of new nearly zero-energy buildings is deemed necessary to achieve significant energy savings and cost savings rates for people, while at the same time improving comfort, health and safety in the use of buildings.

In this context, the long-term renovation strategy focuses on the drastic reduction in CO_2 emissions from buildings by 2050, taking into account measures which are currently being implemented with a view to achieving the climate and energy goals for 2020, as well as additional measures, policies and progress indicators included in the NECP for the period 2020-2030 and in the long-term strategy plan (LS50)[6] for the period 2030-2050.

The aim of the NECP is to achieve energy upgrading of 12 %-15 % of the buildings and/or building units in the 10-year period from 2021 to 2030 through targeted policy measures. In relation to that aim, and in order for the stock of buildings to become nearly zero-energy buildings, the targets for 2050 must be much more ambitious, and therefore the policy instruments must be much more extensive, in particular:

i. stringent specifications must be applied for new buildings with regard to the energy performance of the envelope; *and*

ii. older buildings must undergo major energy upgrading, to make sure that almost the total stock of buildings is upgraded in terms of energy by 2050.

Given the relatively low construction rate of new buildings and taking into account that historical data suggest that the increase will remain low in the future, the energy upgrading of older buildings is crucial. With a view to making sure that the national stock of buildings are highly efficient and decarbonised buildings and to facilitating the cost-effective transformation of existing buildings into nearly zero-energy buildings, the long-term renovation strategy, in application of the EPBD and Commission Recommendation (EU) 2019/786 (OJ L 127)[7] on building renovation, is drawn up on the basis of the following:

- Overview of the national building stock

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[1] https://eur-lex.europa.eu/legal-content/EL/TXT/PDF/?uri=CELEX:32018L0844&from=EL
[2] 2 ΥΑ ΔΕΠ//2018 (Ministerial Decision No ΔΕΠΕΑ/Γ/οικ.175603 (Government Gazette, Series II, No 2258),
[3] https://eur-lex.europa.eu/legal-content/EL/TXT/PDF/?uri=CELEX:32012L0027&from=EL
[4] http://www.ypeka.gr/Portals/0/Files/Energeia/Eksikonomisi/ESEK_Dec_2019.pdf
[5] https://eur-lex.europa.eu/legal-content/EL/TXT/PDF/?uri=CELEX:32018R1999&from=EN
[6] http://www.ypeka.gr/Portals/0/Files/Energeia/Eksikonomisi/Strategy_2050_070120.pdf
[7] https://eur-lex.europa.eu/legal-content/EL/TXT/PDF/?uri=CELEX:32019H0786&from=GA

- Technology- and cost-optimal approaches for building stock renovation
- Estimate of energy savings and associated wider benefits
- Roadmap with measures and domestically established measurable progress indicators, with a view to the long-term 2050 goal of reducing greenhouse gas emissions in the Union by 80-95 % compared to 1990
- Indicative milestones for 2030, 2040 and 2050
- Policies based on appropriate financial mechanisms to support the mobilisation of investments in the renovation of buildings needed to achieve the goals.

2 METHODOLOGY

The methodology used to develop the long-term renovation strategy is based on **(i)** the calculation of cost/benefit-optimal levels of minimum energy performance requirements for buildings in the domestic and tertiary sectors, on the basis of the (2017) report submitted by Greece in application of Directive 2010/31/EU[8], and **(ii)** the results of the LS50 scenarios for the energy upgrading of the stock of buildings by 2050, which were generated using the PRIMES Buildings Model (PRIMES-BuiMo).

The determination of technology- and cost-optimal interventions concerns new and existing buildings undergoing major renovation and replacement or energy upgrading of building elements, such as the envelope and heating and cooling systems. At the same time, the LS50 scenarios include highly ambitious goals, as well as policies and measures aiming to drastically reduce the energy consumption of the stock of buildings by 2050. To achieve those goals, the scenarios have looked into alternative paths focusing on two different strategic priorities: one aiming to reduce emissions in the context of trying to achieve the 2°C target and one aiming to reduce emissions in the context of trying to achieve the 1.5°C target. The scenarios also take into account alternative hypotheses regarding the technological progress and available technological solutions available in the period 2030-2050.

Following are these scenarios:

- **EE2 scenario** (Energy Efficiency and Electrification for 2°C)
- **NC2 scenario** (New energy carriers for 2°C)
- **EE1.5 scenario** (Energy Efficiency and Electrification for 1.5°C)
- **NC1.5 scenario** (New energy carriers for 1.5°C)

More specifically, the EE scenarios are based on the assumption that the development of climate-neutral new energy carriers (i.e. products) as replacements for fossil fuels – thus promoting progress in energy efficiency and electrification of energy uses, to a high degree, in all sectors – is financially and technically uncertain. As opposed to that, the NC scenarios, while providing for ambitious policies with regard to progress in energy efficiency and electrification in heating, are based on the assumption that technologies using hydrogen, biogas and synthetic methane in line with climate-neutral specifications, will gradually mature, thus leading to a drastic reduction in the carbon footprint of the gas distributed.

Apart from those scenarios, which take for granted the achievement of the NECP goals by 2030 and are not different from one another during the 10-year period from 2020 to 2030, the analysis includes two more scenarios. Following are these scenarios:

- **NECP-2030:** Implementation of the NECP policies without any new goals and additional policy measures after 2030

[8] https://ec.europa.eu/energy/topics/energy-efficiency/energy-performance-of-buildings/energy-performance-buildings-directive/eu-countries- 2018-cost-optimal-reports_en?redir=1

- **NECP-2050:** Implementation of the NECP policies – which are fundamental and undoubtedly useful – with increased intensity after 2030

Energy savings in buildings, residential dwellings and services sector buildings is one of the fundamental policies which are undoubtedly useful and is the area that presents the greatest possibility of reducing energy consumption in a cost-effective manner.

The PRIMES Buildings Model (PRIMES-BuiMo) was used to generate the results of the LS50 scenarios, drawing data from an extensive database which contains information on the structure of the building stock (number of buildings by category, etc.), the energy behaviour of buildings (U-Values, etc.) and the consumption of energy by end use and by fuel for each building category. The model looks into each sector – domestic sector and tertiary – separately. Consequently, a separate database is created for each sector.

Various sources are used and combined to create the databases. For example, national and European statistical reports are used, such as energy balances and technical studies or research programmes focusing on energy savings in buildings. The table below lists the main sources.

Table 1: List of sources used by the PRIMES-BuiMo model

SOURCE	REFERENCE TO THE SOURCE	USE
EUROSTAT	Energy Balances[9]	Structure of final energy consumption
	Energy Consumption in households by type of end use[10]	
	SECH Project[11]	
EUROSTAT[12]	Distribution of population by degree of urbanization, dwelling type and income group [ilc_lvho01]	Classification of buildings by category (number of buildings, floor area of buildings, urbanisation of buildings, etc.)
	Average number of rooms per person by degree of urbanisation [ilc_lvho04d]	
	Demographic balance and crude rates [demo_gind]	
	Household characteristics by urbanisation degree [hbs_car_t315]	
	Living conditions - cities and greater cities [urb_clivcon]	
EPISCOPE projects [13]	EPISCOPE, 2017	
EU Building Stock Observatory[14]	EU BSO Database	
The Housing statistics[15]	Haffner, 2010	

[9] https://ec.europa.eu/eurostat/web/energy/data/energy-balances
[10] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_consumption_in_households&oldid=437946#Energy_products_used_in_the_residential_sector
[11] https://ec.europa.eu/eurostat/cros/system/files/SECH_final_report_Greece.pdf
[12] https://ec.europa.eu/eurostat/web/microdata/european-union-statistics-on-income-and-living-conditions
[13] https://episcope.eu/iee-project/episcope/
[14] https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/eu-bso_en
[15] https://www.researchgate.net/publication/334030779_housing-statistics-in-the-european-union-2010

TABULA[16]	TABULA, 2017	EN 13790:2008 for determining the need for heating/cooling in buildings
BPIE[17]	BPIE, 2011	U-Values of the stock of buildings
ODYSEE-MURE[18]	ODYSEE Database	Number and final consumption of equipment in buildings
BRG Building Solutions[19]	The European Heating Product Markets, 2018	Number of heating and cooling technologies
Heat Roadmap Europe	Profile of heating and cooling demand in 2015, 2017[20]	Structure of final energy consumption
	Deliverable 3.2: Cooling technology datasheets in the 14 MSs in the EU28[21]	

3 OVERVIEW OF THE NATIONAL BUILDING STOCK

The Greek building stock consists mainly of residential dwellings and a number of tertiary sector buildings intended for other purposes, for which an inventory is taken for the entire territory of Greece every ten years. The long-term renovation strategy uses the results of the latest building inventory (2011) and the database referred to in Table 1. The overview of the building stock covers the number and age, climatic zone, energy consumption levels and energy characteristics of buildings.

3.1 NUMBER OF BUILDINGS

Table 2 lists the total number of buildings in Greece (2015), broken down into residential dwellings and tertiary sector buildings. Residential dwellings represent 95.4 % of the building stock, whereas the respective percentages of tertiary sector buildings are as follows: commercial stores 1.4 %, offices and other buildings 1.1 %, hospitals and health centres 0.8 %, hotels and restaurants 0.5 %, schools and educational facilities and all warehouses 0.4 %. The very large share of residential dwellings in the total number of buildings indicates that particular emphasis must be placed on the energy upgrading of those buildings.

In accordance with the Hellenic Statistical Authority (ELSTAT), 'main dwelling – household' means a permanent and independent dwelling intended to be used as the abode of a household for at least one year. The total number of main residential dwellings in 2015 was broken down as follows: 2 514 821 multi-dwelling buildings and 2 116 707 single-family houses, representing 54.3 % and 45.7 % of the total number respectively.

Table 2: Total number and use of buildings in 2015

BUILDING USE	NUMBER OF BUILDINGS
RESIDENTIAL DWELLINGS – HOUSEHOLDS	
Residential dwellings	*4 631 528*
TERTIARY SECTOR	
Hotels and restaurants	24 109

16 https://episcope.eu/building-typology/tabula-webtool/
17 http://bpie.eu/
18 https://www.indicators.odyssee-mure.eu/energy-efficiency-database.html
19 http://www.brgbuildingsolutions.com/industry-sectors/building-technologies-market-research-reports
20 http://publica.fraunhofer.de/eprints/urn_nbn_de_0011-n-4912287.pdf
21 https://heatroadmap.eu/wp-content/uploads/2018/11/HRE4_D3.2.pdf

Schools and educational facilities	19 167
Offices and other buildings	53 064
Hospitals and health centres	38 664
Commercial stores	65 957
Warehouses	20 374
Cold stores	308
Tertiary sector	*221 643*
TOTAL	**4 853 172**

Source: EU BSO and own estimates

Table 3: Breakdown of residential dwellings in 2015

TYPE OF DWELLING	NUMBER OF BUILDINGS
Single-family houses	2 116 707
Multi-dwelling buildings	2 514 821
TOTAL	4 631 528

Source: EU BSO

As regards buildings used to house public agencies, which are deemed to be highly energy-intensive, it should be stressed that there are no sufficient data regarding their exact number in relation to their intended use and energy characteristics. On the basis of the 2011 inventory, it is estimated that there are approximately 112 000 buildings used to house central and decentralised administrative agencies, local authorities and legal persons governed by public and private law, and the table below shows their ownership status:

BODY USING THE BUILDING	TOTAL NUMBER OF BUILDINGS	OWNER		
		HELLENIC STATE	PRIVATE INDIVIDUAL	BOTH
Central/decentralised administrative agencies	4 141	3 449	631	61
Local authorities and their bodies	31 167	28 791	2 111	265
Other persons governed by public law	57 959	55 838	1 876	245
Other persons governed by private law	18 789	4 772	12 958	1 059

Source: National plan for increasing the number of nearly zero-energy buildings (Ministry of the Environment and Energy, 2017)

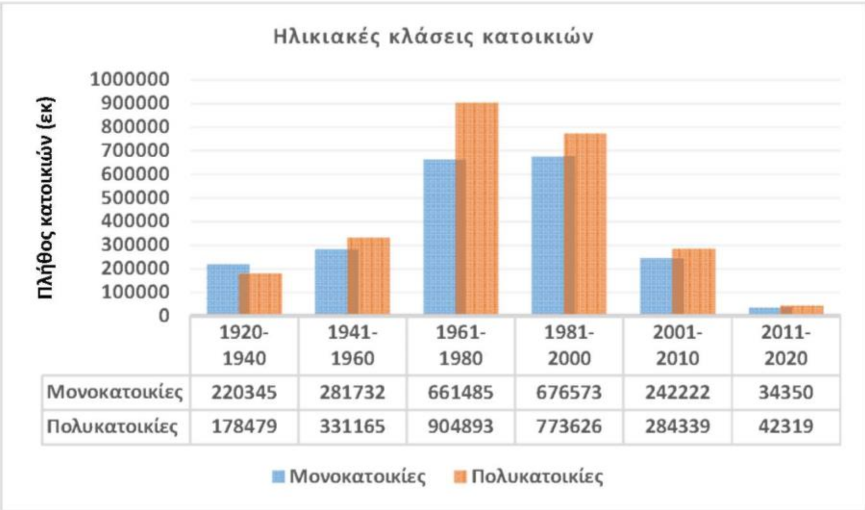
3.2 AGE OF BUILDINGS

The legal framework setting out the age categories of buildings was first established in 1980 by adopting the Regulation on the Thermal Insulation of Buildings (KTHK) and was then amended by adopting the Regulation on the Energy Performance of Buildings (KENAK) in 2010, which was amended in 2017. The age categories of buildings were set over a 20-year period until 2000 and over a 10-year period thereafter. As shown in Figure 1, over half of residential dwellings (55.7 %) were constructed before 1980, i.e. before the KTHK was adopted, therefore having no thermal protection at all.

Of those buildings, 42.7 % were constructed up until 2010, therefore having partial thermal insulation systems in place, whereas only 1.6 % of residential dwellings were constructed after 2010, i.e. after the adoption of KENAK.

As opposed to residential dwellings, in the tertiary sector 38.7 % of the total number of buildings were constructed before 1980 and 59 % were constructed up until 2010. The other 2.3 % were constructed in the last five years. Generally, this is due to the fact that the turnover rate (the rate of demolition of older buildings and construction of new ones) for tertiary sector buildings is higher than for residential dwellings (Table 5). Residential dwellings have a low turnover rate, as older buildings are used for many years after they are constructed.

Figure 1: Breakdown of residential dwellings by construction period



Source: EU BSO and BPIE

	Age categories of residential dwellings
	Number of residential dwellings (million)
	Single-family houses
	Multi-dwelling buildings

Table 4: Construction of tertiary sector buildings in 1920-2020

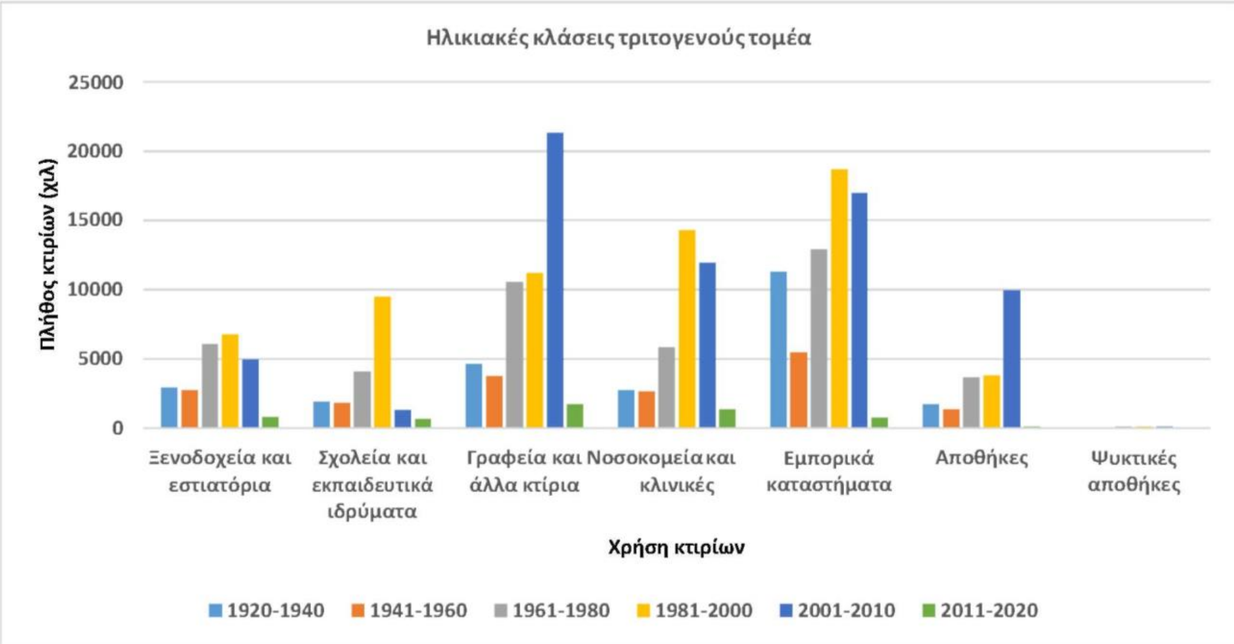
TERTIARY SECTOR	1920-1940	1941-1960	1961-1980	1981-2000	2001-2010	2011-2020
Hotels and restaurants	2 904	2 719	6 056	6 738	4 921	769
Schools and educational facilities	1 900	1 801	4 050	9 488	1 270	658
Offices and other buildings	4 632	3 720	10 517	11 186	21 316	1 694
Hospitals and health centres	2 714	2 608	5 814	14 265	11 937	1 327
Commercial stores	11 264	5 428	12 909	18 649	16 963	743
Warehouses	1 700	1 311	3 637	3 762	9 914	51
Cold stores	36	28	75	81	88	1

Source: Combined EU BSO, EUROSTAT, BPIE and own estimates

It is inferred from the old age of the building stock and the relatively low rate of construction of new buildings that the major energy upgrading of older buildings is crucial for achieving the goal of having almost all older buildings upgraded in terms of energy by 2050.

The energy savings potential is very high in residential dwellings, as these represent the majority of older buildings in Greece, compared to tertiary sector buildings in which energy savings are ensured mostly through the construction of new buildings in line with the building regulations and/or energy performance regulations in force in each case. Correlating the construction period of a building with its energy performance, as a result of developments in terms of the legal framework and technology, is also confirmed by statistics from the energy performance certificates (EPCs) (Figure 3).

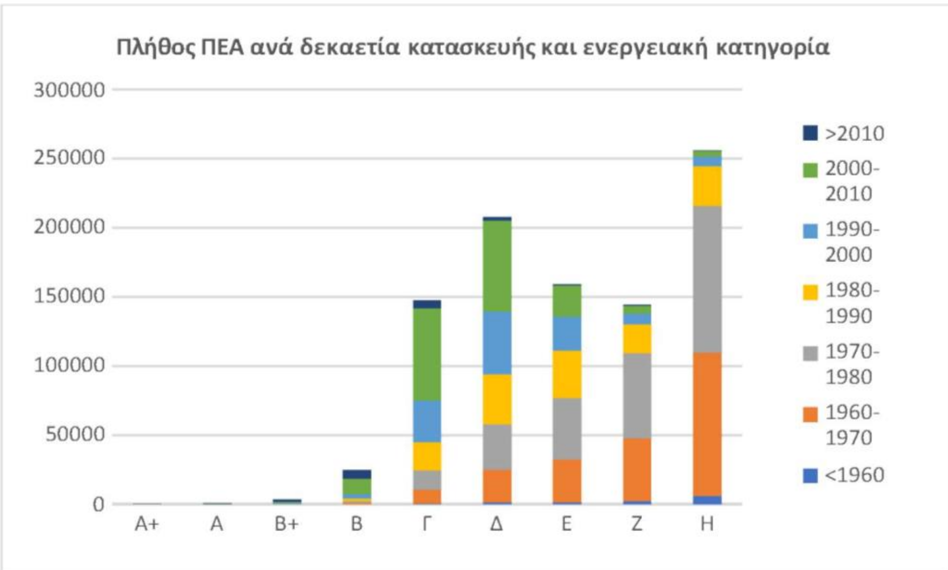
Figure 2: Breakdown of tertiary sector buildings by construction period



Source: Combined EU BSO, EUROSTAT, BPIE and own estimates

	Age categories in the tertiary sector
	Number of buildings (thousand)
	Hotels and restaurants
	Schools and educational facilities
	Offices and other buildings
	Hospitals and health centres
	Commercial stores
	Warehouses
	Cold stores
	Building use

Figure 3: Number of EPCs by 10-year construction period and by energy category



Source: Energy performance certificates for buildings: Statistical analysis for 2016

	Number of EPCs by 10-year construction period and by energy category
	A +
	A
	B +
	B
	C
	D
	E
	F
	G

Most buildings constructed before 1980 are classified under energy category G, with a gradual improvement in the period in which the KTHK was adopted (1981-2009) as those buildings are classified under categories D and C. Where some of them are classified under energy categories C to A+, this is so either due to energy interventions implemented through various financing programmes or due to major renovation. Buildings have been upgraded to categories C and B after 2010. The EPCs issued pertained mainly to buildings constructed up until 2009, as construction activity declined after 2010 and therefore the number of EPCs issued was also reduced. The fact that most EPCs were issued for buildings whose construction was completed in the period 1970-1980 is due to the fact the EPC was included in the supporting documents that had to be submitted during the initial phase of the 'Savings at Home' programme.

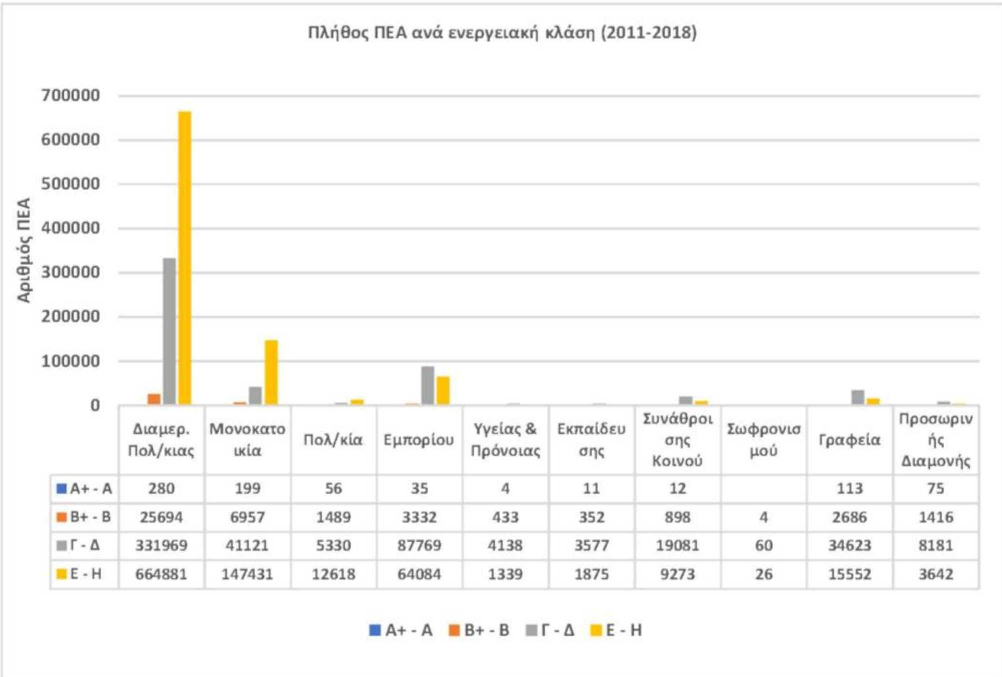
A total of 1 500 613 EPCs were issued in the period 2011-2018, of which 82.50 % pertained to residential dwellings and 17.50 % to tertiary sector buildings. The EPCs issued pertain mainly to older buildings (99.47 %) constructed up until 2009. Most of those buildings (61.36 %) are classified under categories E and G, 35.71 % under categories C and D and 2.94 % under categories A and B. Moreover, as regards newly constructed buildings or buildings which have undergone major renovation in line with the KENAK, reasonably 94.90 % of them are classified under categories A and B. Most of the EPCs issued (83.80 %) pertain to buildings (mainly apartments) available for rent and/or sale, as shown below. Just like in previous periods, now most of the residential dwellings (66.63 %) are classified under energy categories E-G, and most of the energy is consumed primarily to cover heating needs (188.97 kWh/m2).

Table 5: Energy data for buildings in the period 2011-2018

YEAR	NUMBER OF EPCs	TOTAL FLOOR AREA (m2)
2011	53 666	7 002 025
2012	209 692	23 804 512
2013	221 668	25 534 583
2014	121 491	15 036 106
2015	53 486	7 827 597
2016	281 474	26 671 203
2017	255 041	23 744 256
2018	304 095	31 064 778

Source: Energy performance certificates for buildings: Statistical analysis for 2018

Figure 4: EPCs issued in the period 2011-2018



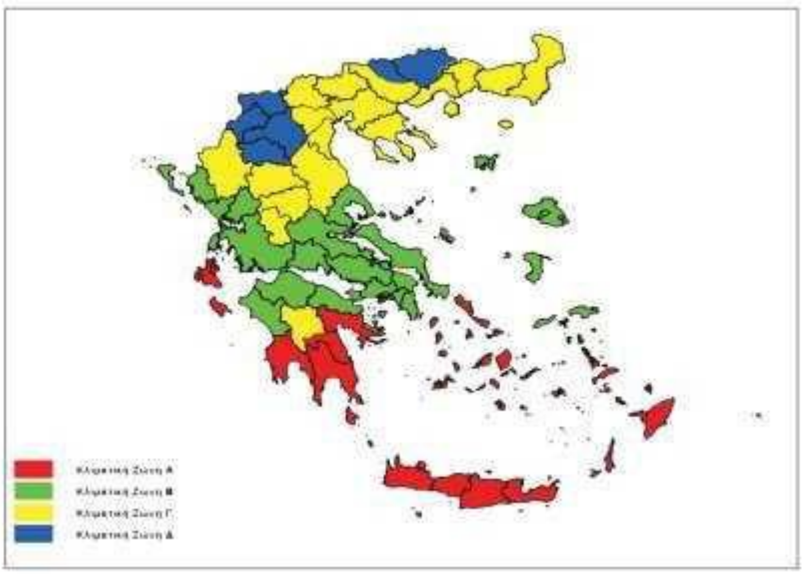
Source: Energy performance certificates for buildings: Statistical analysis for 2018

	Number of EPCs by energy category (2011-2018)
	Number of EPCs
	Apartments in multi-dwelling buildings
	Single-family houses
	Multi-dwelling buildings
	Commercial buildings
	Health and welfare facilities
	Educational facilities
	Meeting venues
	Correctional facilities
	Offices
	Buildings for temporary stay
	A+-A
	B+-B
	C-D
	E-G

3.3 CLIMATIC ZONES

The territory of Greece is broken down into 4 climatic zones (A, B, C and D, from hot to cold) depending on heating degree-days. Following are the climatic zones in accordance with the KENAK.

Figure 5: Climatic zones in Greece

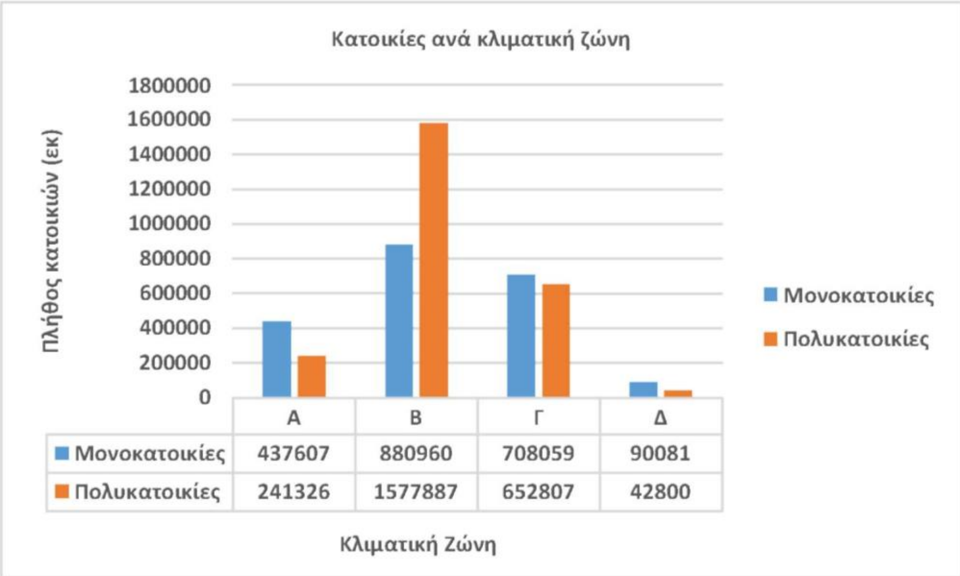


Σχήμα 1.1. Σχηματική Απεικόνιση κλιματικών ζωνών ελληνικής επικράτειας

	Figure 1.1 Graph representing climatic zones in Greece
	Climatic zone A
	Climatic zone B
	Climatic zone C
	Climatic zone D

Figure 6 presents a breakdown of the number of residential dwellings by climatic zone, and Figure 7 presents a corresponding breakdown of the number of tertiary sector buildings intended for various uses.

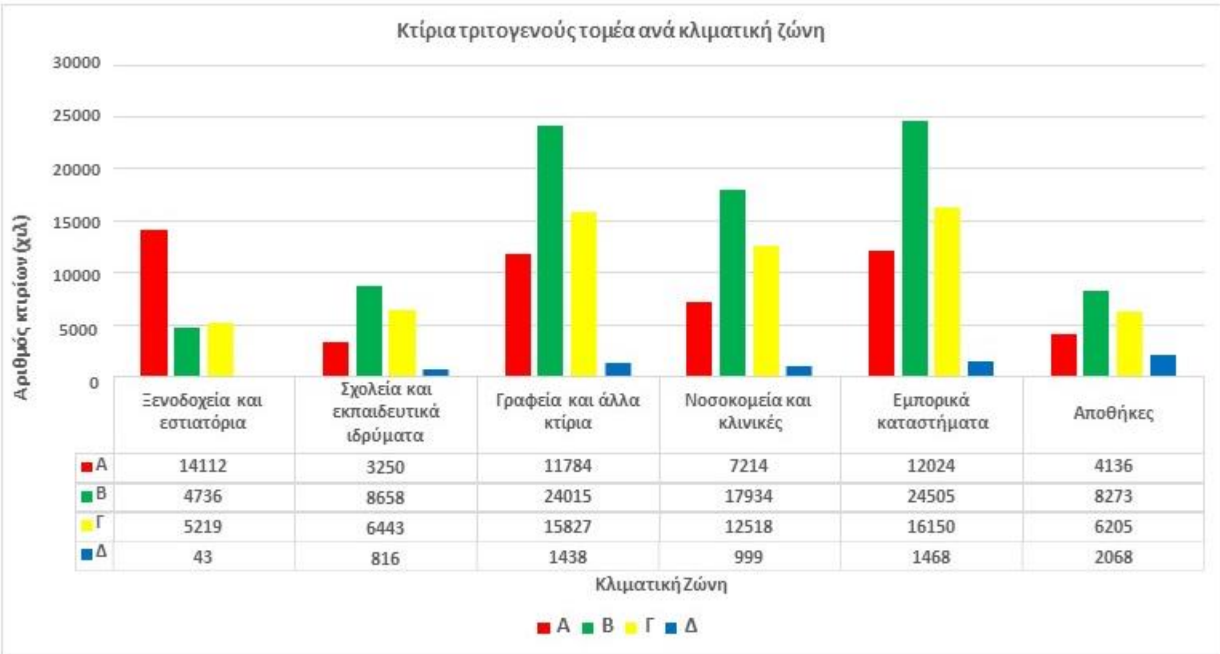
Figure 6: Breakdown of residential dwellings by type and climatic zone



Source: Own estimates based on EU BSO and TABULA

	Residential dwellings by climatic zone
	Number of residential dwellings (million)
	Single-family houses
	Multi-dwelling buildings
	Climatic zone

Figure 7: Breakdown of tertiary sector buildings by type and climatic zone



Source: Own estimates based on EU BSO and TABULA

	Tertiary sector buildings by climatic zone
	Number of buildings (thousand)

	Hotels and restaurants
	Schools and educational facilities
	Offices and other buildings
	Hospitals and health centres
	Commercial stores
	Warehouses
	Climatic zone
	A B C D

3.4 ENERGY CONSUMPTION

Energy savings in buildings, residential dwellings and services sector buildings is one of the fundamental policies which are undoubtedly useful, as it is the area that presents the greatest possibility of reducing energy consumption in a cost-effective manner. On the basis of the 2017 energy balance, building-related energy consumption in Greece stands at 6 605[22] ktoe, representing 42 % of total final energy consumption in Greece.

On the basis of information from the EPCs issued to date, one is able to find out the different consumption levels for each building use in each climatic zone and the significant energy savings rates achieved (Figure 11), as buildings are constructed in accordance with the KENAK specifications, on the basis of the information on the average energy consumption of reference buildings.

Among residential dwellings, the most energy-intensive ones are single-family houses, whereas multi-dwelling buildings have an average annual primary energy consumption of 257.08 kWh/m². It is inferred from a comparison of the average annual primary energy consumption levels of residential dwellings by climatic zone (Figure 8) that single-family houses in climatic zones C and D are more energy-intensive (500.68 kWh/m² and 555.67 kWh/m² respectively). Also, the potential for energy savings is really significant, as energy consumption in these dwellings is two or even three times that of the reference building. More specifically, the highest energy savings rate concerns single-family houses in all climatic zones (Figure 11).

Figure 8: Average annual energy consumption by climatic zone: Residential dwellings v reference building

Source: Energy performance certificates for buildings: Statistical analysis for 2018

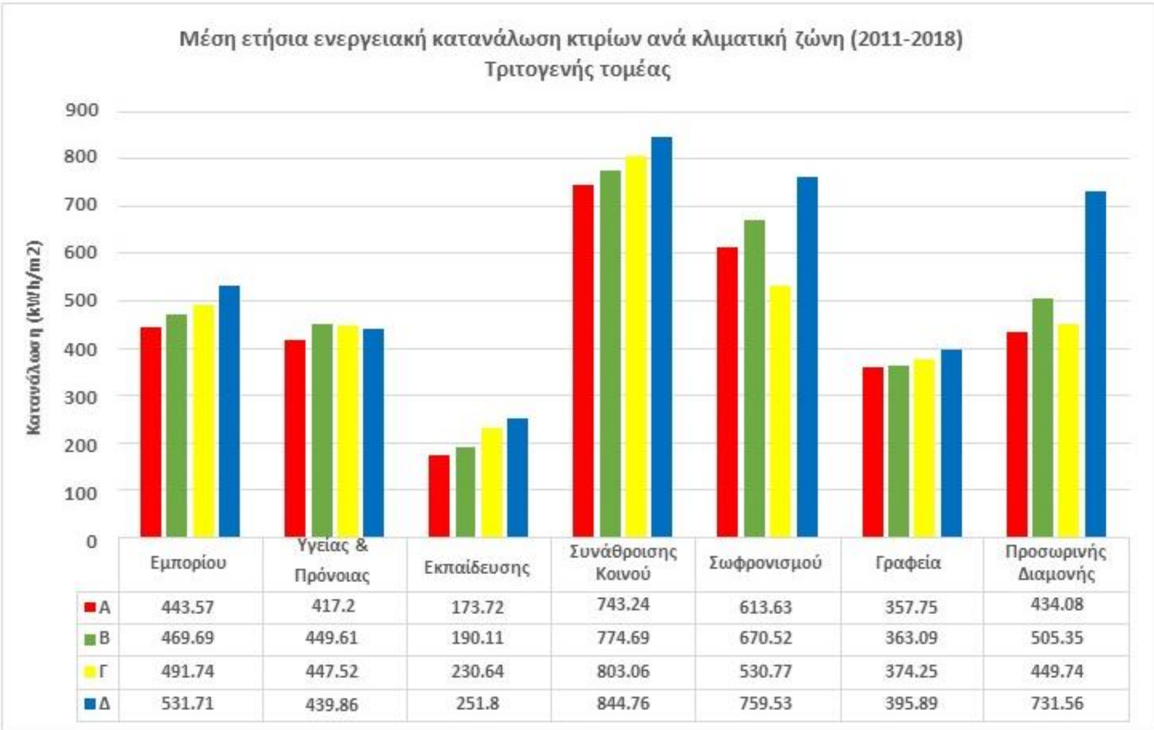
	Average annual energy consumption by climatic zone
	Residential dwellings (2011-2018)
	Apartments in multi-dwelling buildings
	Single-family houses
	Multi-dwelling buildings
	Average annual energy consumption by climatic zone
	Residential dwellings – Reference building (2011-

[22] The corresponding consumption in 2018 stood at 6 012 ktoe, representing 38 % of final energy consumption

	2018)

In the tertiary sector, the buildings used as meeting venues are the most energy-intensive (average annual primary energy consumption 778.24 kWh/m^2), which is also the case for buildings used as correctional facilities (average annual primary energy consumption 622.67 kWh/m^2) in almost all climatic zones. Energy consumption in buildings used as educational facilities increases in colder zones, whereas there are no significant differences between different climatic zones for office and commercial buildings. In buildings used as health and welfare facilities, energy consumption is higher in climatic zone B (due to the need for air-conditioning).

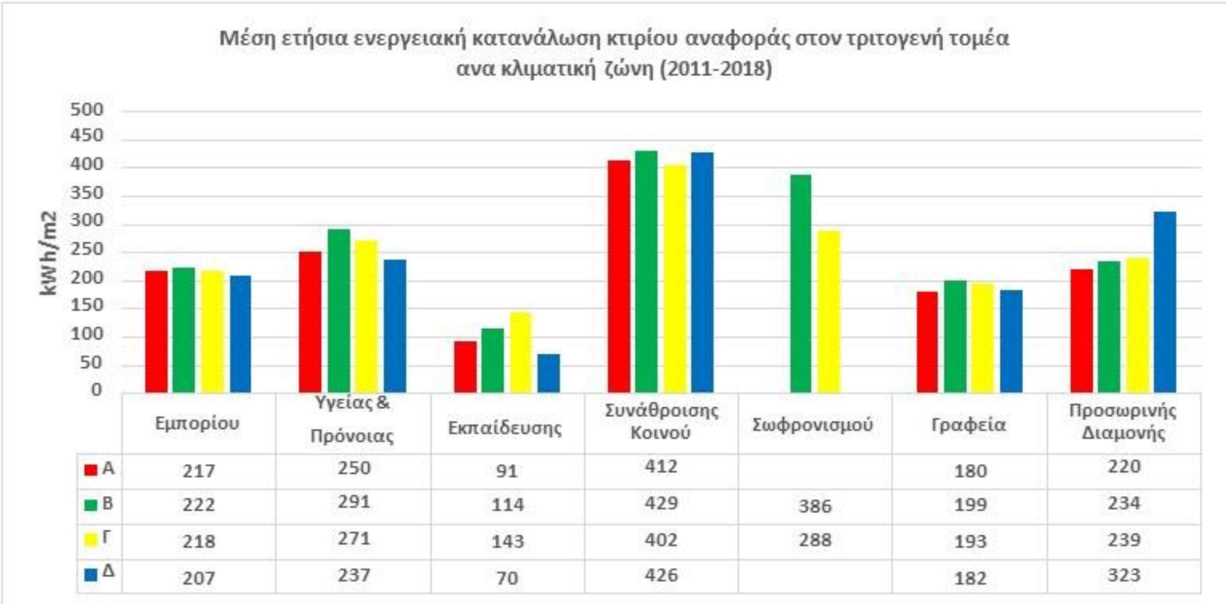
Figure 9: Average annual energy consumption of tertiary sector buildings by climatic zone



Source: Energy performance certificates for buildings: Statistical analysis for 2018

	Average annual energy consumption of buildings by climatic zone (2011-2018)
	Tertiary sector
	Consumption (kWh/m2)
	Commercial buildings
	Health and welfare facilities
	Educational facilities
	Meeting venues
	Correctional facilities
	Offices
	Buildings for temporary stay

Figure 10: Average annual energy consumption of the tertiary sector reference building by climatic zone

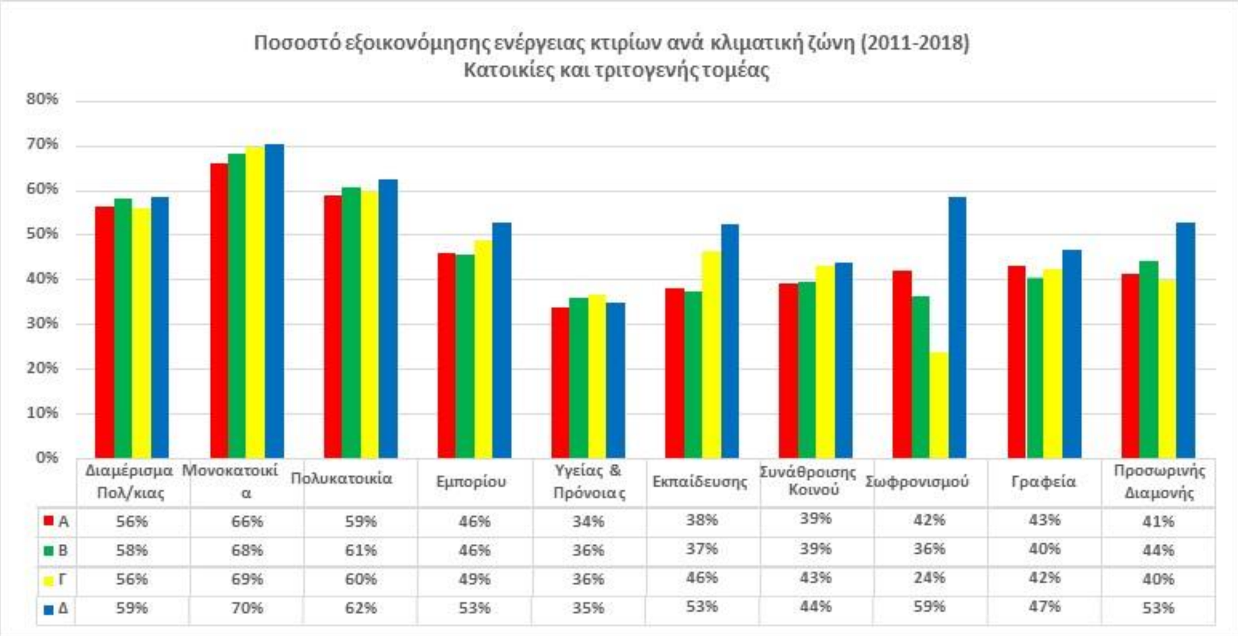


Source: Energy performance certificates for buildings: Statistical analysis for 2018

	Average annual energy consumption of the tertiary sector reference building by climatic zone (2011-2018)
	Commercial buildings
	Health and welfare facilities
	Educational facilities
	Meeting venues
	Correctional facilities
	Offices
	Buildings for temporary stay

Overall, the energy savings rates both in the tertiary sector and in residential dwellings are highly significant, as shown in Figure 11.

Figure 11: Energy savings rate for buildings by climatic zone



Source: Energy performance certificates for buildings: Statistical analysis for 2018

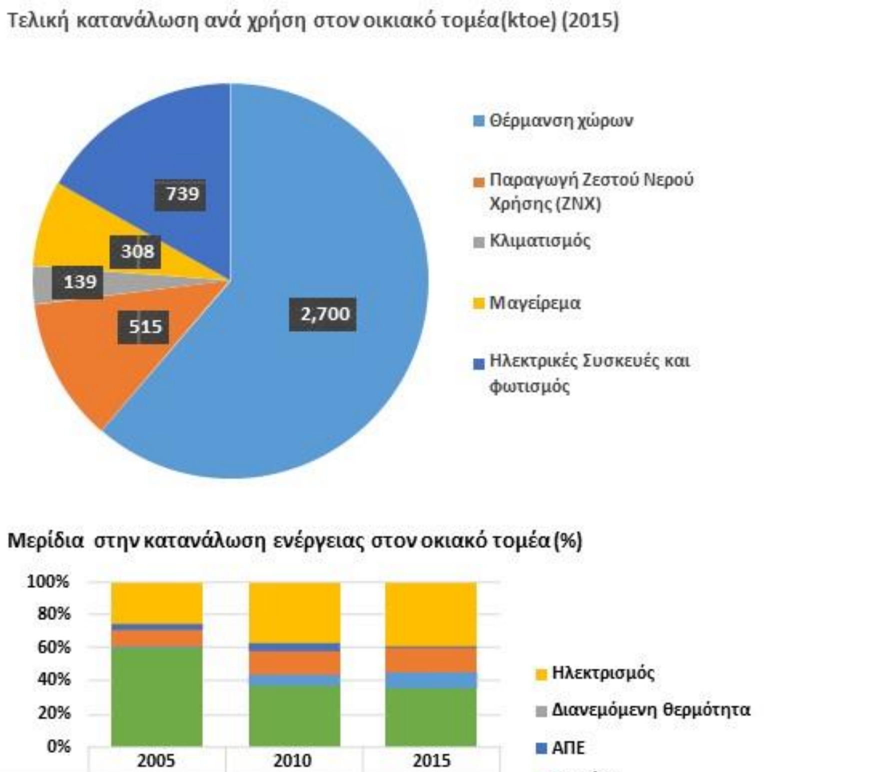
	Energy savings rate for buildings by climatic zone (2011-2018) Residential dwellings and tertiary sector
	Apartments in multi-dwelling buildings
	Single-family houses
	Multi-dwelling buildings
	Commercial buildings
	Health and welfare facilities
	Educational facilities
	Meeting venues
	Correctional facilities
	Offices
	Buildings for temporary stay

It is true that final energy consumption declined in all sectors in Greece in the period 2008-2015, in the industrial, domestic and tertiary sectors in particular, as these were the first sectors to suffer the impact of the economic recession. However, final energy consumption has been rising ever since, as shown by the energy balances of 2016 and 2017.

In accordance with the energy balances provided by Eurostat,[23] consumption of Greek residential dwellings stood at 4 401 ktoe in 2015, compared to 4 615 ktoe in 2010 and 5 510 ktoe in 2005. The previous years' economic recession, combined with the simultaneous rise in fuel prices, significantly affected the energy consumption of households. In the 10-year period from 2005 to 2015 there was a significant drop in the share of diesel (from 57 % to 33 %) and a significant rise in the share primarily of natural gas and secondarily of electricity.

[23] https://ec.europa.eu/eurostat/web/energy/data/energy-balances

Figure 12: Structure of energy consumption in the domestic sector



	2005	2010	2015
Ηλεκτρισμός	26%	34%	34%
Διανεμόμενη θερμότητα	1%	1%	1%
ΑΠΕ	2%	4%	4%
Βιομάζα	13%	13%	19%
Φυσικό αέριο	1%	6%	8%
Πετρέλαιο και στερεά ορυκτά καύσιμα	57%	43%	33%

Source: EUROSTAT

	Final consumption by use in the domestic sector (ktoe) (2015)
	Space heating
	Production of domestic hot water
	Air-conditioning
	Cooking
	Electrical appliances and lighting systems
	Energy consumption shares in the domestic sector (%)
	Electricity
	District heating
	RES
	Biomass
	Natural gas
	Diesel and solid fossil fuels

As regards residential dwellings in particular, energy consumption for heating purposes stood at 2 892 ktoe in 2015, representing 66.62 % of the total energy, and electricity stood at 1 449 ktoe, representing the remaining 33.38 %. The primary type of fuel used to cover the needs for heating was diesel, representing 48 %, followed by biomass, representing 29 %, and natural gas, representing 12 %. These were followed by solar energy, liquefied gas and district heating, representing 6 %, 3 % and 2 % respectively.

Figure 13: Final thermal energy consumption in the domestic sector

Source: EUROSTAT

	Final thermal energy consumption by type of fuel in the domestic sector in 2015 (%)
	Liquefied gas
	Diesel
	Natural gas
	District heating
	Solar energy
	Biomass

In proportion, in accordance with Table 6, diesel boilers are the most widespread heating system used in residential dwellings, and other extensively used systems include wood or wood pellet boilers, space heaters operating on solid or liquid fuel and gas boilers.

Table 6: Heating systems used in buildings in 2015

Residential dwellings	
Number of buildings (thousand)	
Boiler (diesel)	1 773
Boiler (gas)	470
Boiler (wood / wood pellet)	1 237
Independent heating system (gas)	222
Heat pump	146
District heating system	80
Electric space heater	155
Space heaters operating on fuel or liquid fuel	548
Thermal energy consumption to cover heating needs (ktoe of final consumption)	
Boiler (diesel)	928
Boiler (gas)	216
Boiler (wood / wood pellet)	809

Independent heating system (gas)	127
District heating system	50
Space heaters operating on fuel or liquid fuel	402
Electricity consumption to cover heating needs (ktoe of final consumption)	
Heat pump	32
Electric space heater	135
Services sector buildings	
Number of buildings (thousand)	
Boiler (diesel)	56
Boiler (gas)	39
Boiler (wood / wood pellet)	7
Heat pump	107
District heating system	0
Central air-conditioning units	13
Thermal energy consumption to cover heating needs (ktoe of final consumption)	
Boiler (diesel)	280
Boiler (gas)	167
Boiler (wood / wood pellet)	37
District heating system	0
Electricity consumption to cover heating needs (ktoe of final consumption)	
Heat pump	176
Central air-conditioning units	141

Source: Own estimates based on EUROSTAT

In 2015 respectively, in accordance with Figure 14, electricity was used mainly for heating water (18 %) and cooking (15 %), as well as for operating refrigerators and freezers and for space heating (12 % respectively).

Figure 14: Breakdown of final electricity consumption by use

Source: Combined EU BSO, ODYSEE-MURE and own estimates

	Final electricity consumption by use (ktoe) (2015)
	Use
	Lighting
	Entertainment appliances (TV sets, radios)
	Communications appliances (computers, telephones)
	Electric irons
	Vacuum cleaners
	Clothes dryers
	Dishwashers
	Washing machines
	Refrigerators/freezers
	Cooking
	Air-conditioning
	Production of domestic hot water
	Space heating
	Electricity consumed

As opposed to residential dwellings, final consumption rose in the period 2005-2015 from 737 ktoe (2005) to 1 613 ktoe (2015) in the tertiary sector, reflecting the rapid development of the relevant branches in the 10-year period concerned. Space heating and the use of electrical appliances and lighting systems have the largest share in final consumption, followed by air-conditioning and production of domestic hot water.

Electricity is at the top of the list as it covers 73 % of the needs for energy consumption in tertiary sector buildings. Then follows diesel, which recorded a significant drop at the climax of the economic recession, but recovered partly in 2015, while the share of natural gas is relatively low.

Figure 15: Structure of energy consumption in the tertiary sector

	2005	2010	2015
Ηλεκτρισμός	73%	79%	73%
Διανεμόμενη θερμότητα	0%	0%	0%
ΑΠΕ	0%	0%	1%
Βιομάζα	0%	0%	2%
Φυσικό αέριο	4%	7%	8%
Πετρέλαιο και στερεά ορυκτά καύσιμα	23%	13%	17%

Source: EUROSTAT and own estimates

	Final energy consumption by use in the tertiary sector (ktoe) (2015)
	Space heating
	Production of domestic hot water
	Air-conditioning
	Cooking
	Electrical appliances and lighting systems
	Energy consumption shares in the tertiary sector (%)
	Electricity
	District heating
	RES
	Biomass
	Natural gas
	Diesel and solid fossil fuels

As regards thermal uses in tertiary sector buildings, diesel and natural gas have the largest share, i.e. 55 % and 29 % respectively. Liquefied gas and biomass have a 8 % and 6 % share respectively, whereas the share of solar and geothermal energy is negligible.

Figure 16: Breakdown of thermal energy consumption in buildings by type of fuel in the tertiary sector

Source: Combined EUROSTAT and Heat Roadmap Data

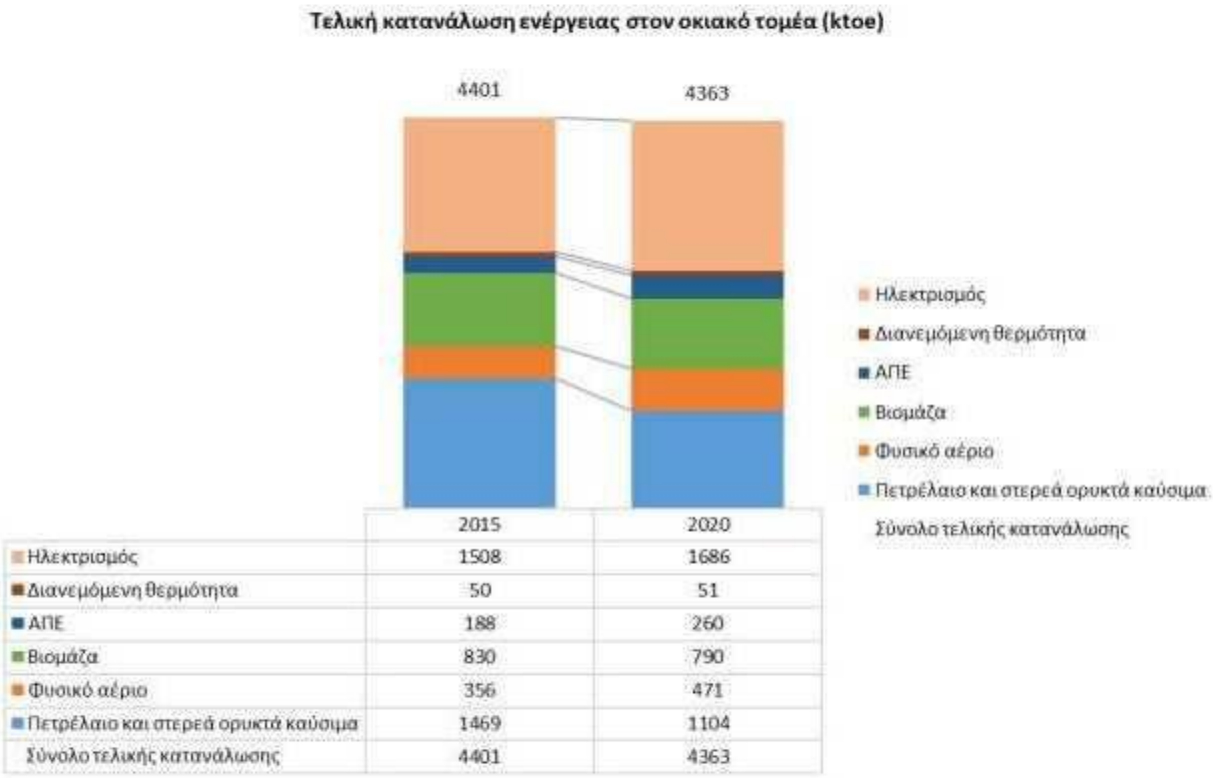
	Final thermal energy consumption by type of fuel in the tertiary sector in 2015 (%)
	■ Liquefied gas
	■ Diesel and natural gas
	■ Solar energy
	■ Biomass
	■ Geothermal energy

3.5 ANTICIPATED PERCENTAGE OF RENOVATED BUILDINGS IN 2020

Existing policies for the energy upgrading of buildings are expected to lead to an increase in the rate of renovation of both residential dwellings and tertiary sector buildings, compared to the rate that has been recorded over time. More specifically, a total of approximately 110 000 residential dwellings are expected to have undergone energy upgrading by the end of the 5-year period from 2015 to 2020. That number refers to the energy upgrading of the building envelope, and as regards the intensity of energy upgrading, it will result in average energy savings of 35 % and may be classified as upgrading of medium intensity.

The renewal of heating and cooling equipment, which may accompany the energy upgrading of buildings or may be carried out independently, is expected to lead to a slight drop in final energy consumption compared to 2015 in both sectors (Figures 17 and 18). As regards the fuel mix in final consumption, a shift is expected from systems using diesel or solid fossil fuels to natural gas and electricity. The latter are systems with a higher energy efficiency (which explains the drop in final consumption) compared to systems using liquid and solid fossil fuels, whereas the use of heat pumps in particular is more cost-effective compared to other heating technologies in buildings whose envelope has undergone energy upgrading.

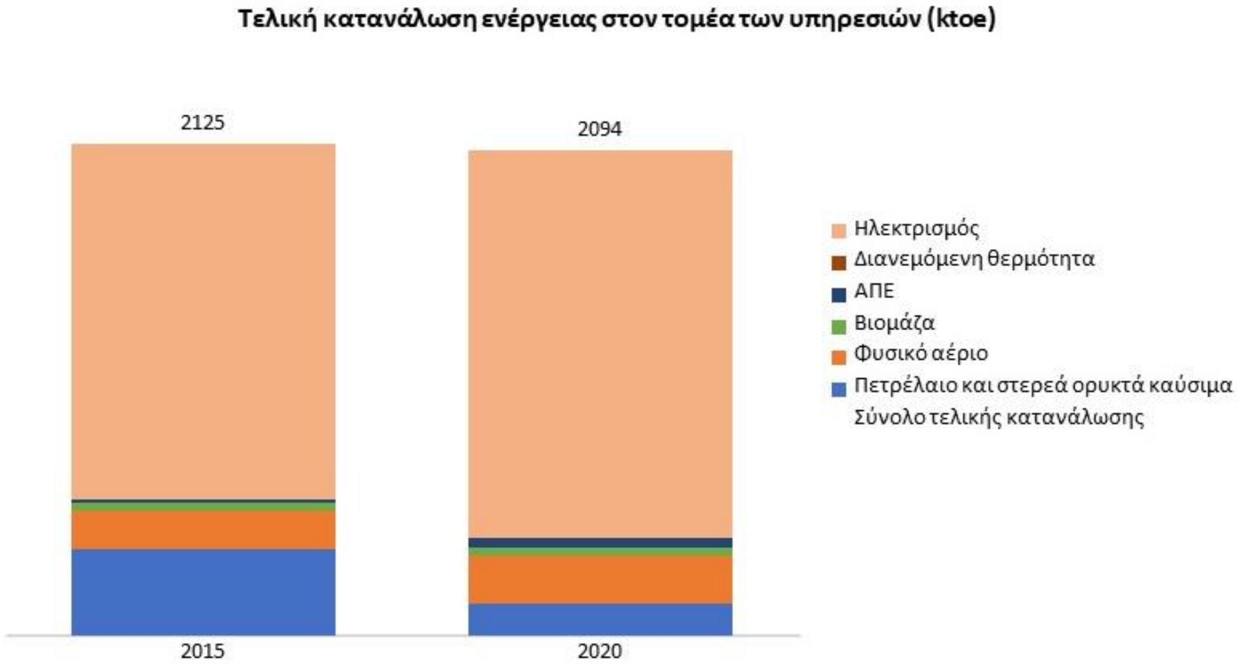
Figure 17: Structure of final energy consumption in the domestic sector in 2020 (compared to 2015).



Source: PRIMES

	Final energy consumption in the domestic sector (ktoe)
	Electricity
	District heating
	RES
	Biomass
	Natural gas
	Diesel and solid fossil fuels
	Total final consumption

Figure 18: Structure of final energy consumption in the services sector in 2020 (compared to 2015).



Source: PRIMES

	Final energy consumption in the services sector (ktoe)
	Electricity
	District heating
	RES
	Biomass
	Natural gas
	Diesel and solid fossil fuels Total final consumption

3.6 CONCLUSIONS

To sum up, the stock of buildings in Greece has a high potential for energy savings, whereas most of those buildings are residential dwellings. Thermal uses in both the domestic and tertiary sectors are dominated by diesel, followed by biomass, electricity and natural gas.

4 COST-EFFECTIVE RENOVATION SCENARIOS BY TYPE OF BUILDING

In the context of applying Law 4122/2013 (Government Gazette, Series I, No 42), transposing Directive 2010/31/EU[24] on the energy performance of buildings (OJ L 153), a report was prepared for the calculation of cost-optimal performance levels of minimum energy performance requirements for buildings. The report was posted on the Commission's website 'EU countries' 2018 cost-optimal reports'[25] in July 2018. The conclusions of the report list the energy interventions which can be implemented in a domestic or tertiary sector building along with a cost-benefit analysis.

[24] https://eur-lex.europa.eu/legal-content/EL/TXT/PDF/?uri=CELEX:32010L0031&from=EL
[25] https://ec.europa.eu/energy/topics/energy-efficiency/energy-performance-of-buildings/energy-performance-buildings-directive/eu-countries-2018-cost-optimal-reports_en?redir=1%22

The optimal results obtained from the report for a financial[26] calculation with a 7 % discount rate and a 2.8 % development in energy prices for each period, climatic zone and type of building are detailed in Annex II. In the context of the calculations, graphs were created to assess all scenarios / sets of measures examined for each period and climatic zone.

4.1 SUMMARY RESULTS

4.1.1 Domestic sector

Following is a summary of the optimal results obtained for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for new and existing domestic sector buildings.

Table 7: Summary results concerning cost-optimal energy savings interventions in residential dwellings

Period	Climatic zone	Single-family houses		Three-floor multi-dwelling building with a ground-floor non-heated space		Three-floor multi-dwelling building with a pilotis system		Five-floor multi-dwelling building with a pilotis system	
		Cons. of Prim. Energy kWh/m².a	Cost €/m²	Cons. of Prim. Energy kWh/m².a	Cost €/m²	Cons. of Prim. Energy kWh/m².a	Cost €/m²	Cons. of Prim. Energy kWh/m².a	Cost €/m²
1955-1980	A	187.4	532.4	87.80	294.99	84.90	304.18		
	B	242.00	599.99	103.9	316.61	100.20	325.57	70.1	263.75
	C	195.50	659.3	138.7	369.06	141.70	383.72	97.2	298.64
	D	192.6	652.7	153.10	390.50	156.60	407.16		
1980-2000	A	134.00	400.31	91.5	254.86	88.5	257.43		
	B	185.80	458.67	104.2	271.47	103.3	277.62	71.50	237.82
	C	242.70	539.37	145.1	324.62	125.40	339.26	97.40	269.55
	D	193.80	584.34	138.3	347.24	140.30	363.19		
2000-2010	A	133.60	413.01	98.00	242.03	94.6	244.76		
	B	127.10	344.30	110.60	258.49	109.3	265.05	71.00	203.83
	C	128.11	417.08	139.6	319.04	116.2	337.29	102.80	242.71
	D	252.30	566.58	158.1	344.34	131.2	360.70		
2010-2017	A	95.20	236.67	69.50	186.08	76.10	186.33		
	B	105.10	254.63	79.20	200.45	88.00	202.57	60.90	156.44
	C	152.80	307.63	131.07	264.87	118.80	263.22	101.9	205.16
	D	166.20	323.41	142.60	264.34	127.90	259.2		
NEW	A	67.10	1 585.05	33.9	1 424.37	33.70	1 402.01		
	B	77.20	1 607.35	42.1	1 453.54	42.00	1 431.13	34.40	1 354.04

[26] The cost-benefit study was carried out / implemented on the basis of both a financial and macroeconomic analysis. The financial analysis was preferred for the long-term strategy report to support the renovation of the stock of buildings.

	C	112.60	1 650.89	63.4	1 502.13	62.30	1 482.70	47.70	1 387.01
	D	102.40	1 670.21	77.2	1 549.24	77.00	1 529.38		

4.1.2 Tertiary sector

Following is a summary of the optimal results obtained for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for new and existing tertiary sector buildings.

Table 8: Summary results concerning cost-optimal energy savings interventions in tertiary sector buildings

Period	Climatic zone	Two-floor office building with an underground non-heated space		Five-floor office building with a ground-floor non-heated space	
		Cons. of Prim. Energy kWh/m².a	Cost €/m²	Cons. of Prim. Energy kWh/m².a	Cost €/m²
1955-1980	A	123.00	383.53	103.7	344.46
	B	135.1	395.75	114.4	358.35
	C	155.9	418.34	131.4	380.02
	D	166.4	430.46	140.5	397.08
1980-2000	A	114.7	359.75	97.6	328.12
	B	122.1	366.6	105.1	337.32
	C	134.0	379.48	115.7	351.03
	D	140.5	387.46	122.0	365.79
2000-2010	A	161.1	315.46	137.6	281.31
	B	171.7	325.75	149.5	293.47
	C	192.0	347.73	167.6	313.69
	D	202.4	362.35	178.1	326.61
2010-2017	A	154.9	310.58	136.7	262.43
	B	79.20	320.93	147.0	274.05
	C	131.07	337.75	160.5	285.98
	D	142.60	348.74	168.0	295.77
NEW	A	162.5	1 556.3	97.5	1 457.42
	B	174.3	1 568.31	104.1	1 467.43
	C	194.7	1 590.28	113.9	1 480.39
	D	202.2	1 600.63	118.6	1 493.21

4.1.3 Statistics

Annex I provides details about the average existing energy consumption (based on the statistical analysis provided in the EPCs), the consumption by energy category and the potential average energy savings in accordance with the report on the cost-optimal renovation of existing, and construction of new, buildings in the domestic and tertiary sectors (please note that office buildings were used as reference buildings for the tertiary sector).

Please note also that consumption of a building is the theoretical consumption calculated on the basis of the building's asset rating, not its operational rating.

5 POLICIES AND MEASURES TO IMPROVE THE ENERGY EFFICIENCY OF BUILDINGS

5.1 MEASURES AND POLICIES UP UNTIL 2020

The national policy for the renovation of buildings in the period 2014-2020 focused primarily on individual residential dwellings and end consumers, and in the context of pilot actions, on public sector buildings (primarily local authorities' buildings). This section lists the most important existing (regulatory and economic) measures taken in recent years to promote the renovation of buildings in the domestic and tertiary sector, in accordance with the 2020 Annual Report on the Achievement of National Energy Efficiency Targets (reporting year 2018). More specifically, we should stress the following measures contributing, directly or indirectly, to the renovation of buildings and the achievement of energy savings:

1. Regulation on the Energy Performance of Buildings (KENAK)

The KENAK was adopted in 2010 and revised in 2017 with a view to reducing the consumption of conventional energy for heating, cooling and air-conditioning, as well as for lighting and production of domestic hot water, while at the same time ensuring comfort conditions in the indoor areas of buildings. This target can be achieved through the energy-efficient design of the envelope, the use of energy-efficient building materials and electromechanical installations, renewable energy sources (RES) and cogeneration of heat and power (CHP). In short, the KENAK sets out:

- the methodology used to calculate the energy efficiency of buildings and an estimate of the amounts of energy consumed for heating, cooling and air-conditioning, as well as for lighting and production of domestic hot water;
- the minimum energy performance requirements and the categories used to classify the buildings;
- the minimum requirements for the architectural design of buildings, the thermal characteristics of the building elements of the envelope and the specifications of electromechanical installations in new buildings which are being designed and in those undergoing major renovation;
- the content of the energy performance design for buildings;
- the format of the energy performance certificate (EPC) issued for buildings, and the information to be included therein;
- the procedure for carrying out energy inspections of buildings and the procedure for carrying out inspections of heating and air-conditioning installations.

Energy inspection is a diagnostic tool used to determine the energy status of existing buildings and the potential for improving it. Energy inspections and EPCs are also a tool in the national energy policy which provides firstly the real estate market with new quality criteria which are directly linked to the value of properties, and secondly people (owners, purchasers or tenants) with measurable data on the annual operating costs for heating and cooling, hot water, lighting, etc.

The table below lists the measures that led to the renovation of buildings and the resulting energy benefits in accordance with the Annual Report on the Achievement of National Energy Efficiency Targets of 1 June 2020 (reporting year 2018):

Table 9: Policy measures for the renovation of buildings and energy savings[27]

No	Policy measures for energy savings from the renovation of buildings	Final energy savings achieved (ktoe) for the period 2014-2018
1	'Savings at home' programme	37
2	'Savings' programme for local authorities	6.75
3	'Savings II' programme for local authorities	0.69
4	Energy upgrading of residential dwellings	9.71
5	Issuing EPCs as a support measure	25.27
6	Offsetting fines for illegal buildings against energy upgrading works	9.88
7	Energy managers in buildings in the public and broader public sector	4.81

2. 'Savings at home' / 'Savings-Independence' programme

The 'Savings at home' programme was launched in 2011 aiming to promote interventions for improving the energy efficiency of the envelope and heating systems in residential dwellings.

The programme concerned is included in actions with a highly developmental character which ensure direct benefits for people, as well as in terms of employment, as it creates immediately turnover for businesses and professionals, small and medium ones in particular, actually in Greek economic sectors which are well-positioned and promising. As regards the construction sector in particular, which has been in recession for a prolonged period of time due to the economic crisis, the programme is a real boost for employment and for the development of the markets in building and other materials used in the energy savings industry, which actually have increased added value as many of them are produced domestically.

3. Increase in the depreciation rate for businesses

Article 24 of Law 4172/2013 (Government Gazette, Series I, No 167)[28], provides for an increased depreciation rate for the assets of businesses that relate to the costs incurred in connection with the energy efficiency of buildings.

4. Increase in the land to building ratio for high energy efficiency buildings

Article 25 or Law 4067/2012 (Government Gazette, Series I, No 79) setting out the new building regulation provides incentives for creating minimum energy consumption buildings. More specifically, if the energy efficiency design classifies a building under the highest energy efficiency listed in the Regulation on the Energy Performance of

[27] 2018 Annual Report on the Achievement of National Energy Efficiency Targets
[28] As amended by Hellenic Government Gazette, Series II, No 5597/2018

Buildings (KENAK), the land to building ratio is increased by 5 %. If the energy efficiency design indicates that a residential dwelling has a primary energy consumption level below 16 % of that of the reference building referred to in the KENAK, the land to building ratio is increased by 10 %. The same increase in the land to building ratio is granted for buildings intended for other purposes which have a primary energy consumption level below 16 % of that of the reference building, provided that they also have an excellent environmental performance level (equal to or higher than the LEED Gold, BREEAM Very Good or DGNB Silver rating).

5. Offsetting fines for illegal buildings against energy upgrading works

This measure is based on the application of Article 20 of Law 4178/2013 (Government Gazette, Series I, No 174), which allows for offsetting the amounts paid for services, works and materials intended for the energy upgrading of buildings against the amounts of the special fine, up to 50 % of the special fine imposed. These amounts are offset on condition that the interventions implemented will upgrade the building by at least one energy category or will ensure primary energy savings higher than 30 % of the consumption of the reference building.

6. Energy manager in public sector buildings

Joint Decision No Δ6/B/14826/17.06.2008 (Government Gazette, Series II, No 1122) of the Minister for the Interior, the Minister for the Economy and Finance and the Minister for Development provides that an energy manager should be appointed in buildings used by the public and broader public sector.

7. Plan for increasing the number of nearly zero-energy buildings (NZEBs)

Ministerial Decision No 85251/242/5.12.2018 (Government Gazette, Series II, No 5447) of the Minister for the Environment and Energy approved the national plan for increasing the number of NZEBs. Please note that the zero or nearly zero energy required for NZEBs must be covered mostly with RES energy generated at or near the building.

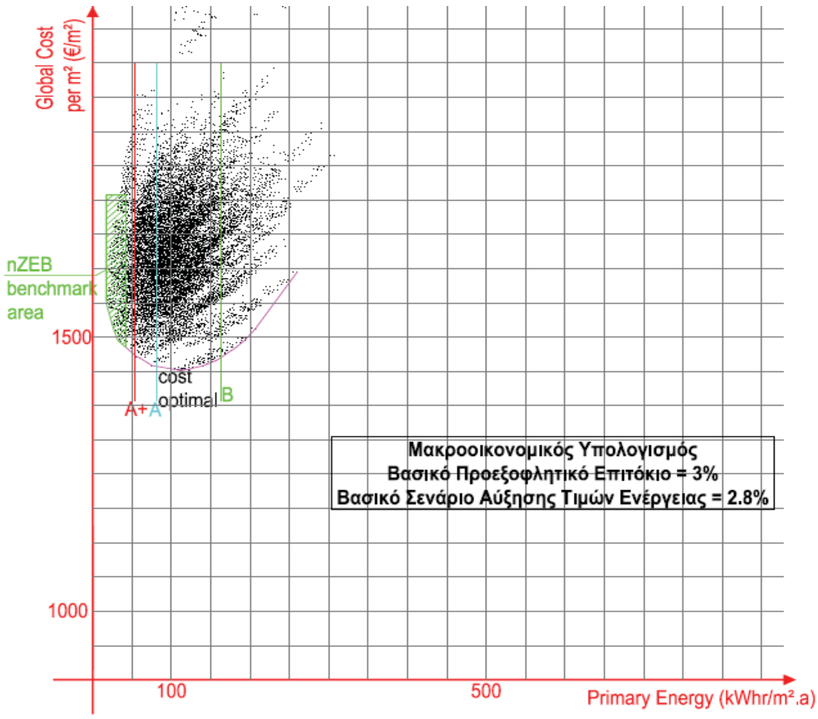
To increase the number of NZEBs it is necessary to determine the range of energy consumption by type of building and climatic zone, the cost-optimal energy consumption and the energy category in order to classify a building as NZEB. The above-mentioned plan sets out the range of primary energy consumption values for energy categories B to A+ by climatic zone.

Table 10: Energy consumption values for buildings classified under categories B and A+

Energy category	Primary energy consumption levels for residential dwellings by climatic zone (kWh/m²a)			
	A	B	C	D
A+	11 - 25	14 - 35	10 - 44	17 - 36
A	18 - 56	21 - 55	26 - 74	54 - 88
B+	32 - 81	31 - 99	45 - 125	37 - 128
B	45 - 112	56 - 126	72 - 172	63 - 184
A+	12 - 77	14 - 91	52 - 69	30
A	65 - 185	41 - 114	68 - 119	82
B+	98 - 218	60 - 196	99 - 218	105 - 156
B	133 - 266	115 - 245	120 - 280	149 - 218

In addition to the cost-optimal method, the scope of the requirements for NZEBs was also determined for 2020. Combinations of measures for improving the energy characteristics of the envelope, including efficient technical systems for buildings and RES technologies (photovoltaic systems, solar thermal systems and heat pump heating and cooling systems) were used for the study.

Figure 19: Delimitation of the NZEB zone in the cloud of scenarios for a new typical building in climatic zone C



(the graph shows the total cost in relation to primary energy consumption)

	Macroeconomic calculation Basic discount rate = 3 % Baseline scenario for the development of energy prices = 2.8 %

In view of the above, the following requirements were laid down for classifying a building as NZEB:

- It must be classified under energy category A, for new buildings.
- It must be classified under energy category B+, for existing buildings.

5.2 BARRIERS TO THE TAKING OF INVESTMENT DECISIONS FOR THE ENERGY UPGRADING OF A BUILDING

Given the scope and scale of the energy savings to be achieved by 2050 in the building stock of Greece, the long-term renovation strategy needs to identify and overcome a number of barriers and challenges relating to the functioning of the energy efficiency market. It also needs to better focus on individual consumers, as utilising the high potential for energy savings, notably in residential dwellings, highly depends on the investment decisions of those consumers. Inadequate response on the part of consumers to energy upgrading policies at a European level, reflected on the lack of energy upgrading investments in domestic sector buildings, creates an energy efficiency gap which can only be filled firstly by understanding the causes of that behaviour and secondly by taking appropriate measures to address it.

The overall picture of the stock of buildings is summarised by the information presented below, which is taken into account in identifying and taking measures to overcome the barriers:

- these are mostly older buildings constructed and operating in line with outdated regulations, with no thermal insulation, thus consuming increased amounts of energy;
- the efficiency of heating systems is deemed to be at a medium level, which increases the energy and environmental impact;
- in many agglomerations in Greece it is necessary to comply with specific rules for the protection cultural and architectural heritage;
- the prolonged economic recession has resulted in conditions which are unfavourable for investment;
- the particular geographic and climatic conditions create special circumstances and needs.

The barriers can be broken down into two main categories: those relating to the functioning of the energy savings market for buildings (market barriers) and those relating to the behaviour of end users/consumers (non-market barriers). The first category includes barriers which depend on the functioning of the institutional framework, the availability of funds to cover the investment costs to be incurred by consumers, the absence of or limited access to cash flows, the technical barriers, the absence or low quality of the energy services provided. The second category includes insufficient information to consumers, uncertainty with regard to the developments in terms of energy price levels and technologies, as well as lack of awareness of technical matters, which affects the consumers' ability to understand and make the most of the benefits of energy upgrading.

5.2.1 Market barriers

Firstly, market barriers relate to the 'actual' costs (sums actually paid by consumers) and access to funds. These also include hidden investment expenses which are not directly related to the cost of renovation materials/work, but are still real expenses. Such expenses may include, for example, the removal of waste or the need to carry out indoor insulation works in multi-floor buildings. Moreover, these expenses may relate to the high investment costs for very old residential dwellings or buildings situated in geographically isolated areas, which entail extra costs for the transportation of materials (e.g. islands). Finally, they may relate to the cost of installing heating and cooling systems, including, apart from the cost of works and materials, the extra costs for upgrading already installed systems (i.e. boreholes in the event of geothermal systems, provision of a chimney in the event of a shift to a different type of fuel, new radiators or piping works, works for installing heat pumps, etc.). Such expenses are further increased where the interventions in the building envelope are subject to limitations (e.g. architectural issues, accessibility to infrastructure, common heating infrastructure).

On top of the costs referred to above, reduced access to cash flows is a key barrier, as investments in energy efficiency measures are capital-intensive and entail a long repayment period. Lower income households are the ones particularly affected by the lack of financing. In addition to that, access to bank financing is still difficult due to the absence of a common understanding of the technical, regulatory and legal issues involved between the banking sector and the energy service providers, which prevents the efficient handling of energy efficiency projects (de-risking mechanisms).

Other barriers relate to the absence of energy, labelling and certification standards for the materials used in construction and the absence of integrated technical support by energy service providers. They are also directly related to the lack of skills and training among the actors involved in the implementation of new techniques and technologies in the energy upgrading industry. The deficiencies are identified both in the area of energy savings technologies and in the area of renewable energy sources used in the renovation industry at a global scale.

At an institutional level, no defined national standard is applied for taking adequate and certified measurements of the actual energy consumption in buildings.

The International Performance Measurement and Verification Protocol (IPMVP) can provide a uniform method for taking and verifying energy and water savings measurements. As regards public buildings, the difficulties in implementing energy upgrading projects relate to the absence of energy data, as energy consumption files are not kept and/or updated. Furthermore, the issues of taking an inventory of the number of public buildings and identifying their ownership status are yet to be tackled, thus acting as roadblocks to the implementation of interventions for improving the energy efficiency of public sector buildings.

5.2.2 Non-market barriers:

This category of barriers relates to the behaviour of individual consumers and is broken down into two subcategories:
(a) lack of information and knowledge; *and*
(b) uncertainty (regarding future developments in terms of technology, energy prices, regulatory framework).

The lack of necessary information or the inability to draw correct conclusions on energy savings interventions leads to an increase in underlying discount rates, thus negatively affecting consumer decisions concerning energy savings investments. The benefits resulting from the energy upgrading of buildings are often calculated over a long period of time and are thus deemed to be uncertain due to a lack of reliable market data from other investments.

In addition to that, the initial high cost of energy efficiency investments causes uncertainty in households, which is associated with the development of energy prices and technological costs, as well as the development of the rate of return of the investment made in each case. Consumers are also reluctant to invest in new technologies which are not yet fully mature or have a low uptake in the market, primarily due to reduced purchasing power and low ‘imitation effect’.

5.3 National energy and climate plan

Improving the energy efficiency of the stock of buildings in Greece is a key priority in the NECP. Making sure that successful financing programmes are maintained and adapted in order to enhance their cost effectiveness by increasing current leverage levels, as well as making a substantial contribution towards the protection of vulnerable social groups are key policy priorities for the period 2020-2030. To that end, plans will be made for the energy upgrading of 12-15 % of the buildings and/or building units in the 10-year period from 2021 to 2030 through targeted policy measures by 2030. Overall, the improvement of the energy efficiency of the stock of buildings is expected to increase the domestic added value by EUR 8 billion, as well as to create and maintain 22 thousand new full-time jobs. Finally, provision has been made for developing a special mechanism to monitor, measure and assess the degree of achievement of the goal and of the intended economic and social benefit for all policy actions in the area of energy efficiency.

To achieve the goal of renovating the stock of buildings, plans are being made for maintaining the measures already implemented successfully and applying new ones which are deemed necessary under the NECP, as presented below.

5.3.1 Regulatory measures

1. Amending the KENAK

The new minimum requirements for increasing the number of NZEBs will be included in the KENAK**.** Consideration is also being given to revising the KENAK by shifting from the reference building method to a method that focuses on the actual functioning of a building. Given that the intended action for the 10-year period from 2021 to 2030 consists in renovating the stock of buildings and securing financing for the energy upgrading of 12-15 % of the buildings and/or bundling units, we have to be aware of the energy status/behaviour of a building in order to determine, as accurately as possible, the optimal mix of interventions for the renovation.

The implementation of energy performance improvement measures, primarily in the tertiary sector, is also a goal for the 10-year period from 2021 to 2030. The contribution of two key systems, i.e. air-conditioning and lighting, used in hospitals, office buildings, commercial establishments, educational buildings, hotels, etc. will have to be re-evaluated in order to improve the energy performance of buildings under renovation. The selection criteria pertain to the energy, economic and environmental benefits, as well as the protection of workers' health. The cost of health and safety in work areas is minimal compared to the benefit of uninterrupted and productive work.

Therefore it is deemed appropriate to add to the building renovation process (notably in the tertiary sector) the design for ensuring healthy conditions in work areas, along with upgrading the systems used for streamlined energy management during the functioning of buildings.

2. Upgrading the role of the energy manager in public buildings

The energy manager is a reference point for a public building, basically with regard to its functioning, but also with regard to its likely renovation. The electronic platform used to monitor the energy behaviour of buildings is clearly a useful tool, which will become even more functional by the use of a building energy management system according to ISO 50001. An ultimate goal is to ensure the energy interconnection of all public sector buildings, by use and by body, and the overall option of real-time monitoring.

3. Using an energy management system according to ISO 50001 in public buildings

Consideration is being given to the use of the energy management system application, and there is a proposal for using it in general government buildings initially, and then in all public buildings. This measure will help monitor the energy consumed in public buildings and plan their renovation. As explained above, it will serve as a key tool to assist energy managers in public buildings with their assigned tasks.

4. Energy poverty

To combat energy poverty, the plan for combating energy poverty, which is already being prepared, provides for making energy vulnerable households the focus of the energy upgrading measures for improving the building stock.

5. Other regulatory measures (NECP)

The NECP also includes the following measures for increasing the number of NZEBs:

- After 31 December 2023, all buildings housing public authorities must be classified under energy category B or higher, in accordance with the EPC.
- As of 1 January 2021, all new buildings or building units which are either leased or purchased by general government bodies must be NZEBs (classified under energy category A or higher).
- As of 1 January 2021, the energy performance indicator of all buildings or building units which are available for sale or lease must be stated in all advertisements.

5.3.2 ECONOMIC MEASURES

The financing programmes for the renovation of buildings in the domestic and tertiary sector during the new programming period will be implemented by adapting and enhancing the existing financing model, to allow beneficiaries to increase the current leverage levels. Following are the aims of those programmes:

- to increase the number of potential beneficiaries;
- to simplify the certification of interventions by using unit cost data;
- to have domestic financial institutions engage more actively in the financing of the required interventions; and

- to promote innovation in the domestic construction and processing industry.

Successful financing programmes for improving the energy efficiency of residential dwellings will be continued in the new programming period, and their operating framework will be duly adjusted by streamlining the incentives in order to maximise the energy benefits, while at the same time providing support to households that are vulnerable in terms of finances and energy.

1. 'Savings at home' / 'Savings-Independence' programme

The 'Savings at home' programme has been in place for years and has worked well in terms of attracting households and mobilising the market. Successful financing programmes for improving the energy efficiency of residential dwellings will be continued in the new programming period, and a new 'smart' component will be added with a view to strengthening the energy independence of residential dwellings, such as RES systems, batteries, chargers for electric vehicles and smart lighting systems. Their operating framework will be duly adjusted by streamlining the incentives in order to maximise the energy benefits, while at the same time providing support to households that are vulnerable in terms of finances and energy.

The renovation of individual residential dwellings (apartments, single-family houses) does not cover multi-dwelling buildings. Provision has already been made for extending the scope of the programme to include these cases in a separate section. The economic and town planning incentives of the new cycle of the programme are expected to strengthen participation in the programme for multi-dwelling buildings, building complexes and agglomerations. This will contribute to the recovery of economic activity in Greece, while at the same time bringing about considerable energy and environmental benefits also due to simultaneous reconstruction.

2. 'Electra' programme

The key aim of the programme is to create attractive and sustainable investments for the energy upgrading of the stock of buildings used by public bodies (general government bodies), through effective leverage of funds both from the private and public sectors. Adjusting the regulatory framework will facilitate the mobilisation of private funds in such a dynamic sector, which will make a substantial contribution towards achieving the ambitious NECP goals for the energy upgrading of buildings.

More specifically, the 'Electra' programme – which consists in financing interventions for improving the energy efficiency of buildings used by the general government and legal persons governed by public law, by having energy services companies participate in the implementation of the interventions through the conclusion of energy performance contracts – will strengthen the energy upgrading of public buildings by financing part of the relevant investments through investment loans to be repaid by the programme.

This approach will bring about better energy results in terms of achieving the goals, also facilitating the leverage of private funds due to better financial performance, whereas the renovation of buildings used by local authorities will also be subsidised so as to ensure also a cost-effective outcome.

3. Competitive procedures for energy savings

During its trial application, the new measure of competitive procedures is expected to focus on final energy savings, thus contributing substantially to the achievement of the goal set out in Article 7 of the Energy Efficiency Directive (EED). Under the measure concerned, financing support will be provided to technical interventions for energy savings in sectors with a high potential, such as the industrial and tertiary sectors. The conduct of the competitive procedure will aim primarily to ensure the cost-effectiveness of the interventions, in accordance with clear-cut instructions for calculating and verifying the energy savings. The measure is also marked with increased flexibility as it will be open to all domestic undertakings and is expected to increase the competitiveness of energy savings investment projects.

It is a measure for strengthening the private sector after a long-standing absence of relevant programmes. The programme will offer significant help towards the renovation of tertiary sector buildings. Energy services companies will be given the opportunity to participate in these projects, thus ensuring the leverage of funds. The measure concerns undertakings of all sizes, and it will be necessary to carry out an energy inspection, for the results of that inspection to provide the basis for planning the energy savings interventions.

In that event, given the economies of scale and the significant technical and financial object, an interest will be expressed immediately by energy carriers, such as energy services companies, construction companies, obligated parties, energy providers and real estate corporations.

4. Energy efficiency obligation scheme

The obligation scheme is expected to make a substantial contribution towards achieving the goal set out in Article 7 EED for the period 2021-2030, to promote energy savings interventions. The obligated parties will take up at least 20 % of the total cumulative energy savings goal under the obligation scheme, whereas energy suppliers and distribution network operators will also take part in the scheme. The target will be allocated to the obligated parties in the new period 2021-2030 on the basis of the realisable technical and financial energy savings potential in the areas in which the obligated parties are operating and on the basis of the mix of alternative policy measures for the new period.

5. Energy Efficiency National Fund

The Energy Efficiency National Fund (ETEAP) is expected to serve as the basis for the development of new financing tools, to finance programmes and other measures for the improvement of energy efficiency and the development of the market in energy services. Also taking into account the use of the revolving capital mechanism, the ETEAP may function as a lending fund, as well as a guarantee fund, to support energy savings projects. To make investment more attractive, available funds may be used to subsidise part of the cost of the programme or to further enhance the terms of financing the loans granted to energy carriers.

6. Innovative financing instruments for blended funding

Innovative blended/hybrid finance programmes will be designed in cooperation with the domestic financial sector. These programmes will combine public and private financing on favourable terms (the conclusion of energy performance contracts will contribute to this by reducing the technical and financial risks), to support energy efficiency improvement in specific sectors with a high potential, such as the tertiary, domestic and industrial sectors. In this direction, new mechanisms will be considered, such as: blended concessional loans, lease-financing, risk-sharing instruments such as blended insurance, and guarantee instruments (as well as aggregating).

Innovative financing instruments will be available for use by energy service companies that need financing to implement energy efficiency plans in order to better manage repayment thereof, whereas consideration will also be given to extending their scope to include other sectors too (SMEs).

The table below shows the cumulative energy savings from the alternative policy measures up until 2020:

Policy measures	**New annual energy savings** **Ktoe**	**Cumulative energy savings** **Ktoe**
1. Energy upgrading of residential dwellings	**52**	**2 878**
2. Energy efficiency obligation schemes	**66**	**1 460**
3. Energy upgrading of public buildings (‘Electra’ programme)	**4**	**208**
4. Energy upgrading of tertiary sector buildings and industrial plants	**8**	**427**
5. Energy managers in public buildings		**1 042**

The cost of each measure is different depending on the use and feasibility of each action[29]

Table 11 below shows the above-mentioned economic measures for renovating the stock of buildings and their respective scopes.

Table 11: Economic measures for renovating the stock of buildings and their respective scopes

No	ECONOMIC MEASURES FOR RENOVATING THE STOCK OF BUILDINGS	DOMESTIC	TERTIARY PRIVATE	TERTIARY PUBLIC
1	'Savings at home'	√		
2	'Electra' programme			√
3	Competitive procedures for energy savings		√	
4	Energy efficiency obligation schemes	√	√	√
5	Energy Efficiency National Fund	√	√	√
6	Innovative financing tools	√	√	√

Obviously the above-mentioned measures comprise a cohesive programme for renovating the stock of buildings, which covers all sectors (domestic, tertiary), provides for the participation of all stakeholders in the market concerned and combines different financing tools.

Under the NECP, in addition to analysing the macroeconomic impact of clean energy technologies, an analysis was carried out of the public health impact of the energy upgrading of buildings, using the DALY indicators[30]. Disability-Adjusted Life Years (DALY) have been used widely since the 1990s to assess the international and/or regional burden from diseases. Given the effects of atmospheric pollutants on human health, the DALY measurement is also used as an indicator for the quantification of the health impact of environmental pollution associated with the burden from diseases. The anticipated public health benefit is expected to exceed one thousand DALY annually, in accordance with the impact assessment included in the NECP.

The key priority of planning with regard to the improvement of the energy efficiency of the stock of buildings in Greece is expected to generate equally significant macroeconomic benefits for Greece. The energy upgrading of 15 % of Greek residential dwellings in the 10-year period from 2021 to 2030 and the improvement of the energy efficiency of the stock of buildings through interventions in the building envelope, are expected to increase the domestic added value by EUR 8 billion, as well as to create and maintain 22 thousand new full-time jobs annually throughout that period. The increase in the income of affected employees is expected to reach approximately EUR 3.4 billion. Please note that these estimates are expected to be significantly higher if the effects of investments in more efficient equipment on heating and cooling systems and other appliances are also taken into account.

The successful implementation of measures and policies up until 2030 is a necessary prerequisite for achieving the goal of the long-term renovation strategy by 2050. The substantial implementation of the measures entails the achievement of the targets set with regard to the renovation of buildings, energy savings, generation of domestic added value and employment. It is also a milestone for identifying problems, with a view to revising the planning for 2040 and 2050.

5.4 THE LONG-TERM STRATEGY BY 2050

As already explained the LS50 provides the base methodology for preparing the long-term renovation strategy for the stock of buildings, by assessing alternatives towards an almost climate neutral economy. The measures and policies aim to drastically reduce greenhouse gases by 2050 and to process two strategies, one aiming to reduce

[29] Study: 'Energy efficiency promotion in Greece in light of risk: Evaluating policies as portfolio assets' https://www.sciencedirect.com/science/article/abs/pii/S0360544218325544?via%3Dihub

[30] National Energy and Climate Plan (NECP), 2019 (Chapter 5.1, Table 4.3)

emissions in the context of trying to achieve the 2°C target and one aiming to reduce emissions in the context of trying to achieve the 1.5°C target for climate neutrality. The total investment costs for the energy upgrading of buildings are much higher under the EE scenarios than under the NC scenarios, which is similar in terms of amount to the NECP for the period 2020-2030.

Energy savings in all sectors of final energy consumption is of fundamental importance for energy transition and cost effectiveness. As regards buildings in particular, the targets of the LS50 scenarios are based on the aim of getting the stock of buildings close to nearly zero-energy consumption by 2050, namely that the stock should consist of buildings with a high energy performance that need zero or nearly zero energy to cover their energy needs, that energy being mostly offset by renewable energy sources which are used either directly or indirectly through heat pumps. In terms of quantity, the energy upgrading of older buildings is most important for energy savings, also given the relatively low renewal rate of the building stock. The climate neutrality scenarios provide for upgrading almost the total stock of buildings by 2050 and applying stringent energy specifications for new buildings.

Energy efficiency improvement is also dependent upon the selection of appliances and equipment that are state-of-the-art and highly efficient in terms of energy. The assumption is made in the scenarios that the eco-design regulations adopt more and more stringent specifications and the industry is able to produce state-of-the-art products that cost less and less over time. While useful energy for all purposes will be increasing in buildings due to a rise in actual income, final energy consumption will tend to drop significantly towards 2050 due to improved energy efficiency. This will also be due to the use of electricity for heating through heat pumps, which are marked with high efficiency levels and dropping costs and are effectively combined with the energy upgrading of buildings.

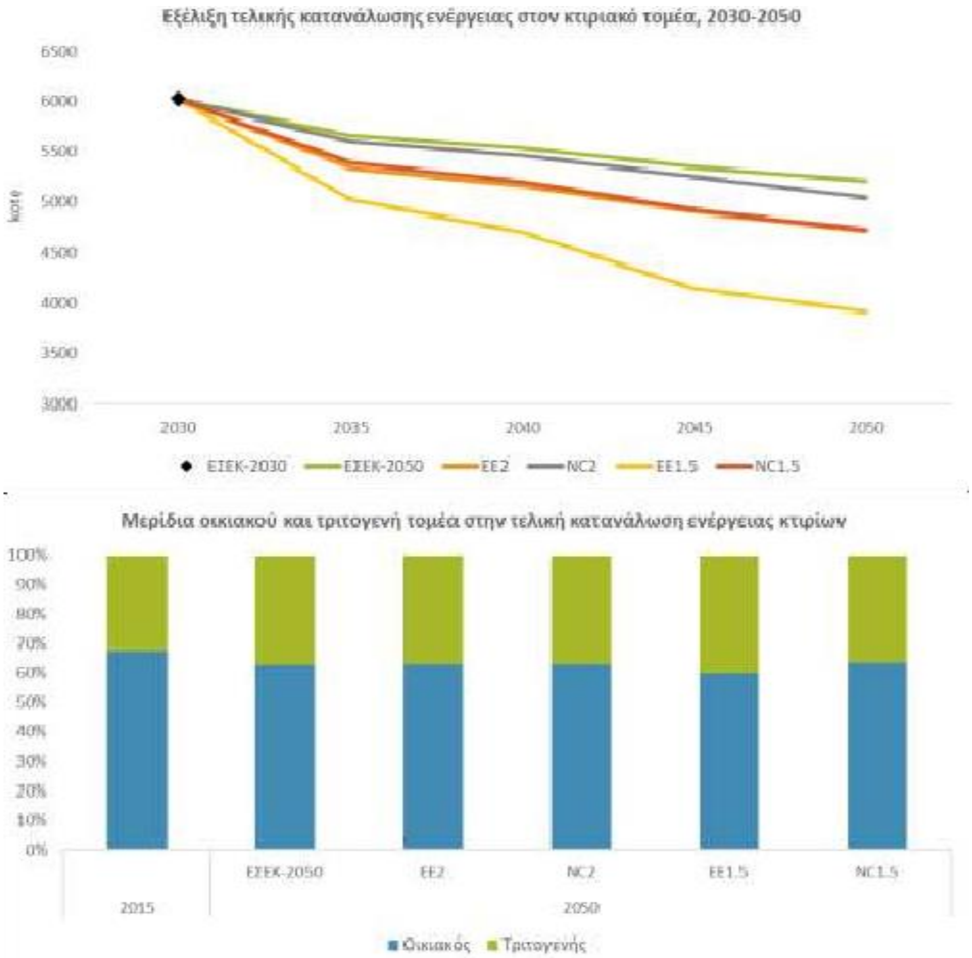
6 LONG-TERM STRATEGY SCENARIOS FOR ENERGY SAVINGS IN BUILDINGS

6.1 DESCRIPTION OF RESULTS

6.1.1 Final energy consumption in buildings

The path to climate neutrality, as described in the LS50 scenarios, includes very ambitious goals and policies for reducing energy consumption in buildings. All buildings will achieve an 8 % reduction by 2030 compared to 2015, whereas the NECP-2050 scenario provides for a reduction of 20 % by 2050 compared to 2015 (Figure 20). Under the scenarios aiming towards increased energy efficiency (EE2C and EE1.5C), the reduction of total consumption in buildings will be even higher. More specifically, under the scenario that provides for a climate target of 1.5°C, the rate of reduction is twice that referred to above, exceeding 40 % compared to 2015. As regards the distribution of the effort between the domestic and tertiary sectors, all scenarios provide for a slight reduction in the share of the domestic sector in total consumption in buildings by 2050 compared to 2015, as the interventions in the domestic sector are more intense (Figure 20).

Figure 20: Development of total final energy consumption in buildings in the period 2030-2050. Source: PRIMES

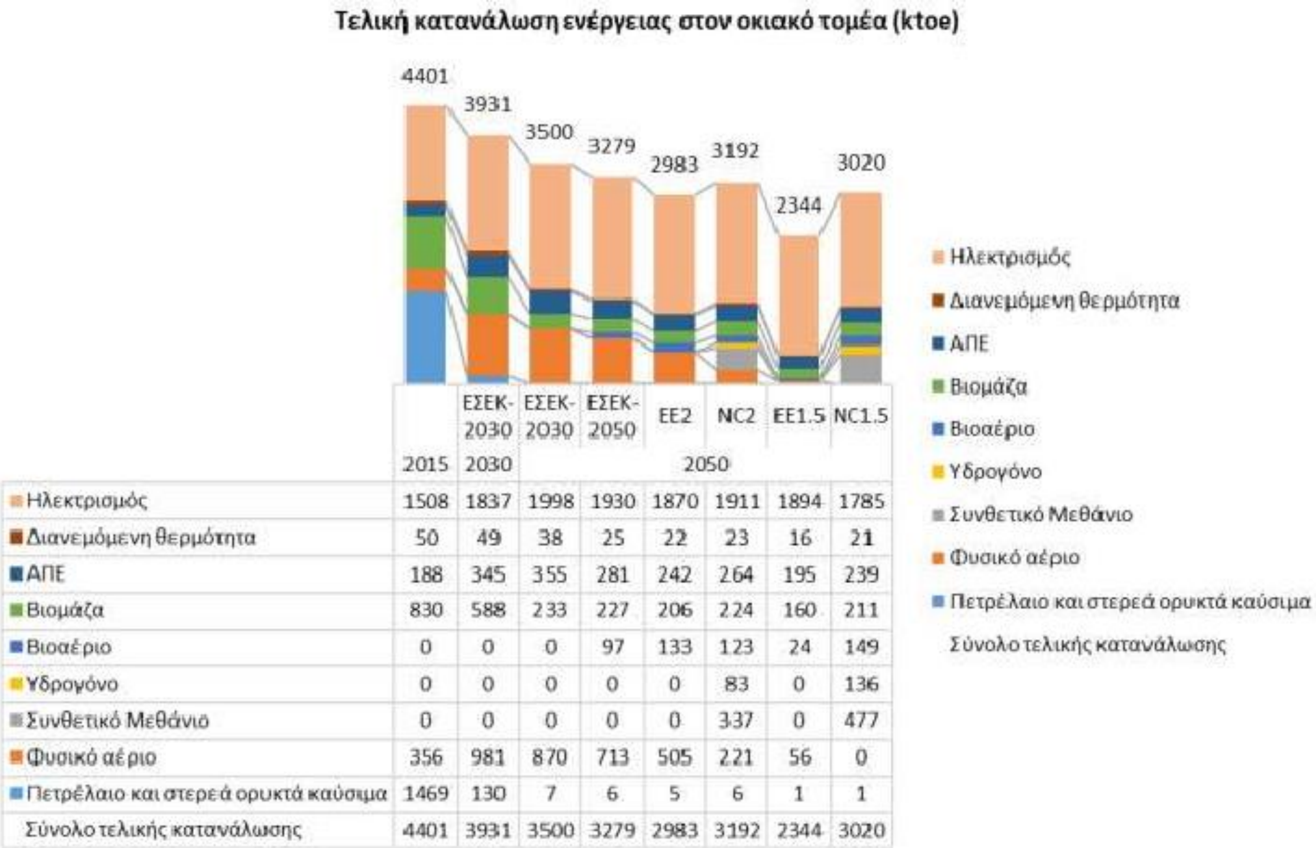


	Development of final energy consumption in buildings, 2030-2050
	NECP-2030 NECP-2050 EE2 NC2 EE1.5 NC1.5
	Shares of the domestic and tertiary sectors in final energy consumption in buildings
	Domestic
	Tertiary

In the domestic sector, apart from the reduction in overall demand, there is also a rapid change to the energy mix compared to 2015 under all scenarios. As early as in 2030, under the NECP-2030 the use of diesel is reduced by 90 %, as it is replaced by natural gas, RES and electricity, as well as due to energy savings (Figure 21). There is also a significant reduction in the use of conventional biomass, bringing about considerable benefits in terms of the air quality and reduced air pollution, which has been seen in statistics in recent years. By 2050, the LS50 climate neutrality scenarios also provide for the elimination of the use of diesel in the domestic sector, and the EE1.5 and NC1.5 scenarios provide for the radical independence of final consumption from fossil fuels. Under these scenarios and under the NC2 scenario, natural gas is replaced by synthetic methane and hydrogen, which are zero-emission gases, as they are produced by the use of zero carbon footprint electricity.

Electrification is the key characteristic of the shift of the energy system both under the NECP-2030 and the LS50 scenarios, always subject to the decarbonisation of electricity generation. As explained in the following sections, this transition in buildings is due to the increased penetration of electrical appliances/devices in households (white appliances, computers, etc.) as well as to the extensive use of heat pumps. There will be a 20 % increase in the use of electricity by 2030 compared to 2015 despite the drop in overall demand, representing 47 % of the total, whereas the penetration of electricity will reach 81 % by 2050 under the EE1.5 scenario, as the use of heat pumps will increase significantly due to their high coefficient of performance (COP) in covering the needs for heating and cooling, as well as due to the renovation of the building envelope which allows for using a heat pump optimally.

Figure 21: Structure of final energy consumption in the domestic sector. Source: PRIMES



	2015	ΕΣΕΚ-2030 2030	ΕΣΕΚ-2030 2050	ΕΣΕΚ-2050 2050	EE2 2050	NC2 2050	EE1.5 2050	NC1.5 2050
Ηλεκτρισμός	1508	1837	1998	1930	1870	1911	1894	1785
Διανεμόμενη θερμότητα	50	49	38	25	22	23	16	21
ΑΠΕ	188	345	355	281	242	264	195	239
Βιομάζα	830	588	233	227	206	224	160	211
Βιοαέριο	0	0	0	97	133	123	24	149
Υδρογόνο	0	0	0	0	0	83	0	136
Συνθετικό Μεθάνιο	0	0	0	0	0	337	0	477
Φυσικό αέριο	356	981	870	713	505	221	56	0
Πετρέλαιο και στερεά ορυκτά καύσιμα	1469	130	7	6	5	6	1	1
Σύνολο τελικής κατανάλωσης	4401	3931	3500	3279	2983	3192	2344	3020

	2015	ΕΣΕΚ-2030 2030	ΕΣΕΚ-2030 2050	ΕΣΕΚ-2050 2050	EE2 2050	NC2 2050	EE1.5 2050	NC1.5 2050
Ηλεκτρισμός	34%	47%	57%	59%	63%	60%	81%	59%
Διανεμόμενο αέριο	8%	25%	25%	25%	21%	24%	3%	25%
Βιομάζα και ΑΠΕ	23%	24%	17%	15%	15%	15%	15%	15%
Λοιπά	35%	5%	1%	1%	1%	1%	1%	1%

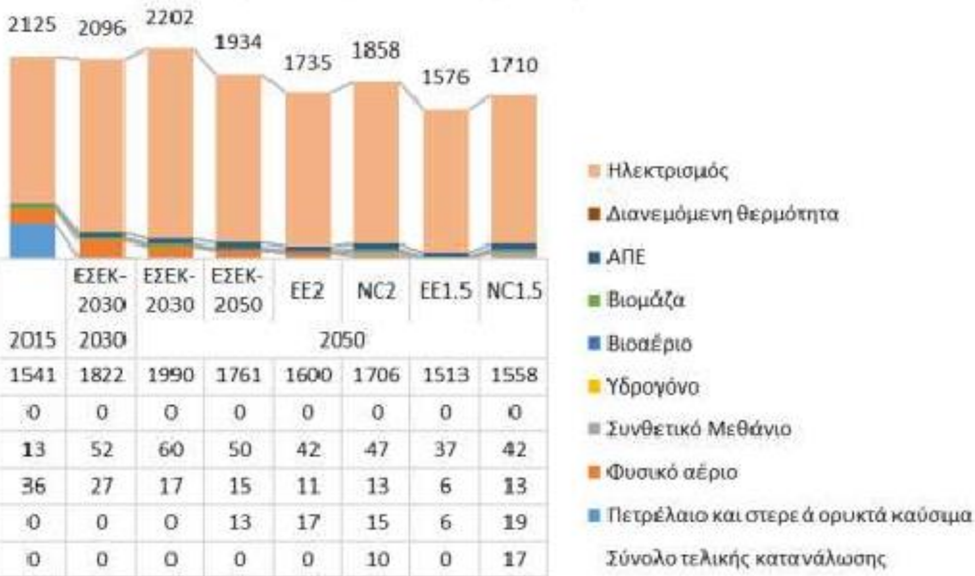
	Final energy consumption in the domestic sector (ktoe)
	NECP-2030 NECP-2050 EE2 NC2 EE1.5 NC1.5
	Electricity
	District heating
	RES
	Biomass
	Biogas
	Hydrogen
	Synthetic methane

	Natural gas
	Diesel and solid fossil fuels
	Total final consumption
	Energy consumption shares in the domestic sector (%)
	Electricity
	Gas distributed
	Biomass and RES
	Other

In the services sector, the changes made to the energy mix are less intense, as electricity had already covered 73 % of the total final demand for energy as of 2015 (Figure 22). The use of electricity will be increased to 87 % by 2030 and will cover almost all the energy needs of tertiary sector buildings by 2050. The introduction of heat pump systems is favoured by the need to install powerful heating/cooling/ventilation units.

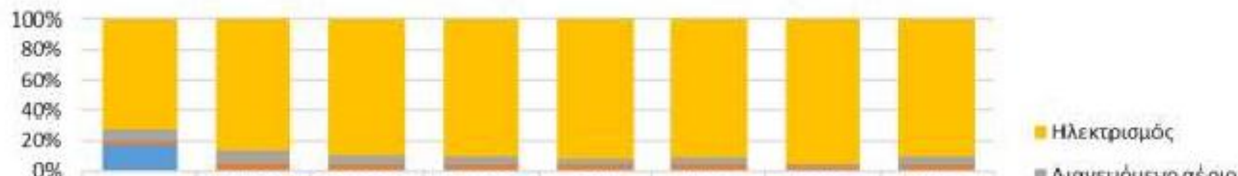
Figure 22: Structure of final energy consumption in the services sector. Source: PRIMES

Τελική κατανάλωση ενέργειας στον τομέα των υπηρεσιών (ktoe)



		ΕΣΕΚ-2030	ΕΣΕΚ-2030	ΕΣΕΚ-2050	EE2	NC2	EE1.5	NC1.5
	2015	2030	2050					
Ηλεκτρισμός	1541	1822	1990	1761	1600	1706	1513	1558
Διανεμόμενη θερμότητα	0	0	0	0	0	0	0	0
ΑΠΕ	13	52	60	50	42	47	37	42
Βιομάζα	36	27	17	15	11	13	6	13
Βιοαέριο	0	0	0	13	17	15	6	19
Υδρογόνο	0	0	0	0	0	10	0	17
Συνθετικό Μεθάνιο	0	0	0	0	0	40	0	61
Φυσικό αέριο	167	179	134	95	65	26	14	0
Πετρέλαιο και στερεά ορυκτά καύσιμα	368	15	0	0	0	0	0	0
Σύνολο τελικής κατανάλωσης	2125	2096	2202	1934	1735	1858	1576	1710

Μερίδια στην κατανάλωση ενέργειας στον τομέα των υπηρεσιών (%)



		ΕΣΕΚ-2030	ΕΣΕΚ-2030	ΕΣΕΚ-2050	EE2	NC2	EE1.5	NC1.5
	2015	2030	2050					
Ηλεκτρισμός	73%	87%	90%	91%	92%	92%	96%	91%
Διανεμόμενο αέριο	8%	9%	6%	6%	5%	5%	1%	6%
Βιομάζα και ΑΠΕ	2%	4%	4%	3%	3%	3%	3%	3%
Λοιπά	17%	1%	0%	0%	0%	0%	0%	0%

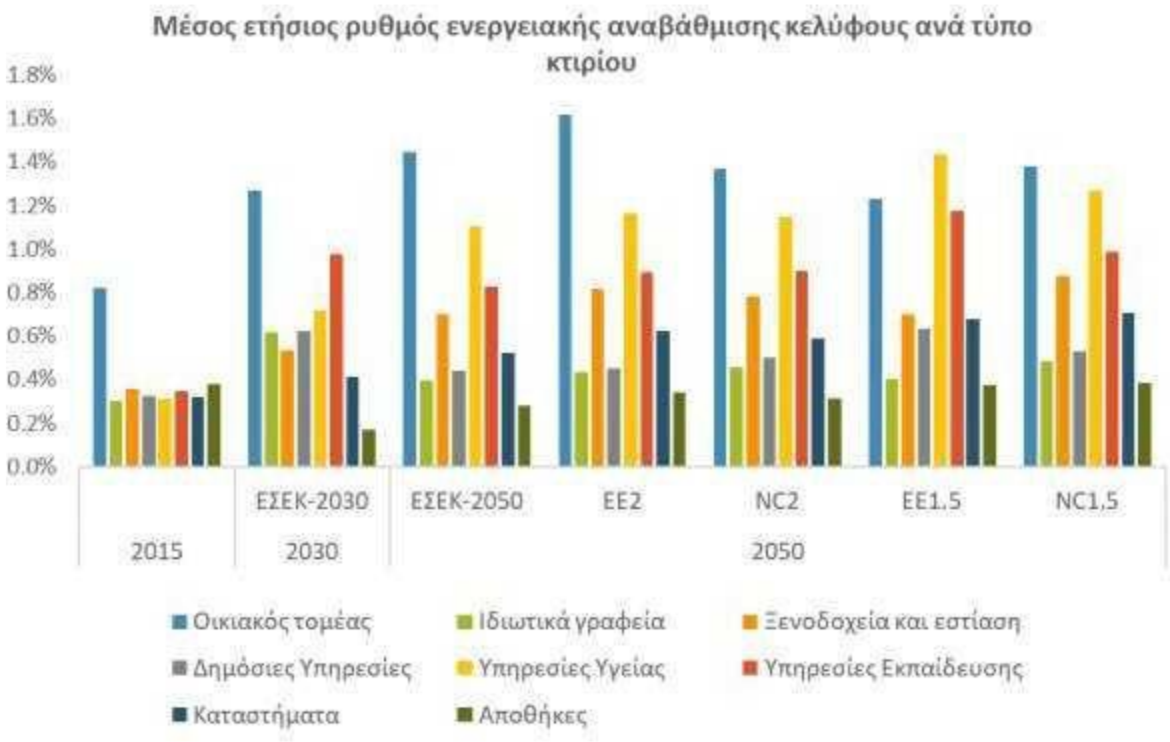
	Final energy consumption in the services sector (ktoe)
	NECP-2030 NECP-2050 EE2 NC2 EE1.5 NC1.5
	Electricity
	District heating
	RES
	Biomass
	Biogas
	Hydrogen
	Synthetic methane
	Natural gas
	Diesel and solid fossil fuels

	Total final consumption
	Energy consumption shares in the services sector (%)
	Electricity
	Gas distributed
	Biomass and RES
	Other

6.1.2 Renovation of building envelope

Interventions on the building envelope is a primary energy upgrading measure. The average annual energy upgrading rate for the envelope of buildings will remain higher in residential dwellings compared to other buildings throughout the period 2015-2050 and will record a significant increase compared to the 2015 levels as early as by 2030 (Figure 23). Under the LS50 EE2 scenario in particular, which places emphasis on energy savings, the average annual rate will be double that of 2015, reaching 1.6 % per year by 2050, resulting in an average 46 % drop in the demand for useful energy. As regards the period 2030-2050, the maximum renovation rate is recorded with regard to the envelope of buildings, consisting in medium and major renovation interventions, under the corresponding scenario, which is compatible with the climate neutrality goals (EE1.5).

Figure 23: Average annual envelope upgrading rate by type of building. Source: PRIMES



	Average annual envelope energy upgrading rate by type of building
	NECP-2030 NECP-2050 EE2 NC2 EE1.5 NC1.5
	■ Domestic sector
	■ Public agencies

	■ Stores
	■ Private offices
	■ Health services
	■ Warehouses
	■ Hotels and restaurants
	■ Education services

	2020-2030	2031-2050				
	NECP-2030	NECP-2050	EE2	NC2	EE1.5	NC1.5
Average annual envelope energy upgrading rate						
Domestic sector	1.28 %	1.24 %	1.30 %	1.24 %	1.52 %	1.32 %
Private offices	0.56 %	0.53 %	0.61 %	0.54 %	0.82 %	0.61 %
Hotels and restaurants	0.48 %	0.69 %	0.85 %	0.73 %	1.25 %	0.87 %
Public agencies	0.65 %	0.68 %	0.77 %	0.70 %	0.86 %	0.79 %
Health services	0.79 %	1.06 %	1.17 %	1.08 %	1.29 %	1.19 %
Education services	1.05 %	1.06 %	1.21 %	1.09 %	1.35 %	1.21 %
Stores	0.41 %	0.56 %	0.66 %	0.59 %	0.74 %	0.69 %
Warehouses	0.19 %	0.29 %	0.34 %	0.31 %	0.39 %	0.36 %

The greatest increase in the envelope renovation rate is recorded in health and education services buildings, as these have a particularly high untapped potential for energy savings interventions. However, as shown by the information listed in Table 12, the number of buildings in the services sector is much lower than that of the domestic sector.

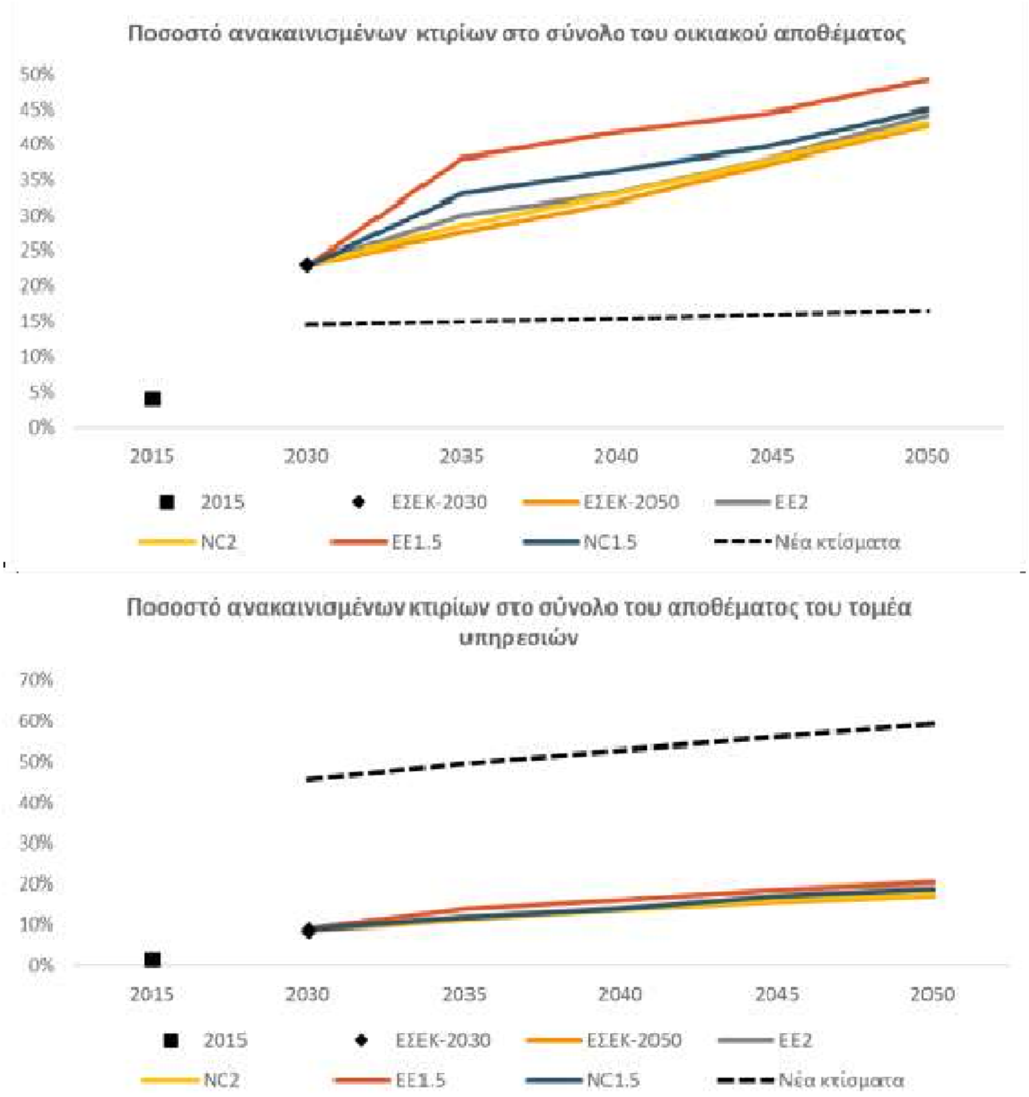
Table 12: Number of buildings which have, or have not, undergone envelope energy upgrading, cumulatively in the period 2031-2050. Source: PRIMES

	2031-2050					
	NECP-2030	**NECP-2050**	**EE2**	**NC2**	**EE1.5**	**NC1.5**
Residential dwellings						
Number of older buildings which have undergone energy upgrading (thousand)	728	856	913	874	1 136	956
Number of older buildings which have not undergone energy upgrading (thousand)	1 904	1 775	1 719	1 759	1 495	1 675
Services						
Number of older buildings which have undergone energy upgrading (thousand)	19	31	35	33	42	37
Number of older buildings which have not undergone energy upgrading (thousand)	96	84	79	83	73	78

The steadily increasing envelope energy upgrading rate in residential buildings in the period 2030-2050 leads to a gradual increase in the percentage of renovated buildings out of the total stock. Thanks to the energy savings policies and incentives, the penetration level of interventions will increase from 4 % in 2015 to 23 % of the building stock by 2030 and will be twice as much by 2050 under the LS50 scenarios (Figure 24). Major renovation interventions in the domestic sector are a necessary prerequisite for achieving the energy savings goals, as the percentage of newly-constructed buildings is low and almost stable in the period 2015-2050. On the contrary, the percentage of newly-constructed buildings in the services sector exceeds 50 % after 2035, thus reducing the renovation potential for the total stock of buildings.

In 2015, all households made almost solely minor renovations (door and window frames), whereas under the climate neutrality scenarios an increase is expected in the rate of minor (door and window frames, envelope insulation, roof) and major renovations as early as by 2030. For low-income households the highest renovation rate will concern minor renovations, but medium- and upper-income households will make more intense renovations (Table 13). For low-income households the corresponding rate for medium and major renovations will remain remarkably low, as the cost of the required equipment is very high and represents a large share in the total available income of those households, thus making the interventions concerned non-affordable without the provision of economic incentives and relief measures. On the contrary, high- and medium-income households are expected to have access to lower borrowing rates, thus considering more intense interventions to be more advantageous. Financing renovation projects through subsidisation that is subject to income-related criteria may be a tool for the implementation of more major renovations in the residential dwellings of low-income households, which are typically classified under low energy categories.

Figure 24: Shares of renovated and new buildings in the domestic and services sectors in the period 2030-2050. Source: PRIMES



	Percentage of renovated buildings out of the total stock of residential dwellings
	NECP-2030 NECP-2050 EE2 NC2 EE1.5 NC1.5
	New buildings
	Percentage of renovated buildings out of the total stock of buildings in the services sector
	NECP-2030
	EE1.5
	NECP-2050 NC1.5
	EE2
	New buildings

Table 13: Average annual envelope upgrading rate by type of intervention for three income levels. Source: PRIMES

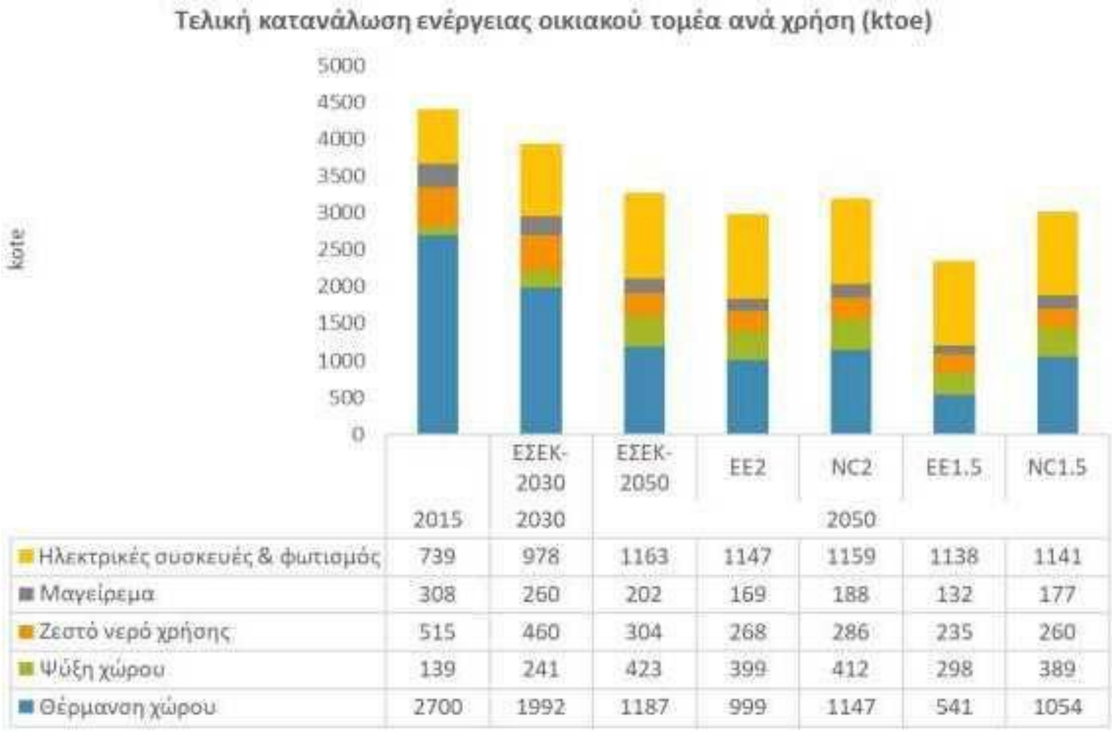
		2015	2030	2050				
			NECP-2030	NECP-2050	EE2	NC2	EE1.5	NC1.5
Low income	Minor	0.31 %	0.24 %	0.33 %	0.36 %	0.30 %	0.25 %	0.29 %
	Medium	0.00 %	0.02 %	0.02 %	0.04 %	0.02 %	0.03 %	0.03 %
	Major	0.00 %	0.01 %	0.01 %	0.01 %	0.01 %	0.01 %	0.01 %
Medium income	Minor	0.31 %	0.42 %	0.54 %	0.57 %	0.50 %	0.43 %	0.49 %
	Medium	0.00 %	0.07 %	0.06 %	0.09 %	0.06 %	0.07 %	0.07 %
	Major	0.00 %	0.03 %	0.03 %	0.04 %	0.03 %	0.04 %	0.03 %
High income	Minor	0.21 %	0.36 %	0.40 %	0.41 %	0.37 %	0.31 %	0.36 %
	Medium	0.00 %	0.09 %	0.07 %	0.09 %	0.07 %	0.07 %	0.07 %
	Major	0.00 %	0.06 %	0.04 %	0.05 %	0.04 %	0.04 %	0.04 %

6.1.3 Renovation of energy systems in buildings

Combined with the renovation of the envelope of buildings, the renovation of the energy systems used for space and water heating, and to a lesser degree for cooling and cooking, are an important parameter in achieving the energy savings goals. While the envelope renovation reduces the energy required for heating and cooling, the upgrading of energy systems contributes to a further reduction in the demand for energy due to increased system efficiency, as well as to ensuring near zero emissions thanks to using forms of energy with a zero carbon footprint. By combining these two forms of interventions, the building sector can contribute towards achieving climate neutrality.

More specifically, converting the energy systems used for heating is a priority in the domestic sector as heating systems had a 61 % share in final consumption in 2015 (Figure 25). Using more efficient systems will reduce that share to 51 % by 2030 in accordance with the NECP-2030. Under the LS50 scenarios for 2050, the share of energy consumption for heating will drop to near 30 %, whereas the absolute value of energy needs will drop by more than 60 % compared to 2015. Similarly, a substantial drop will be recorded in the energy consumed for domestic hot water, given the more efficient systems used under the LS50 scenarios. On the contrary, the energy required for the functioning of electrical appliances and lighting systems will be on the rise due to the increase in the standard of living of households and the resulting use of white appliances and technology and communications devices. Moreover, the rising standard of living and the changing climatic conditions will lead to an increase in the energy required for cooling compared to 2015 under all scenarios, despite the actions for building envelope renovation.

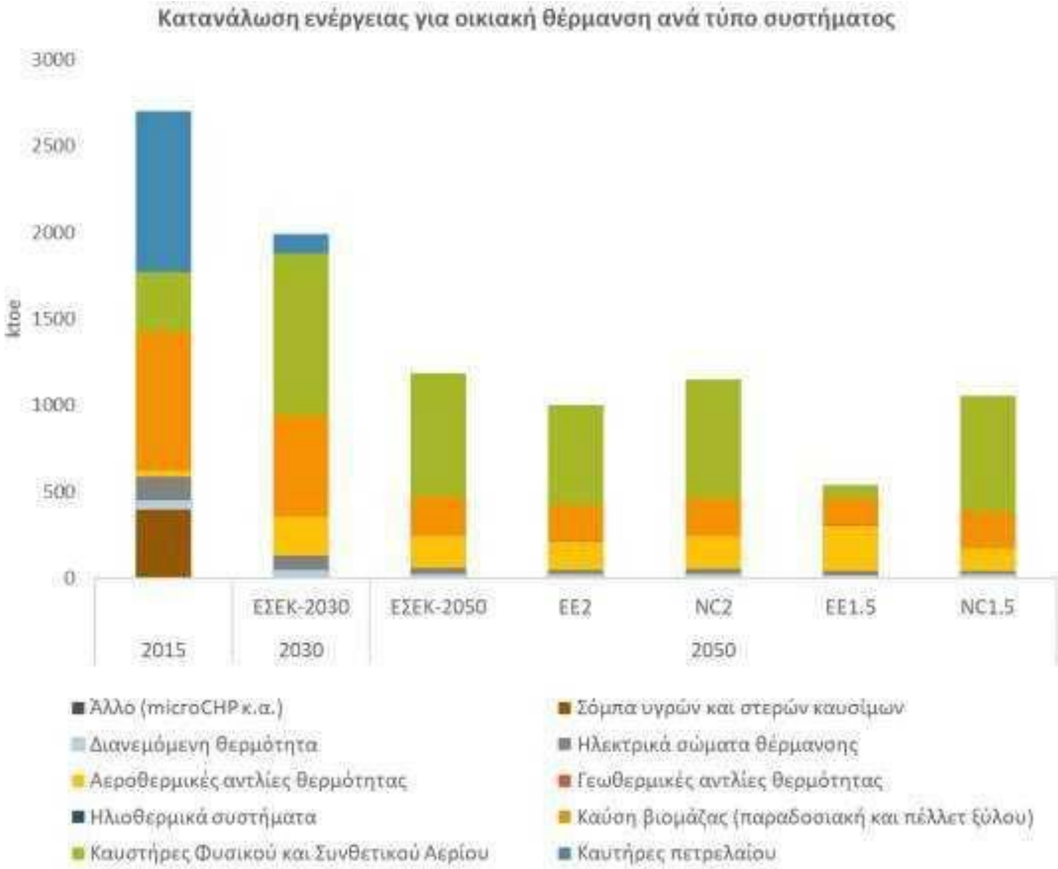
Figure 25: Final energy consumption in the domestic sector per energy use. ***Source: PRIMES***



	Final energy consumption in the domestic sector by use (ktoe)
	NECP-2030 NECP-2050 EE2 NC2 EE1.5 NC1.5
	Electrical appliances and lighting systems
	Cooking
	Domestic hot water
	Space cooling
	Space heating

The policy tools for energy savings in buildings cause significant changes to heating systems in residential buildings. After 2020, the NECP LS50 scenarios provide for putting a definitive end to the use of space heaters operating on liquid or solid fuel. From 2030 onwards, there will be major changes to heating systems, by gradually putting an end to the use of diesel burners due to their high carbon intensity and low performance (Figure 26). Towards 2050, the use of oil for heating purposes in burners and space heaters will be replaced by energy sources with a much lower carbon intensity, e.g. climate-neutral synthetic gas, which is used under the NC2 and NC1.5 scenarios, as well as electricity, which has practically zero emissions, by 2050. Electricity is used in higher efficiency systems such as heat pumps, but is no longer used in individual low-efficiency electric radiators. After 2030, heat pumps will also be used for space cooling, combined with lower efficiency air-conditioning units. Similarly, the needs for domestic hot water will no longer be covered by electric water heaters, due to their low efficiency levels, but by the gradually increasing use of RES, i.e. solar water heaters.

Figure 26: Energy consumption for domestic heating by type of system. ***Source: PRIMES***



	Energy consumption for domestic heating by type of system
	NECP-2030 NECP-2050 EE2 NC2 EE1.5 NC1.5
	Other (mikroCHP, etc.)
	District heating
	Aerothermal heat pumps
	Solar thermal systems
	Burners operating on natural and synthetic gas
	Space heaters operating on liquid and solid fuel
	Electric radiators
	Geothermal heat pumps
	Biomass burners (operating on traditional wood or pellet)
	Diesel burners

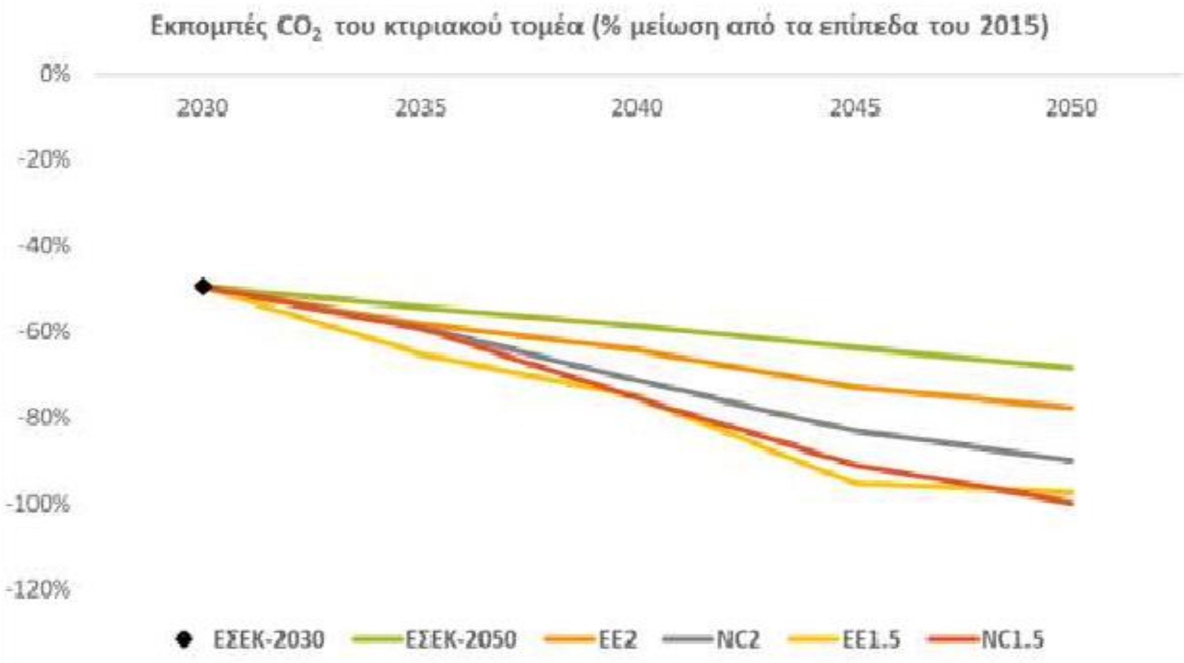
Figure 27: Energy consumption for domestic space cooling by type of system. *Source: PRIMES*

	Energy consumption for domestic cooling by type of system
	Aerothermal heat pumps
	Air-conditioning units

6.1.4 Carbon dioxide emissions

The measures and policies for the energy upgrading of buildings result in a significant drop in carbon dioxide emissions (CO_2) under all scenarios. More specifically, under the NECP-2030 scenario, there will be a 50 % drop by 2030, compared to 2015. There will be gradual further reductions in emissions in the period 2030-2050 due to the drop in overall final energy consumption, but primarily due to the reduced or even zero carbon intensity of the energy consumed. More specifically, the penetration of clean electricity and new, climate-neutral synthetic fuels will allow for major reductions in the emission levels of buildings. Figure 28 shows that the drop in emissions will reach 100 % in 2050 under the two scenarios for achieving the 1.5°C target.

Figure 28: Carbon dioxide emissions from buildings in the period 2030-2050, as a drop (%) compared to 2015. ***Source: PRIMES***



	CO2 emissions from buildings (drop [%] compared to 2015)
	NECP-2030-
	NECP-2030
	EE2
	NC2
	EE1.5
	NC1.5

6.2 COMBINING THE RESULTS OF COST-EFFECTIVE APPROACHES UNDER THE LONG-TERM STRATEGY SCENARIOS

On the basis of the results of the technical and financial study on the optimal (cost-optimal, Chapter 4) selection of interventions by type of building (domestic or tertiary sector building), it is possible to assess the performance of scenarios looking into the long-term renovation strategy (Chapter 6.1).

Technical studies have shown that upgrading only the envelope of a building may contribute significantly to the total energy savings of that building, at rates between 25 % and 75 % of the total energy savings achieved through partial or major renovation of the building, depending on its climatic zone and use. More specifically, on the basis of the summary data of Table 18 – with regard to the potential energy savings in accordance with the building classification target in relation to the average consumption of the building stock – and the above-mentioned energy savings limits only from the energy upgrading of the building envelope, Table 14 is drawn up, listing the energy savings limits from the energy upgrading of the envelope (in relation to the average energy consumption of the building stock), which, if achieved, can lead to buildings being classified under categories B to A+ (i.e. nearly zero-energy buildings [NZEBs], which is the goal of building renovation).

Table 14: Energy savings limits from the energy upgrading of the envelope (in relation to the average energy consumption of the building stock) with a view to achieving the building classification targets.

	A+			A				B+				B		
	Potential energy savings on the basis of the building classification target in relation to the average consumption of the building stock													
Residential dwellings		85 %			81 %	77 %			71 %	65 %			59 %	
Offices		80 %			75 %	70 %			63 %	55 %			48 %	
Health and welfare facilities		79 %			73 %	68 %			60 %	52 %			44 %	
	Contribution (%) of the energy upgrading of the envelope to the total energy savings from the renovation of the building													
	max		min	max			min	max			min	max		min
Residential dwellings	75 %		65 %	73 %			56 %	67 %			36 %	56 %		25 %
Offices	75 %		54 %	67 %			49 %	63 %			34 %	48 %		25 %
Health and welfare facilities	60 %		52 %	57 %			49 %	55 %			34 %	48 %		25 %
	Energy savings limits from the contribution of the energy upgrading of the building envelope													
	max		min	max			min	max			min	max		min
Residential dwellings	63 %		55 %	59 %			43 %	47 %			23 %	33 %		15 %
Offices	60 %		43 %	50 %			34 %	40 %			19 %	23 %		12 %
Health and welfare facilities	47 %		41 %	42 %			33 %	33 %			18 %	21 %		11 %

A comparison of the data in Table 14 against the long-term renovation strategy scenarios, as presented in Table 15, indicates that the average energy savings from the upgrading of the building envelope will be in line with the energy consumption requirements for NZEBs as early as by 2030. More specifically, as most of the building stock in Greece falls under climatic zone B (see Figures 6 and 7), the average energy savings from the upgrading of the building envelope both in domestic and tertiary sector buildings (for indicative examples see Table 15) fall within the range of cost-optimal levels calculated by the cost-benefit analysis under all LS50 scenarios. As regards the climate neutrality scenarios in particular (EE1.5 and NC1.5), as well as the 2oC scenario for energy savings (EE2), which are the most ambitious ones with regard to the reduction in energy consumption, they are close to the upper savings limits. This leads to the conclusion that under these scenarios, on average, the buildings which have undergone energy upgrading (at least on their envelope) will be classified under energy category A+ by 2050.

Table 15: Energy savings rate from the energy upgrading of the envelope of domestic sector buildings and indicative tertiary sector buildings (climatic zone B) under the LS50 scenarios.

	2021-2030	2031-2050					
	NECP-2030	NECP-2030	NECP-2050	EE2	NC2	EE1.5	NC1.5
Domestic sector							
Energy savings rate from the energy upgrading of the envelope							
Total number of older buildings	54 %	31 %	50 %	56 %	52 %	62 %	58 %
By age category							
1920-1960	66 %	39 %	64 %	71 %	66 %	77 %	73 %
1961-1990	53 %	30 %	50 %	56 %	52 %	62 %	58 %
1991-	36 %	25 %	34 %	35 %	34 %	34 %	34 %
Tertiary sector							
Office buildings							
Energy savings rate from the energy upgrading of the envelope							
Total number of older buildings	38 %	27 %	45 %	52 %	47 %	58 %	54 %
By age category							
1920-1960	41 %	30 %	47 %	55 %	49 %	61 %	56 %
1961-1990	33 %	23 %	36 %	42 %	38 %	50 %	44 %
1991-	44 %	44 %	48 %	49 %	49 %	50 %	51 %
Health and welfare facilities							
Energy savings rate from the energy upgrading of the envelope							
Total number of older buildings	36 %	20 %	36 %	43 %	38 %	45 %	44 %
By age category							
1920-1960	39 %	22 %	45 %	55 %	47 %	58 %	56 %
1961-1990	35 %	19 %	37 %	45 %	39 %	47 %	46 %
1991-	30 %	20 %	29 %	32 %	31 %	33 %	34 %

This is inferred from a detailed examination of the energy savings rate by age of older buildings which have undergone energy upgrading under the different scenarios. More specifically, under the highly ambitious scenarios (EE2, NC1.5 and EE1.5), the energy upgrading interventions on the envelope will lead to a stock of buildings by 2050 in which:

- very old buildings (those constructed until 1960) which have undergone energy upgrading will be classified under category A+;

- medium age buildings (those constructed between 1961 and 1990) will be classified under category A or A+; and
- more recent buildings, which were constructed in compliance with very stringent requirements, will be classified at least under category B+.

Apart from the upgrading of the building envelope, the best-case financial calculation scenarios have also identified the heating/cooling system which will allow a building to meet the minimum requirements laid down in the KENAK. The LS50 scenarios are in line with the best-case financial calculation scenarios and, as shown also in the scenario results (Table 16), the prevailing heating technologies in domestic sector buildings are gas boilers (conventional technology and condensation technology) and heat pumps. In tertiary sector buildings, central air-conditioning units, including heat pumps, prevail over other heating systems.

Table 16: Rate of penetration of technologies in domestic and tertiary sector buildings under the LS50 scenarios

	2030	2050					
	NECP-2030	NECP-2030	NECP-2050	EE2	NC2	EE1.5	NC1.5
Domestic sector							
Rate of penetration in buildings							
Heat pump	10 %	20 %	20 %	24 %	21 %	73 %	19 %
Gas boiler	42 %	55 %	56 %	53 %	55 %	8 %	57 %
Conventional technology	28 %	40 %	41 %	39 %	40 %	4 %	42 %
Condensation technology	14 %	16 %	15 %	14 %	15 %	3 %	16 %
Solar thermal systems for domestic hot water	70 %	91 %	90 %	88 %	90 %	77 %	89 %
Tertiary sector							
Rate of penetration in buildings							
Central air-conditioning units	59 %	83 %	85 %	87 %	87 %	97 %	85 %
Conventional technology	17 %	34 %	35 %	33 %	34 %	30 %	33 %
Heat pump	42 %	49 %	50 %	54 %	52 %	67 %	52 %
Gas boiler	18 %	15 %	13 %	11 %	12 %	2 %	13 %
Solar thermal systems for domestic hot water	19 %	25 %	25 %	24 %	25 %	22 %	24 %

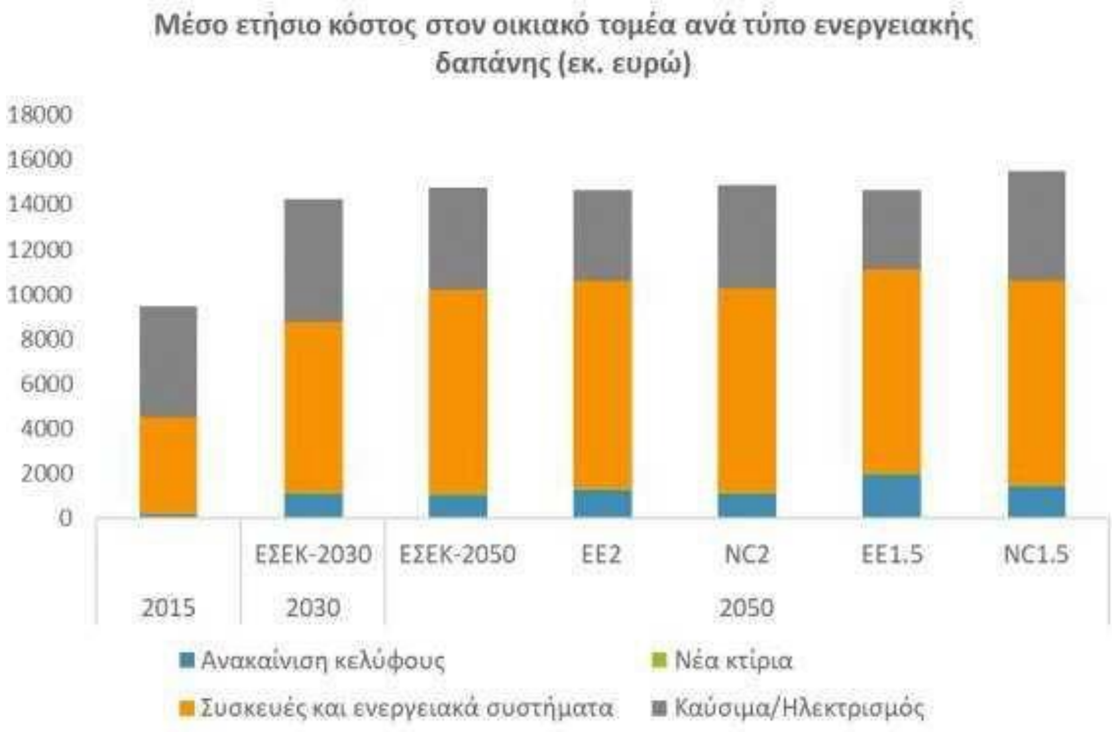
Finally, the penetration of solar thermal systems for domestic hot water is important, as inferred also from the best-case financial calculation scenarios, in residential dwellings in particular, where at least 77 % of those dwellings will be equipped with solar water heaters as a support system for the production of domestic hot water under the LS50 scenarios by 2050.

6.2.1 Investment costs for energy savings in buildings

The energy upgrading programmes for the stock of buildings under the LS50 scenarios entail significant investment costs for the renovation of the building envelope and the purchase of new efficient appliances and energy systems. In the domestic sector, the total average annual cost will be increased compared to 2015, both by 2030 and by 2050 under all scenarios. This increase is mainly due to the substantial increase in capital expenditure (CAPEX) for the purchase of new energy systems and appliances. The costs incurred for more and more efficient telecommunications and entertainment devices and computers (other devices) increase significantly over time and have a significant impact on the increase in energy costs. Moreover, the costs for white appliances will also increase significantly compared to 2015, given the increasing penetration of those appliances in households. The key factors leading to an increase in the costs for appliances are further digitisation and the rise in the standard of living of households and the increase of the floor area of residential buildings. The average capital expenditure for heating and cooling systems will almost double by 2050 compared to 2015 under all LS50 scenarios. However, it is much less than the total corresponding cost of appliances despite their higher unit cost, as these systems have a longer lifespan.

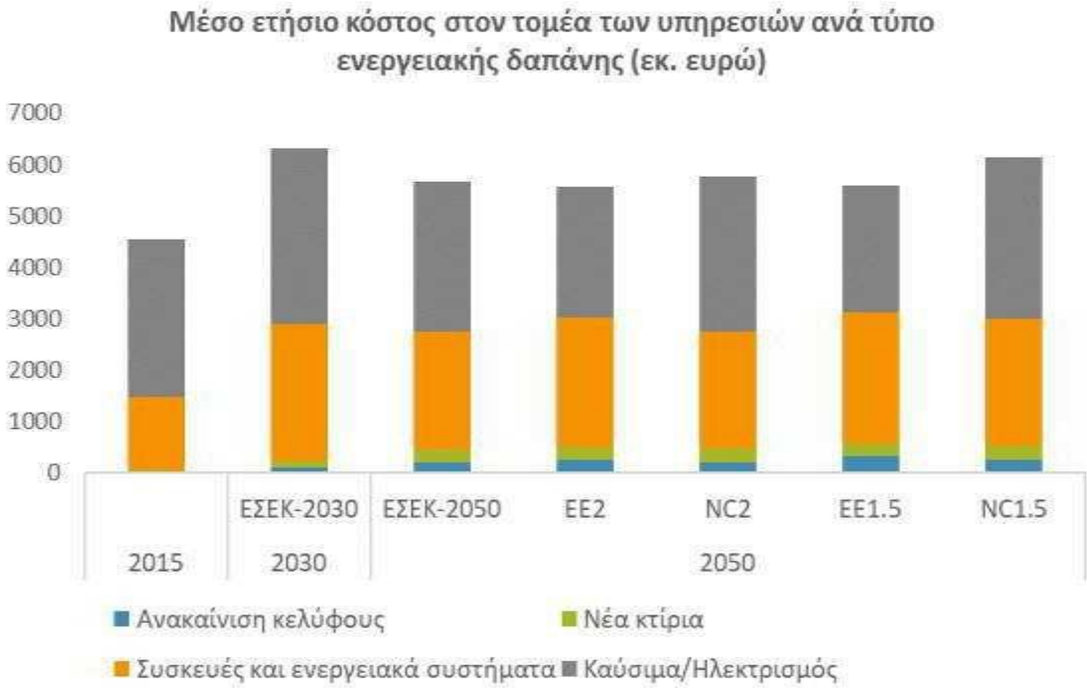
As opposed to the costs incurred for appliances and energy systems, the operating expenses (OPEX) for purchasing energy (electricity or fuels) will decrease under all scenarios after 2035, but not to a degree that is proportionate to energy consumption, as the new lower carbon intensity forms of energy used by the system will have a higher cost compared to 2050 (e.g. electricity, synthetic gas). The average capital expenditure for investments in envelope renovation will increase significantly in the period 2030-2050, but it will still represent a small share in the total expenditure of households. In the services sector, there will also be a great increase in the costs incurred for appliances and energy systems, but the reduction in fuel and electricity costs will be lower than in the domestic sector.

Figure 29: Average annual cost by type of energy expenditure in domestic sector buildings. ***Source: PRIMES***



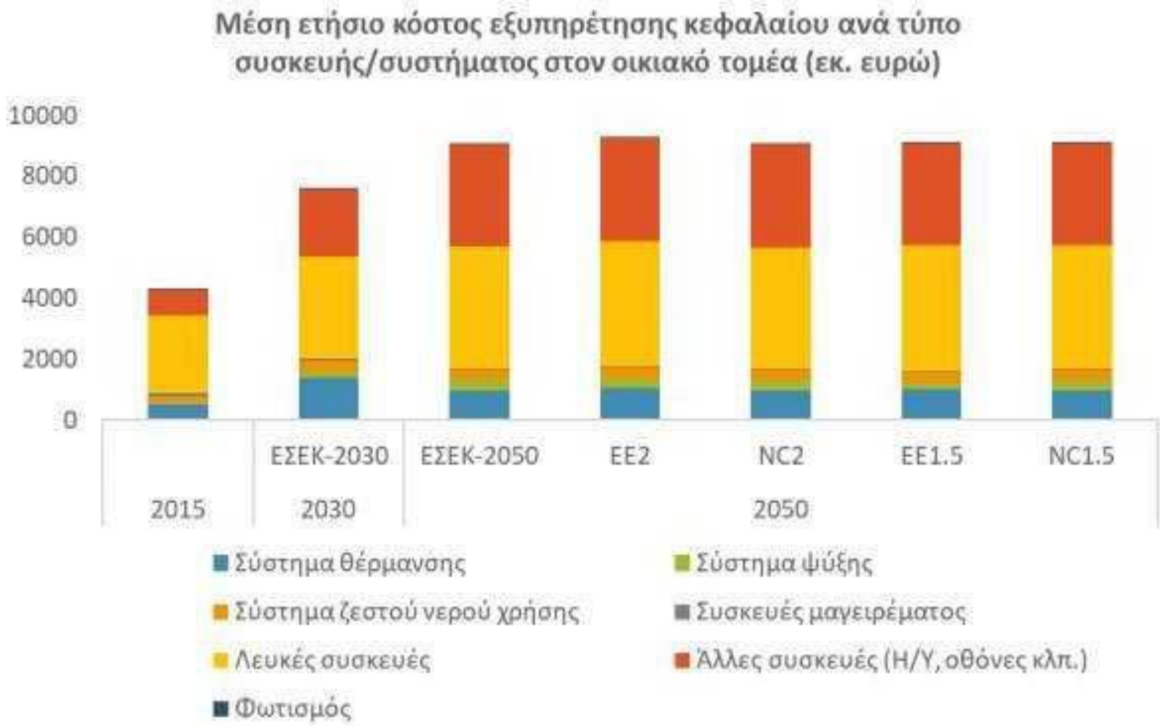
	Average annual cost in the domestic sector by type of energy expenditure (EUR million)
	NECP-2030 **NECP-2050** **EE2** **NC2** **EE1.5** **NC1.5**
	Renovation of envelope
	Appliances and energy systems
	New buildings
	Fuels/electricity

Figure 30: Average annual cost by type of energy expenditure *in services sector buildings. Source: PRIMES*



	Average annual cost in the services sector by type of energy expenditure (EUR million)					
	NECP-2030	**NECP-2050**	**EE2**	*NC2*	**EE1.S**	**NC1.5**
	Renovation of envelope					
	Appliances and energy systems					
	New buildings					
	Fuels/electricity					

Figure 31: Average capital expenditure by type of appliance/system in the domestic sector. ***Source: PRIMES***

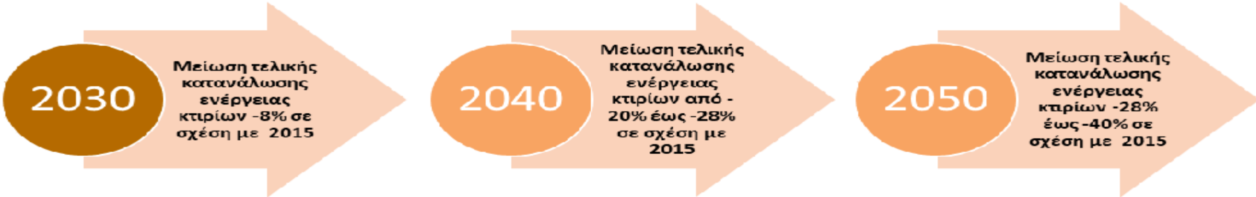


	Average capital expenditure by type of appliance/system in the domestic sector (EUR million)
	NECP-2030 NECP-2050 EE2 NC2 EE1.S NC1.5
	Heating system
	Domestic hot water system
	White appliances
	Lighting
	Cooling system
	Cooking appliances
	Other appliances (computers, monitors, etc.)

6.3 Roadmap for energy savings in buildings

The results of the LS50 scenarios have resulted in a roadmap for achieving large-scale energy savings in buildings by 2050. The roadmap describes a set of measures and policies relating mainly to the domestic sector, as well as the tertiary sector. These measures are set out in detail in Chapter 6. The roadmap also includes quantitative benchmarks for monitoring the progress made in implementing the measures and policies, as well as milestones in achieving them.

Figure 32: Roadmap for reducing final consumption in buildings in the period 2030-2050. Source: PRIMES



	Reduction of final energy consumption in buildings of 8 % compared to 2015
	Reduction of final energy consumption in buildings between 20 % and 28 % compared to 2015
	Reduction of final energy consumption in buildings of between 28 % and 40 % compared to 2015

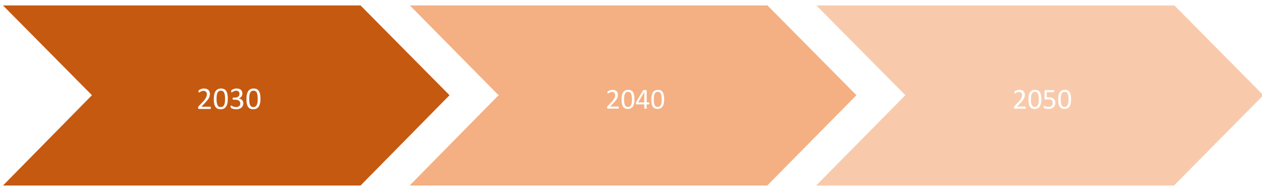
As shown by the figure above, to make sure that the stock of buildings complies with the climate neutrality goals by 2050, final energy consumption in buildings must be reduced by 8 % compared to 2015 as early as by 2030, whereas that rate must reach almost 40 % by 2050 (Figure 32). Apart from the environmental and economic benefits (new jobs, etc.) resulting form that level of energy savings, significant resources will also be saved thanks to the reduced amount required to cover the annual basic energy needs of households.

Naturally, given that significant investments are required to achieve the above goals and that securing the required start-up capital is a key barrier, it is proposed that financing should be leveraged in order to mobilise the necessary investments, so that households in particular, but also the services sector, are finally able to achieve the required energy savings rates.

To achieve the high energy savings rates provided for in the long-term renovation strategy, firstly specific targets should be set for the energy upgrading of the building envelope. These interventions are capital-intensive, but make a higher contribution towards the final energy savings. In addition, interventions on the envelope will bring about other benefits too, such as an improvement of the quality of life in the building and the achievement of thermal comfort conditions all year long. Also, given that the construction rate of new buildings in the domestic sector – which is responsible for the largest share in the final energy consumption in buildings (Figure 20) – is relatively low and is expected to remain low in the future, the energy upgrading of older buildings is very important. Therefore, the envelope of 23 % of older residential dwellings must be upgraded in terms of energy by 2030, and that rate must almost double by 2040 and must reach 50 % by 2050 (Figure 33). The corresponding targets for the services sector are lower as the construction rate of new buildings – which are in line with the energy consumption regulations – is much higher in that sector, and therefore the potential for the energy upgrading of the envelope of older buildings is clearly lower.

Figure 33: Roadmap for building envelope renovation in the period 2030-2050. Source: PRIMES

Figure 34: Roadmap for energy system renovation in residential dwellings in the period 2030-2050. Source: PRIMES



Dramatic drop in the use of diesel, Natural gas burners 47 % of the total, Aerothermal heat pumps 11 % of the total
Drop in the use of traditional biomass

Zero use of diesel, Aerothermal heat pumps up to 12 %-21 % of the total
Burners operating on natural and synthetic gas 20 % of the total
Solar thermal systems for domestic hot water by 83 %-86 %

Aerothermal heat pumps up to 12 %-50 % of the total
Solar thermal systems for domestic hot water by 83 %-92 %
Burners operating on natural and synthetic gas 14 %-64 % of the total
Zero use of electric water heaters

In conclusion, the energy upgrading of the building envelope must be accompanied by a change to the energy mix used in those buildings, in order to get the stock of buildings close to nearly zero-energy consumption by 2050, namely the stock should consist of buildings with a high energy performance that need zero or nearly zero energy to cover their energy needs, that energy being mostly offset by renewable energy sources which are used either directly or indirectly through heat pumps. Consequently, 21 % of the final energy consumption for heating in the domestic sector must be covered by heat pumps by 2040, and 50 % by 2050. Furthermore, the penetration of solar water heaters for the production of domestic hot water will have to reach such a level that will allow for 86 % of the final energy consumption for the production of domestic hot water to be covered by solar thermal systems by 2040, and 92 % by 2050 (Figure 32).

To achieve the above goals, ongoing information and awareness actions are needed, along with significant (economic, town planning, tax) incentives, to encourage a change of attitude among people with regard to the use of energy.

ANNEX I

This Annex provides details about the average existing energy consumption (based on the statistical analysis provided in the EPCs), the consumption by energy category and the potential average energy savings in accordance with the report on the cost-optimal renovation of existing, and construction of new, buildings in the domestic and tertiary sectors.

Table 17: Average current energy consumption and energy consumption by energy category in accordance with the report on cost-optimal levels for the renovation of existing and the construction of new domestic and tertiary sector buildings

USE	Total Aver. Cons. of Prim. En.	A+	A		B+		B	Reference building	C		D		E		F	G
	kWh/m2	0.33	0.42	0.50	0.63	0.75	0.88	1.00	1.21	1.41	1.62	1.82	2.05	2.27	2.50	2.73
Commercial buildings	**485.72**	**87.3**	**109.8**	**132.2**	**165.3**	**198.3**	**231.4**	**264.5**	**318.7**	**372.9**	**427.1**	**481.3**	**540.8**	**600.3**	**661.1**	**722.0**
Markets	539.97	95.1	119.6	144.1	180.2	216.2	252.3	288.3	347.4	406.5	465.6	524.7	589.6	654.4	720.7	787.0
Shopping centres	478.55	94.1	118.4	142.6	178.2	213.9	249.5	285.2	343.7	402.1	460.6	519.1	583.2	647.4	713.0	778.6
Gyms	738.13	140.5	176.7	212.9	266.1	319.3	372.5	425.8	513.0	600.3	687.6	774.9	870.7	966.5	1 064.4	1 162.3
Stores	483.94	86.7	109.1	131.4	164.3	197.2	230.0	262.9	316.8	370.6	424.5	478.4	537.6	596.7	657.2	717.6
Hairdressing establishments	581.76	111.1	139.7	168.3	210.4	252.5	294.6	336.7	405.7	474.7	543.7	612.7	688.5	764.2	841.7	919.1
Barber shops	610.63	112.1	141.0	169.9	212.3	254.8	297.2	339.7	409.3	479.0	548.6	618.3	694.7	771.1	849.3	927.4
Hypermarkets	441.28	83.8	105.4	127.0	158.8	190.5	222.3	254.0	306.1	358.2	410.3	462.4	519.5	576.7	635.1	693.6
Pharmacies	422.26	79.4	99.9	120.4	150.4	180.5	210.6	240.7	290.1	339.4	388.8	438.1	492.3	546.4	601.8	657.2
Health and welfare facilities	**448.06**	**94.9**	**119.4**	**143.8**	**179.8**	**215.7**	**251.7**	**287.6**	**346.6**	**405.6**	**464.5**	**523.5**	**588.2**	**652.9**	**719.1**	**785.3**
Rural dispensaries	617.66	110.0	138.3	166.6	208.3	249.9	291.6	333.2	401.6	469.9	538.2	606.5	681.5	756.5	833.1	909.8
Day-care stations for babies	276.49	61.4	77.2	93.0	116.2	139.5	162.7	185.9	224.1	262.2	300.3	338.4	380.3	422.1	464.9	507.6
Nurseries	683.38	98.6	124.0	149.4	186.8	224.1	261.5	298.8	360.1	421.3	482.6	543.8	611.1	678.3	747.0	815.8

Dispensaries	439.56	95.2	119.7	144.2	180.3	216.3	252.4	288.4	347.5	406.7	465.8	524.9	589.8	654.7	721.0	787.4
Institutions	734.39	132.4	166.4	200.5	250.7	300.8	350.9	401.1	483.3	565.5	647.8	730.0	820.2	910.5	1 002.7	1 095.0
Healthcare centres	435.46	95.9	120.6	145.3	181.6	217.9	254.2	290.5	350.1	409.6	469.2	528.8	594.1	659.5	726.3	793.1
Health centres	814.45	159.8	201.0	242.2	302.7	363.2	423.8	484.3	583.6	682.9	782.1	881.4	990.4	1 099.4	1 210.8	1 322.1
Hospitals	662.61	119.5	150.3	181.1	226.4	271.6	316.9	362.2	436.4	510.7	584.9	659.1	740.6	822.1	905.4	988.7
Retirement homes	801.48	153.3	192.8	232.3	290.4	348.4	406.5	464.6	559.8	655.1	750.3	845.6	950.1	1 054.6	1 161.5	1 268.4
Day-care stations for children	277.11	56.4	70.9	85.4	106.7	128.1	149.4	170.8	205.8	240.8	275.8	310.8	349.2	387.7	426.9	466.2
Healthcare stations	486.48	102.7	129.2	155.7	194.6	233.5	272.4	311.3	375.2	439.0	502.8	566.7	636.7	706.8	778.4	850.0
Mental institutions	780.88	132.2	166.2	200.3	250.4	300.4	350.5	400.6	482.7	564.8	646.9	729.1	819.2	909.3	1 001.4	1 093.6
Buildings for temporary stay	**457.86**	**94.9**	**119.3**	**143.7**	**179.7**	**215.6**	**251.5**	**287.4**	**346.4**	**405.3**	**464.2**	**523.2**	**587.8**	**652.5**	**718.6**	**784.7**
Dormitories	738.16	131.4	165.3	199.1	248.9	298.7	348.5	398.3	479.9	561.6	643.2	724.9	814.5	904.1	995.7	1 087.3
Hotels – operating all year round	648.78	125.5	157.8	190.1	237.6	285.2	332.7	380.2	458.2	536.1	614.1	692.0	777.6	863.1	950.6	1 038.0
Hotels – operating in the summer	362.92	79.8	100.3	120.9	151.1	181.3	211.5	241.7	291.3	340.9	390.4	440.0	494.4	548.7	604.3	659.9
Hotels – operating in the winter	457.83	93.6	117.7	141.8	177.2	212.7	248.1	283.6	341.7	399.8	458.0	516.1	579.9	643.7	708.9	774.2
Hostels – operating all year round	678.63	132.2	166.3	200.4	250.5	300.5	350.6	400.7	482.9	565.0	647.2	729.3	819.5	909.6	1 001.8	1 094.0
Hostels – operating in the summer	374.28	77.8	97.8	117.8	147.3	176.8	206.2	235.7	284.0	332.3	380.6	429.0	482.0	535.0	589.2	643.4
Hostels – operating in the winter	656.83	106.1	133.4	160.7	200.9	241.1	281.3	321.5	387.4	453.3	519.2	585.1	657.4	729.8	803.7	877.6
Boarding institutions	618.69	134.0	168.5	203.0	253.7	304.4	355.2	405.9	489.1	572.3	655.6	738.8	830.1	921.4	1 014.8	1 108.2
Educational facilities	**202.38**	**39.6**	**49.8**	**60.0**	**75.0**	**90.0**	**105.0**	**120.0**	**144.6**	**169.2**	**193.7**	**218.3**	**245.3**	**272.3**	**299.9**	**327.5**
Classrooms	290.01	62.5	78.6	94.7	118.3	142.0	165.7	189.4	228.2	267.0	305.8	344.6	387.2	429.8	473.4	516.9
Secondary education	187.44	33.9	42.7	51.4	64.2	77.1	89.9	102.8	123.9	144.9	166.0	187.1	210.2	233.3	257.0	280.6
Kindergartens	160.83	31.0	39.0	47.0	58.8	70.5	82.3	94.1	113.3	132.6	151.9	171.2	192.3	213.5	235.1	256.8
Primary education	195.00	34.9	43.9	52.9	66.1	79.3	92.5	105.7	127.4	149.1	170.8	192.4	216.2	240.0	264.3	288.6

Higher education	288.62	61.9	77.9	93.8	117.3	140.7	164.2	187.6	226.1	264.5	303.0	341.5	383.7	425.9	469.0	512.2
Tutoring centres	189.32	38.1	48.0	57.8	72.2	86.7	101.1	115.5	139.2	162.9	186.6	210.3	236.3	262.3	288.9	315.4
Conservatories	205.87	40.3	50.6	61.0	76.3	91.5	106.8	122.0	147.1	172.1	197.1	222.1	249.6	277.0	305.1	333.2
Meeting venues	**785.33**	**152.8**	**192.1**	**231.5**	**289.3**	**347.2**	**405.1**	**462.9**	**557.9**	**652.8**	**747.7**	**842.6**	**946.7**	**1 050.9**	**1 157.4**	**1 263.8**
Courtrooms	415.65	80.0	100.6	121.2	151.5	181.8	212.1	242.4	292.0	341.7	391.4	441.1	495.6	550.2	605.9	661.6
All-purpose rooms	375.55	73.8	92.8	111.8	139.7	167.7	195.6	223.6	269.4	315.2	361.1	406.9	457.2	507.5	558.9	610.3
Amphitheatres	346.02	68.8	86.5	104.2	130.2	156.3	182.3	208.3	251.1	293.8	336.5	379.2	426.1	473.0	520.9	568.8
Restaurants	797.98	159.1	200.0	241.0	301.2	361.5	421.7	482.0	580.8	679.6	778.4	877.2	985.7	1 094.1	1 205.0	1 315.9
Pastry shops	822.96	163.7	205.9	248.1	310.1	372.1	434.1	496.1	597.8	699.5	801.2	902.9	1 014.6	1 126.2	1 240.3	1 354.4
Theatres	427.27	76.9	96.7	116.6	145.7	174.8	204.0	233.1	280.9	328.7	376.5	424.3	476.7	529.2	582.8	636.4
Coffee shops	894.21	168.8	212.2	255.7	319.6	383.6	447.5	511.4	616.3	721.1	826.0	930.8	1 045.9	1 160.9	1 278.6	1 396.2
Cinemas	399.19	73.3	92.2	111.0	138.8	166.5	194.3	222.1	267.6	313.1	358.6	404.2	454.1	504.1	555.2	606.2
Indoor gyms	1 021.35	207.5	260.9	314.4	393.0	471.6	550.2	628.8	757.7	886.6	1 015.5	1 144.4	1 285.9	1 427.3	1 572.0	1 716.6
Indoor swimming pools	1 038.20	220.4	277.2	333.9	417.4	500.9	584.4	667.9	804.8	941.7	1 078.6	1 215.5	1 365.8	1 516.0	1 669.7	1 823.3
Museums	367.70	67.8	85.3	102.8	128.5	154.2	179.9	205.6	247.7	289.9	332.0	374.2	420.4	466.7	514.0	561.3
Live music establishments	306.39	55.4	69.6	83.9	104.9	125.8	146.8	167.8	202.2	236.6	271.0	305.4	343.1	380.9	419.5	458.1
Nightclubs	340.51	64.9	81.6	98.3	122.9	147.4	172.0	196.6	236.9	277.2	317.5	357.8	402.0	446.3	491.5	536.7
Banks	296.31	66.1	83.2	100.2	125.2	150.3	175.3	200.4	241.5	282.5	323.6	364.7	409.8	454.9	500.9	547.0
Exhibition venues	374.51	69.8	87.7	105.7	132.1	158.6	185.0	211.4	254.8	298.1	341.4	384.8	432.3	479.9	528.5	577.2
Concert halls	519.71	98.6	124.0	149.4	186.7	224.1	261.4	298.7	360.0	421.2	482.5	543.7	610.9	678.2	746.9	815.6
Conference venues	384.05	83.1	104.5	125.9	157.3	188.8	220.3	251.7	303.3	354.9	406.5	458.1	514.8	571.4	629.3	687.2
Correctional facilities	**632.23**	**129.8**	**163.3**	**196.7**	**245.9**	**295.1**	**344.2**	**393.4**	**474.1**	**554.7**	**635.4**	**716.0**	**804.5**	**893.1**	**983.6**	**1 074.0**
Police centres	644.58	134.3	168.9	203.5	254.4	305.3	356.2	407.1	490.5	574.0	657.4	740.9	832.5	924.1	1 017.7	1 111.3
Police detention facilities	475.26	82.1	103.3	124.4	155.5	186.6	217.7	248.8	299.8	350.8	401.9	452.9	508.9	564.8	622.1	679.3

Offices	**371.63**	**73.0**	**91.8**	**110.6**	**138.2**	**165.9**	**193.5**	**221.2**	**266.5**	**311.9**	**357.2**	**402.6**	**452.3**	**502.1**	**553.0**	**603.9**
Libraries	334.37	60.3	75.8	91.3	114.2	137.0	159.9	182.7	220.1	257.6	295.1	332.5	373.6	414.7	456.7	498.8
Offices	371.67	73.0	91.8	110.6	138.3	165.9	193.6	221.2	266.6	312.0	357.3	402.7	452.4	502.2	553.1	604.0
Residential dwellings	**276.79**	**42.8**	**53.9**	**64.9**	**81.1**	**97.3**	**113.6**	**129.8**	**156.4**	**183.0**	**209.6**	**236.2**	**265.4**	**294.6**	**324.5**	**354.3**
Apartments in multi-dwelling buildings	255.22	40.0	50.3	60.6	75.8	91.0	106.1	121.3	146.1	171.0	195.9	220.7	248.0	275.3	303.2	331.1
Single-family houses	395.72	57.4	72.1	86.9	108.6	130.4	152.1	173.8	209.5	245.1	280.7	316.4	355.5	394.6	434.6	474.6
Multi-dwelling buildings	260.21	41.2	51.9	62.5	78.1	93.7	109.3	124.9	150.6	176.2	201.8	227.4	255.5	283.6	312.4	341.1

Primary energy consumption in accordance with the classification target for new tertiary and domestic sector buildings
Primary energy consumption in accordance with the classification target for renovated tertiary and domestic sector buildings
Average primary energy consumption in accordance with the EPCs issued for the stock of tertiary and domestic sector buildings

Table 18: Potential average energy savings in accordance with the report on cost-optimal levels for the renovation of existing, and the construction of new, domestic and tertiary sector buildings

		ES	ES	ES	ES	ES	ES	ES	% ES	% ES	% ES	% ES	% ES	% ES	% ES
USE	Total Aver. Cons. of Prim. En.	A+	A		B+		B	Reference building	A+	A		B+		B	Reference Building
	kWh/m2	0.33	0.42	0.50	0.63	0.75	0.88	1.00	0.33	0.42	0.50	0.63	0.75	0.88	1.00
Commercial buildings	**485.72**	**398.45**	**376.0**	**353.5**	**320.4**	**287.4**	**254.32**	**221.26**	**82.0 %**	**77.4 %**	**72.8 %**	**66.0 %**	**59.2 %**	**52.4 %**	**45.6 %**
Markets	539.97	444.83	420.3	395.8	359.8	323.7	287.71	251.68	82.4 %	77.8 %	73.3 %	66.6 %	60.0 %	53.3 %	46.6 %
Shopping centres	478.55	384.44	360.2	336.0	300.3	264.7	229.00	193.35	80.3 %	75.3 %	70.2 %	62.8 %	55.3 %	47.9 %	40.4 %
Gyms	738.13	597.63	561.4	525.3	472.0	418.8	365.60	312.38	81.0 %	76.1 %	71.2 %	64.0 %	56.7 %	49.5 %	42.3 %
Stores	483.94	397.19	374.8	352.5	319.6	286.8	253.93	221.07	82.1 %	77.5 %	72.8 %	66.1 %	59.3 %	52.5 %	45.7 %
Hairdressing establishments	581.76	470.66	442.0	413.4	371.3	329.3	287.17	245.09	80.9 %	76.0 %	71.1 %	63.8 %	56.6 %	49.4 %	42.1 %
Barber shops	610.63	498.53	469.7	440.8	398.3	355.9	313.39	270.92	81.6 %	76.9 %	72.2 %	65.2 %	58.3 %	51.3 %	44.4 %

Hypermarkets	441.28	357.44	335.8	314.3	282.5	250.7	218.99	187.23	81.0 %	76.1 %	71.2 %	64.0 %	56.8 %	49.6 %	42.4 %
Pharmacies	422.26	342.82	322.4	301.9	271.8	241.7	211.63	181.54	81.2 %	76.3 %	71.5 %	64.4 %	57.2 %	50.1 %	43.0 %
Health and welfare facilities	**448.06**	**353.14**	**328.7**	**304.2**	**268.3**	**232.3**	**196.38**	**160.42**	**78.8 %**	**73.4 %**	**67.9 %**	**59.9 %**	**51.9 %**	**43.8 %**	**35.8 %**
Rural dispensaries	617.66	507.69	479.4	451.0	409.4	367.7	326.07	284.41	82.2 %	77.6 %	73.0 %	66.3 %	59.5 %	52.8 %	46.0 %
Day-care stations for babies	276.49	215.13	199.3	183.5	160.3	137.0	113.79	90.54	77.8 %	72.1 %	66.4 %	58.0 %	49.6 %	41.2 %	32.7 %
Nurseries	683.38	584.77	559.4	534.0	496.6	459.3	421.92	384.57	85.6 %	81.9 %	78.1 %	72.7 %	67.2 %	61.7 %	56.3 %
Dispensaries	439.56	344.38	319.9	295.4	259.3	223.2	187.20	151.14	78.3 %	72.8 %	67.2 %	59.0 %	50.8 %	42.6 %	34.4 %
Institutions	734.39	602.03	567.9	533.8	483.7	433.6	383.44	333.31	82.0 %	77.3 %	72.7 %	65.9 %	59.0 %	52.2 %	45.4 %
Healthcare centres	435.46	339.59	314.9	290.2	253.9	217.6	181.25	144.93	78.0 %	72.3 %	66.6 %	58.3 %	50.0 %	41.6 %	33.3 %
Health centres	814.45	654.63	613.5	572.3	511.8	451.2	390.68	330.15	80.4 %	75.3 %	70.3 %	62.8 %	55.4 %	48.0 %	40.5 %
Hospitals	662.61	543.10	512.3	481.5	436.3	391.0	345.72	300.45	82.0 %	77.3 %	72.7 %	65.8 %	59.0 %	52.2 %	45.3 %
Retirement homes	801.48	648.16	608.7	569.2	511.1	453.0	394.96	336.88	80.9 %	75.9 %	71.0 %	63.8 %	56.5 %	49.3 %	42.0 %
Day-care stations for children	277.11	220.75	206.2	191.7	170.4	149.0	127.68	106.33	79.7 %	74.4 %	69.2 %	61.5 %	53.8 %	46.1 %	38.4 %
Healthcare stations	486.48	383.74	357.3	330.8	291.9	253.0	214.05	175.13	78.9 %	73.4 %	68.0 %	60.0 %	52.0 %	44.0 %	36.0 %
Mental institutions	780.88	648.69	614.6	580.6	530.5	480.4	430.37	380.30	83.1 %	78.7 %	74.4 %	67.9 %	61.5 %	55.1 %	48.7 %
Buildings for temporary stay	**457.86**	**363.00**	**338.6**	**314.1**	**278.2**	**242.3**	**206.34**	**170.41**	**79.3 %**	**73.9 %**	**68.6 %**	**60.8 %**	**52.9 %**	**45.1 %**	**37.2 %**
Dormitories	738.16	606.73	572.9	539.0	489.2	439.5	389.67	339.89	82.2 %	77.6 %	73.0 %	66.3 %	59.5 %	52.8 %	46.0 %
Hotels – operating all year round	648.78	523.31	491.0	458.7	411.1	363.6	316.08	268.56	80.7 %	75.7 %	70.7 %	63.4 %	56.0 %	48.7 %	41.4 %
Hotels – operating in the summer	362.92	283.15	262.6	242.1	211.8	181.6	151.40	121.18	78.0 %	72.4 %	66.7 %	58.4 %	50.0 %	41.7 %	33.4 %
Hotels – operating in the winter	457.83	364.25	340.1	316.0	280.6	245.1	209.70	174.26	79.6 %	74.3 %	69.0 %	61.3 %	53.5 %	45.8 %	38.1 %
Hostels – operating all year round	678.63	546.39	512.3	478.3	428.2	378.1	328.00	277.91	80.5 %	75.5 %	70.5 %	63.1 %	55.7 %	48.3 %	41.0 %
Hostels – operating in the summer	374.28	296.50	276.5	256.4	227.0	197.5	168.05	138.59	79.2 %	73.9 %	68.5 %	60.6 %	52.8 %	44.9 %	37.0 %
Hostels – operating in the	656.83	550.74	523.4	496.1	455.9	415.7	375.53	335.35	83.8 %	79.7 %	75.5 %	69.4 %	63.3 %	57.2 %	51.1 %

winter															
Boarding institutions	618.69	484.74	450.2	415.7	365.0	314.3	263.51	212.77	78.3 %	72.8 %	67.2 %	59.0 %	50.8 %	42.6 %	34.4 %
Educational facilities	**202.38**	**162.79**	**152.6**	**142.4**	**127.4**	**112.4**	**97.41**	**82.42**	**80.4 %**	**75.4 %**	**70.4 %**	**63.0 %**	**55.5 %**	**48.1 %**	**40.7 %**
Classrooms	290.01	227.52	211.4	195.3	171.7	148.0	124.33	100.66	78.5 %	72.9 %	67.4 %	59.2 %	51.0 %	42.9 %	34.7 %
Secondary education	187.44	153.52	144.8	136.0	123.2	110.3	97.50	84.65	81.9 %	77.2 %	72.6 %	65.7 %	58.9 %	52.0 %	45.2 %
Kindergartens	160.83	129.79	121.8	113.8	102.0	90.3	78.53	66.77	80.7 %	75.7 %	70.8 %	63.4 %	56.1 %	48.8 %	41.5 %
Primary education	195.00	160.11	151.1	142.1	128.9	115.7	102.49	89.27	82.1 %	77.5 %	72.9 %	66.1 %	59.3 %	52.6 %	45.8 %
Higher education	288.62	226.71	210.8	194.8	171.4	147.9	124.45	101.00	78.5 %	73.0 %	67.5 %	59.4 %	51.2 %	43.1 %	35.0 %
Tutoring centres	189.32	151.19	141.4	131.5	117.1	102.7	88.22	73.77	79.9 %	74.7 %	69.5 %	61.9 %	54.2 %	46.6 %	39.0 %
Conservatories	205.87	165.59	155.2	144.8	129.6	114.3	99.08	83.82	80.4 %	75.4 %	70.4 %	62.9 %	55.5 %	48.1 %	40.7 %
Meeting venues	**785.33**	**632.56**	**593.2**	**553.9**	**496.0**	**438.1**	**380.25**	**322.38**	**80.5 %**	**75.5 %**	**70.5 %**	**63.2 %**	**55.8 %**	**48.4 %**	**41.1 %**
Courtrooms	415.65	335.67	315.1	294.5	264.2	233.9	203.58	173.29	80.8 %	75.8 %	70.8 %	63.6 %	56.3 %	49.0 %	41.7 %
All-purpose rooms	375.55	301.77	282.8	263.8	235.8	207.9	179.93	151.99	80.4 %	75.3 %	70.2 %	62.8 %	55.4 %	47.9 %	40.5 %
Amphitheatres	346.02	277.26	259.6	241.8	215.8	189.8	163.71	137.67	80.1 %	75.0 %	69.9 %	62.4 %	54.8 %	47.3 %	39.8 %
Restaurants	797.98	638.92	598.0	557.0	496.7	436.5	376.23	315.98	80.1 %	74.9 %	69.8 %	62.2 %	54.7 %	47.1 %	39.6 %
Pastry shops	822.96	659.24	617.1	574.9	512.9	450.9	388.85	326.84	80.1 %	75.0 %	69.9 %	62.3 %	54.8 %	47.3 %	39.7 %
Theatres	427.27	350.34	330.5	310.7	281.6	252.4	223.30	194.16	82.0 %	77.4 %	72.7 %	65.9 %	59.1 %	52.3 %	45.4 %
Coffee shops	894.21	725.44	682.0	638.5	574.6	510.6	446.71	382.78	81.1 %	76.3 %	71.4 %	64.3 %	57.1 %	50.0 %	42.8 %
Cinemas	399.19	325.91	307.0	288.2	260.4	232.6	204.88	177.13	81.6 %	76.9 %	72.2 %	65.2 %	58.3 %	51.3 %	44.4 %
Indoor gyms	1 021.35	813.85	760.4	707.0	628.4	549.8	471.17	392.57	79.7 %	74.5 %	69.2 %	61.5 %	53.8 %	46.1 %	38.4 %
Indoor swimming pools	1 038.20	817.81	761.0	704.3	620.8	537.3	453.82	370.34	78.8 %	73.3 %	67.8 %	59.8 %	51.8 %	43.7 %	35.7 %
Museums	367.70	299.85	282.4	264.9	239.2	213.5	187.80	162.11	81.5 %	76.8 %	72.0 %	65.1 %	58.1 %	51.1 %	44.1 %
Live music establishments	306.39	251.02	236.8	222.5	201.5	180.5	159.57	138.59	81.9 %	77.3 %	72.6 %	65.8 %	58.9 %	52.1 %	45.2 %
Nightclubs	340.51	275.63	258.9	242.2	217.6	193.1	168.49	143.92	80.9 %	76.0 %	71.1 %	63.9 %	56.7 %	49.5 %	42.3 %
Banks	296.31	230.19	213.2	196.1	171.1	146.0	120.98	95.94	77.7 %	71.9 %	66.2 %	57.7 %	49.3 %	40.8 %	32.4 %

Exhibition venues	374.51	304.74	286.8	268.8	242.4	216.0	189.52	163.10	81.4 %	76.6 %	71.8 %	64.7 %	57.7 %	50.6 %	43.5 %
Concert halls	519.71	421.12	395.7	370.3	333.0	295.7	258.31	220.96	81.0 %	76.1 %	71.3 %	64.1 %	56.9 %	49.7 %	42.5 %
Conference venues	384.05	300.98	279.6	258.2	226.7	195.3	163.80	132.33	78.4 %	72.8 %	67.2 %	59.0 %	50.8 %	42.7 %	34.5 %
Correctional facilities	**632.23**	**502.40**	**469.0**	**435.5**	**386.3**	**337.2**	**287.99**	**238.81**	**79.5 %**	**74.2 %**	**68.9 %**	**61.1 %**	**53.3 %**	**45.6 %**	**37.8 %**
Police centres	644.58	510.25	475.6	441.0	390.2	339.3	288.39	237.51	79.2 %	73.8 %	68.4 %	60.5 %	52.6 %	44.7 %	36.8 %
Police detention facilities	475.26	393.15	372.0	350.8	319.7	288.6	257.54	226.43	82.7 %	78.3 %	73.8 %	67.3 %	60.7 %	54.2 %	47.6 %
Offices	**371.63**	**298.63**	**279.8**	**261.0**	**233.4**	**205.7**	**178.08**	**150.43**	**80.4 %**	**75.3 %**	**70.2 %**	**62.8 %**	**55.4 %**	**47.9 %**	**40.5 %**
Libraries	334.37	274.08	258.6	243.0	220.2	197.3	174.51	151.68	82.0 %	77.3 %	72.7 %	65.9 %	59.0 %	52.2 %	45.4 %
Offices	371.67	298.66	279.9	261.0	233.4	205.7	178.08	150.43	80.4 %	75.3 %	70.2 %	62.8 %	55.4 %	47.9 %	40.5 %
Residential dwellings	**276.79**	**233.96**	**222.9**	**211.9**	**195.7**	**179.4**	**163.22**	**146.99**	**84.5 %**	**80.5 %**	**76.6 %**	**70.7 %**	**64.8 %**	**59.0 %**	**53.1 %**
Apartments in multi-dwelling buildings	255.22	215.20	204.9	194.6	179.4	164.3	149.11	133.95	84.3 %	80.3 %	76.2 %	70.3 %	64.4 %	58.4 %	52.5 %
Single-family houses	395.72	338.36	323.6	308.8	287.1	265.3	243.62	221.89	85.5 %	81.8 %	78.0 %	72.5 %	67.1 %	61.6 %	56.1 %
Multi-dwelling buildings	260.21	218.98	208.4	197.7	182.1	166.5	150.89	135.27	84.2 %	80.1 %	76.0 %	70.0 %	64.0 %	58.0 %	52.0 %

Primary energy savings in tertiary and domestic sector buildings undergoing renovation in relation to the average consumption of the building stock
Primary energy savings in new tertiary and domestic sector buildings in relation to the average consumption of the building stock

ANNEX II

The optimal results obtained from the report for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for each period, climatic zone and type of building are detailed in this Annex.

Existing buildings: Single-family houses

Table 19: Best-case financial calculation scenario at a building level for the period 1955-1980

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
1955-1980	A	1_1_1_2.31_0.84_2.68_4.47_1_2_1.02_2_1.02_3_1.5_0_0_0_O_O	187.4	532.4
	B	1_2_1_2.32_0.84_1.74_4.47_1_2_1.02_2_1.02_3_1.5_0_0_0_O_O	242.00	599.99
	C	1_3_1_0.58_0.49_0.44_2.24_1_2_1.02_2_1.02_3_1.5_0_0_0_O_O	195.50	659.3
	D	1_4_1_0.58_0.49_2.68_1.12_1_2_1.02_2_1.02_3_1.5_0_0_0_O_O	192.6	652.7

Table 20: Best-case financial calculation scenario at a building level for the period 1980-2000

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy kWh/m2.a	Cost €/m2
1980-2000	A	2_1_1_0.64_0.48_0.48_4.42_1_2_1.02_2_1.02_3_1.5_0_0_0_O_ O	134.00	400.31
	B	2_2_1_0.63_0.45_1.07_4.43_1_2_1.02_2_1.02_3_1.5_0_0_0_O_ O	185.80	458.67
	C	2_3_1_0.64_0.45_0.48_4.42_1_2_1.02_2_1.02_3_1.5_0_0_0_O_ O	242.70	539.37
	D	2_4_1_0.64_0.45_0.48_4.42_1_5_0.99_5_0.99_3_1.5_0_0_0_O_ O	193.80	584.34

Table 21: Best-case financial calculation scenario at a building level for the period 2000-2010

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
2000-2010	A	3_1_1_0.64_0.48_1.6_4.3_1_2_1.02_2_1.02_3_1.5_0_0_0_O_O	133.60	413.01
	B	3_2_1_0.64_0.48_1.04_4.35_1_2_1.02_2_1.02_3_1.5_0_0_0_O_O	127.10	344.30
	C	3_3_1_0.32_0.46_0.6_4.35_1_2_1.02_2_1.02_3_1.5_0_0_0_ O_O	128.11	417.08
	D	3_4_1_0.64_0.45_0.6_4.3_1_2_1.02_2_1.02_3_1.5_0_0_0_O_O	252.30	566.58

Table 22: Best-case financial calculation scenario at a building level for the period 2010-2017

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
2010-2017	A	4_1_3_0.54_0.47_1.02_2.5_1_1_0.8_3_1_3_1.5_0_0_3_α_O	95.20	236.67
	B	4_2_3_0.47_0.42_0.7_2.5_1_1_0.8_3_1_3_1.5_0_0_3_α_O	105.10	254.63
	C	4_3_1_0.42_0.39_0.64_2.5_O_1_0.8_3_1_3_1.5_0_0_3_α_ O	152.80	307.63
	D	4_4_1_0.37_0.32_0.64_2.04_O_1_0.8_3_1_3_1.5_0_0_3_α_ O	166.20	323.41

New buildings: Single-family houses

Following are the results obtained for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for new single-family houses.

Table 23: Best-case financial calculation scenario at a building level for new buildings

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
NEW	A	5_1_2_0.6_0.5_0.6_2.6_O_2_1.02_2_1.02_3_3.5_0_0_3_α_O	67.10	1 585.05
	B	5_2_2_0.5_0.45_0.9_2.6_O_2_1.02_2_1.02_3_3.5_0_0_3_α_O	77.20	1 607.35
	C	5_3_1_0.45_0.4_0.38_1.3_O_1_0.98_1_0.98_3_3.5_0_0_3_α_O	112.60	1 650.89
	D	5_4_1_0.8_0.35_0.7_1.3_O_5_0.99_5_0.99_3_3.5_0_0_3_α_O	102.40	1 670.21

Existing buildings: Three-floor multi-dwelling building with a ground-floor non-heated space

Following are the results for a three- and five-floor multi-dwelling building, resulting from financial calculations at a building level. Here are the results obtained from the report for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for existing buildings.

Table 24: Best-case financial calculation scenario at a building level for the period 1955-1980

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
1955-1980	A	1_1_1_2.4_0.84_1.73_2.14_O_2_1.02_2_1.02_3_1.5_0_0_0_O_ O	87.80	294.99
	B	1_2_1_2.4_0.84_1.73_2.14_O_2_1.02_2_1.02_3_1.5_0_0_0_O_ O	103.9	316.61
	C	1_3_1_2.4_0.84_0.44_2.14_O_2_1.02_2_1.02_3_1.5_0_0_0_O_ O	138.7	369.06
	D	1_4_1_2.4_0.84_0.44_2.14_O_2_1.02_2_1.02_3_1.5_0_0_0_O_ O	153.10	390.50

Table 25: Best-case financial calculation scenario at a building level for the period 1980-2000

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
1980-2000	A	2_1_1_0.64_0.48_1.67_4.38_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	91.5	254.86
	B	2_2_1_0.64_0.48_1.04_4.38_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	104.2	271.47
	C	2_3_1_0.64_0.48_0.6_4.38_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	145.1	324.62
	D	2_4_1_0.64_0.48_0.6_2.19_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	138.3	347.24

Table 26: Best-case financial calculation scenario at a building level for the period 2000-2010

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
2000-2010	A	3_1_3_0.64_0.48_1.6_2.97_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	98.00	242.03
	B	3_2_3_0.64_0.48_1.07_2.97_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	110.60	258.49
	C	3_3_3_0.64_0.48_0.6_1.49_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	139.6	319.04
	D	3_4_3_0.64_0.48_0.6_1.49_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	158.1	344.34

Table 27: Best-case financial calculation scenario at a building level for the period 2010-2017

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
2010-2017	A	4_1_3_0.55_0.47_1.04_2.78_O_2_1.02_2_1.02_3_1.5_0_0_3_α_O	69.50	186.08
	B	4_2_3_0.47_0.42_0.71_2.78_O_2_1.02_2_1.02_3_1.5_0_0_3_α_O	79.20	200.45
	C	4_3_3_0.42_0.37_0.65_2.78_O_2_1.02_2_1.02_3_1.5_0_0_3_α_O	131.07	264.87
	D	4_4_3_0.37_0.34_0.65_2.25_O_2_1.02_2_1.02_3_1.5_0_0_3_α_O	142.60	264.34

New buildings: Three-floor multi-dwelling building with a ground-floor non-heated space

Following are the results obtained for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for new multi-dwelling buildings.

Table 28: Best-case financial calculation scenario at a building level for new buildings

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
NEW	A	5_1_3_0.3_0.25_0.6_1.3_O_3_4.5_3_4.5_3_4.2_0_0_20_α_ β	33.9	1 424.37
	B	5_2_3_0.25_0.23_0.45_1.3_O_3_4.5_3_4.5_3_4.2_0_0_20_ α_β	42.1	1 453.54
	C	5_3_3_0.23_0.4_0.38_1.3_O_3_4.5_3_4.5_3_4.2_0_0_20_α_β	63.4	1 502.13
	D	5_4_3_0.4_0.35_0.35_1.3_O_3_4.5_3_4.5_3_4.2_0_0_20_α_β	77.2	1 549.24

Existing buildings: Three-floor multi-dwelling building with a pilotis system

Following are the results obtained for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for existing buildings.

Table 29: Best-case financial calculation scenario at a building level for the period 1955-1980

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
1955-1980	A	1_1_1_2.4_0.84_0.58_2.14_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	84.90	304.18
	B	1_2_1_2.4_0.84_0.58_2.14_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	100.20	325.57
	C	1_3_1_2.4_0.84_0.58_2.14_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O_	141.70	383.72
	D	1_4_1_2.4_0.84_0.58_2.14_O_2_1.02_2_1.02_3_1.5_0_0_0_ O_O	156.60	407.16

Table 30: Best-case financial calculation scenario at a building level for the period 1980-2000

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
1980-2000	A	2_1_1_0.64_0.48_0.475_4.38_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	88.5	257.43
	B	2_2_1_0.64_0.48_0.475_4.38_O_2_1.02_2_1.02_3_1.5_0_0_0_ O_O	103.3	277.62
	C	2_3_1_0.64_0.48_0.475_2.19_O_2_1.02_2_1.02_3_1.5_0_0_0_ O_O	125.40	339.26
	D	2_4_1_0.64_0.48_0.475_2.19_O_2_1.02_2_1.02_3_1.5_0_0_0_ O_O	140.30	363.19

Table 31: Best-case financial calculation scenario at a building level for the period 2000-2010

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m^2
2000-2010	A	3_1_3_0.64_0.48_0.47_2.97_O_2_1.02_2_1.02_3_1.5_0_0_0_O_ O	94.6	244.76
	B	3_2_3_0.64_0.48_0.47_2.97_O_2_1.02_2_1.02_3_1.5_0_0_0_O_ O	109. 3	265.05
	C	3_3_1_0.64_0.48_0.47_1.49_O_2_1.02_2_1.02_3_1.5_0_0_0_O_ O	116.2	337.29
	D	3_4_1_0.64_0.48_0.47_1.49_O_2_1.02_2_1.02_3_1.5_0_0_0_O_ O	131.2	360.70

Table 32: Best-case financial calculation scenario at a building level for the period 2010-2017

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
2010-2017	A	4_1_3_0.55_0.475_0.47_2.78_O_1_0.98_1_0.98_3_1.5_0_0_3_α_O	76.10	186.33
	B	4_2_3_0.47_0.42_0.41_2.78_O_1_0.98_1_0.98_3_1.5_0_0_3_α_O	88.00	202.57
	C	4_3_1_0.42_0.37_0.37_2.78_O_1_0.98_1_0.98_3_1.5_0_0_3_α_O	118.80	263.22

	D	4_4_1_0.37_0.34_0.33_2.25_O_1_0.98_1_0.98_3_1.5_0_0_3_α_O	127.90	259.2

New buildings: Three-floor multi-dwelling building with a pilotis system

Following are the results obtained for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for new multi-dwelling buildings.

Table 33: Best-case financial calculation scenario at a building level for new buildings

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
NEW	A	5_1_3_0.3_0.25_0.25_1.3_O_3_4.5_3_4.5_3_4.2_0_0_20_α_β	33.70	1 402.01
	B	5_2_3_0.25_0.23_0.23_1.3_O_3_4.5_3_4.5_3_4.2_0_0_20_α_β	42.00	1 431.13
	C	5_3_3_0.45_0.4_0.4_1.3_O_3_4.5_3_4.5_3_4.2_0_0_20_α_β	62.30	1 482.70
	D	5_4_3_0.4_0.35_0.18_1.3_O_3_4.5_3_4.5_3_4.2_0_0_20_α_β	77.00	1 529.38

Existing buildings: Five-floor multi-dwelling building with a pilotis system

Following are the results obtained for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for existing buildings.

Table 34: Best-case financial calculation scenario at a building level for the period 1955-1980

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
1955-1980	A			
	B	1_2_1_0.61_0.84_0.58_2.17_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	70.1	263.75
	C	1_3_1_0.61_0.84_0.58_2.17_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	97.2	298.64
	D			

Table 35: Best-case financial calculation scenario at a building level for the period 1980-2000

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
1980-2000	A			
	B	2_2_1_0.64_0.48_0.475_2.16_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	71.50	237.82
	C	2_3_1_0.64_0.48_0.48_2.16_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	97.40	269.55
	D			

Table 36: Best-case financial calculation scenario at a building level for the period 2000-2010

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
2000-2010	A			
	B	3_2_1_0.64_0.48_0.48_2.97_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	71.00	203.83
	C	3_3_1_0.64_0.48_0.48_2.97_O_2_1.02_2_1.02_3_1.5_0_0_0_O_O	102.80	242.71
	D			

Table 37: Best-case financial calculation scenario at a building level for the period 2010-2017

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
2010-2017	A			
	B	4_2_3_0.47_0.42_0.41_2.78_O_2_1.02_2_1.02_3_1.5_0_0_3_α_O	60.90	156.44
	C	4_3_3_0.42_0.37_0.37_2.78_O_2_1.02_2_1.02_3_1.5_0_0_3_α_O	101.9	205.16
	D			

New buildings: Five-floor multi-dwelling building with a pilotis system

Following are the results obtained for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for new multi-dwelling buildings.

Table 38: Best-case financial calculation scenario at a building level for new buildings

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
NEW	A			
	B	5_2_3_0.5_0.45_0.23_1.3_O_3_4.5_3_4.5_3_4.2_0_0_20_α_β	34.40	1 354.04
	C	5_3_3_0.45_0.4_0.4_1.3_O_3_4.5_3_4.5_3_4.2_0_0_20_α_β	47.70	1 387.01
	D			

Following are the results for office buildings, resulting from financial calculations at a building level.

Existing buildings: Two-floor office building with an underground non-heated space

The optimal results for each period, climatic zone and existing typical building, resulting from financial calculations at a building level, are detailed below.

Following are the results obtained for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for existing buildings.

Table 39: Best-case financial calculation scenario at a building level for the period 1955-1980

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
1955-1980	A	1_1_2_2.66_1.13_2_6.1_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	123.00	383.53
	B	1_2_2_2.66_1.13_2_6.1_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	135.1	395.75
	C	1_3_2_2.66_1.13_2_6.1_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	155.9	418.34
	D	1_4_2_2.66_1.13_2_6.1_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	166.4	430.46

Table 40: Best-case financial calculation scenario at a building level for the period 1980-2000

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
1980-2000	A	2_1_2_0.65_0.48_1.91_3.96_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	114.7	359.75
	B	2_2_2_0.65_0.48_0.96_3.96_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	122.1	366.6
	C	2_3_2_0.65_0.48_0.61_3.96_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	134.0	379.48
	D	2_4_2_0.65_0.48_0.61_3.96_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	140.5	387.46

Table 41: Best-case financial calculation scenario at a building level for the period 2000-2010

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
2000-2010	A	3_1_3_0.65_0.48_1.91_4.55_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_O	161.1	315.46
	B	3_2_3_0.65_0.48_0.96_4.55_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_O	171.7	325.75
	C	3_3_3_0.65_0.48_0.61_4.55_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_O	192.0	347.73
	D	3_4_3_0.65_0.48_0.61_4.55_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_O	202.4	362.35

Table 42: Best-case financial calculation scenario at a building level for the period 2010-2017

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
2010-2017	A	4_1_3_0.55_0.48_0.94_2.26_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_ O	154.9	310.58
	B	4_2_3_0.48_0.42_0.72_2.26_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_ O	79.20	320.93
	C	4_3_3_0.42_0.37_0.61_2.26_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_ O	131.07	337.75
	D	4_4_3_0.38_0.34_0.61_2.26_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_ O	142.60	348.74

New buildings: Two-floor office building with an underground non-heated space

Following are the results obtained for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for new buildings.

Table 43: Best-case financial calculation scenario at a building level for new buildings

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
NEW	A	5_1_3_1.2_1_0.8_3.5_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_O	162.5	1 556.3
	B	5_2_3_1_0.9_0.75_3.5_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_ O	174.3	1 568.31
	C	5_3_3_0.9_0.8_0.68_3.5_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_ O_O	194.7	1 590.28
	D	5_4_3_0.8_0.7_0.65_3.5_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_ O_O	202.2	1 600.63

Existing buildings: Five-floor office building with a ground-floor non-heated space

The optimal results for each period, climatic zone and existing typical building, resulting from financial calculations at a building level, are detailed below.

Following are the results obtained for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for existing buildings.

Table 44: Best-case financial calculation scenario at a building level for the period 1955-1980

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
1955-1980	A	1_1_2_2.5_1.14_2_6.12_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	103.7	344.46
	B	1_2_2_2.5_1.14_2_6.12_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	114.4	358.35
	C	1_3_2_2.5_1.14_2_6.12_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	131.4	380.02
	D	1_4_2_2.5_1.14_2_6.12_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	140.5	397.08

Table 45: Best-case financial calculation scenario at a building level for the period 1980-2000

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
1980-2000	A	2_1_2_0.64_0.48_1.91_4_O_3_Σ4_3_B_0_Φ6_100_0.17_0_ O_O	97.6	328.12
	B	2_2_2_0.64_0.48_0.96_4_O_3_Σ4_3_B_0_Φ6_100_0.17_0_ O_O	105.1	337.32
	C	2_3_2_0.64_0.48_0.61_4_O_3_Σ4_3_B_0_Φ6_100_0.17_0_ O_O	115.7	351.03
	D	2_3_2_0.64_0.48_0.61_4_O_3_Σ4_3_B_0_Φ6_100_0.17_0_ O_O	122.0	365.79

Table 46: Best-case financial calculation scenario at a building level for the period 2000-2010

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
2000-2010	A	3_1_3_0.64_0.48_1.91_4.66_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_O	137.6	281.31
	B	3_2_3_0.64_0.48_0.96_4.66_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_O	149.5	293.47
	C	3_3_3_0.64_0.48_0.61_4.66_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_O	167.6	313.69
	D	3_4_3_0.64_0.48_0.61_4.66_O_3_Σ3_3_Γ_0_Φ6_100_0.17_0_O_O	178.1	326.61

Table 47: Best-case financial calculation scenario at a building level for the period 2010-2017

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy,kWh/m2.a	Cost €/m2
2010-2017	A	4_1_3_0.55_0.47_0.94_2.29_O_3_Σ2_3_Γ_0_Φ6_100_0.17_0_O_O	136.7	262.43
	B	4_2_3_0.47_0.42_0.72_2.29_O_3_Σ2_3_Γ_0_Φ6_100_0.17_0_O_O	147.0	274.05
	C	4_3_3_0.42_0.37_0.61_2.29_O_3_Σ2_3_Γ_0_Φ6_100_0.17_0_O_O	160.5	285.98
	D	4_4_3_0.37_0.34_0.61_2.29_O_3_Σ2_3_Γ_0_Φ6_100_0.17_0_O_O	168.0	295.77

New buildings: Five-floor office building with a ground-floor non-heated space

Following are the results obtained for a financial calculation with a 7 % discount rate and a 2.8 % development in energy prices for new buildings.

Table 48: Best-case financial calculation scenario at a building level for new buildings

Period	Climatic zone	Best-case financial calculation scenario	Results at a building level	
			Cons. of Prim. Energy, kWh/m2.a	Cost €/m2
NEW	A	5_1_2_1.2_1_2_3.5_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	97.5	1 457.42
	B	5_2_2_1_0.9_0.75_3.5_O_3_Σ4_3_B_0_Φ6_100_0.17_0_O_O	104.1	1 467.43
	C	5_3_2_0.9_0.8_0.68_3.5_O_3_Σ4_3_B_0_Φ6_100_0.17_0_ O_O	113.9	1 480.39
	D	5_4_2_0.8_0.7_0.65_3.5_O_3_Σ4_3_B_0_Φ6_100_0.17_0_ O_O	118.6	1 493.21

ANNEX III – Public consultation report