Hellenic Republic
Ministry of Environment and Energy

Long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private
The Greek case

CA EED Hague, 17.03.2016

Synthesis Report on the assessment of MS building renovation strategies

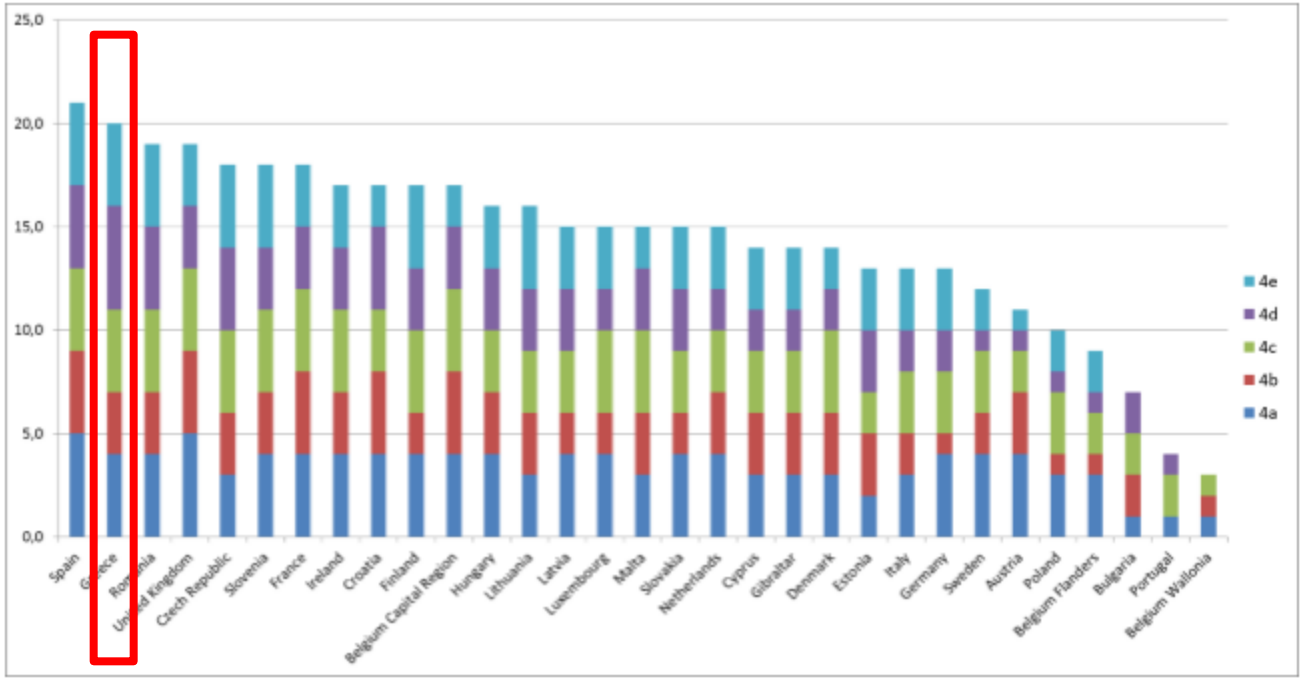


Figure 1: Comparison of the scores of the 31 evaluations of Member States notifications

Greece
Total score
(20/25 - 80%)

Best practice:
Forward-looking perspective to guide investment decisions - Article 4(d)

Cooperation of

- the Ministry of Environment and Energy and
- the Technological Education Institute of Piraeus

(Laboratory of Soft Energy Applications and Environmental Protection of the Mechanical Engineering Department)

In accordance with

- the NEEAP
- the National Energy Planning

Compliance with the requirements set out in Article 4 of Directive 2012/27/EU

(a) **an overview of national building stock** based on statistical sampling

(b) **identification of cost-effective approaches** to renovations depending on the building type and climatic zone

(c) **policies and measures** to stimulate the cost-effective renovations of buildings, including gradual major renovations

(d) **a** forward-looking perspective to **guide investment decisions** of individuals, the construction industry and financial institutions

(e) **an** estimate of **expected energy savings** and **wider benefits** based on specific data and a specific methodology

The study was also based on:

- Annex B of Commission Staff Working Document SWD(2013)180 final/22.5.2013, which describes certain individual sections that need to be analyzed
- The CRISP methodology, developed by the LSEA&EO for creating innovative sustainable pathways
- The report “Towards assisting EU MS on developing long term strategies for mobilizing investment in building energy renovation”, prepared by JWG of CA EED, CA EPBD and CA RES, 2013
- Data from the Hellenic Statistical Authority (ELSTAT) and other official public authorities
- Records from researchers and scientists in related fields
- Studies from laboratories and R&D centers

Targets – Timeframe

No specific target has been set for energy savings in the building sector

The report aims to assist the vision of having a **sustainable building stock by 2050**:

- gradual and coordinated upgrade of the building stock
- the entire stock consists of high energy performance buildings
- Ideally of nearly zero-energy buildings
- ensuring maximum utilization of renewable energy sources

Stakeholders

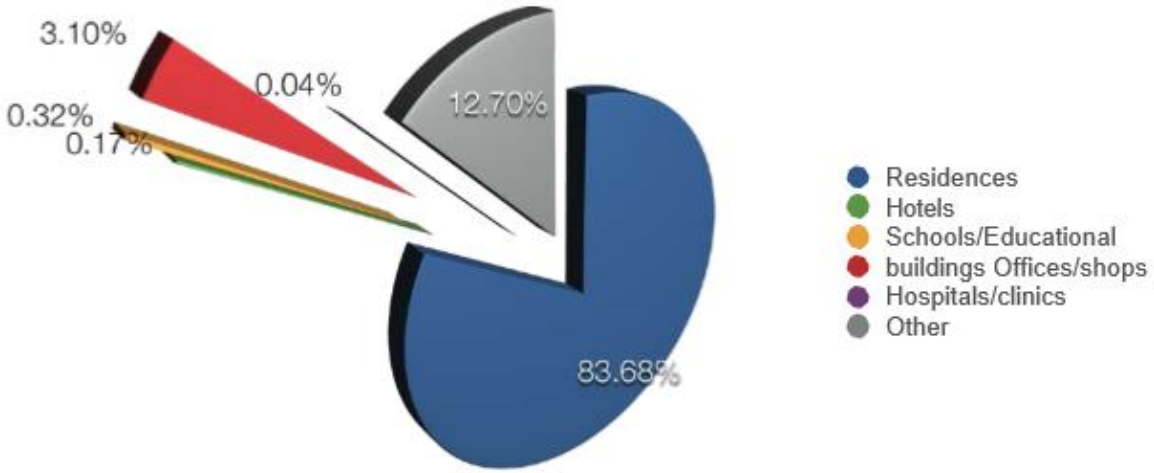
Key factors involved in the decision-making process for the renovation of buildings

Consultation with other Ministries and public bodies, as well as important bodies and institutions that are directly or indirectly associated with the energy upgrade of buildings

Review of the building stock

Based on
- Hellenic Statistic Agency
- TABULA
- Other databases

Use of building	Number of residences and tertiary sector buildings
Residences	4 122 088
Hotels	8 309
Schools - educational buildings	15 576
Offices - shops	152 550
Hospitals - clinics	1 742
Other	625 630
	4 925 895



Review of the building stock

Other significant information for potential investors

Significant drop in the number of building permits issued in the period 2008-2011, due to the **economic crisis**

25% annually reduction

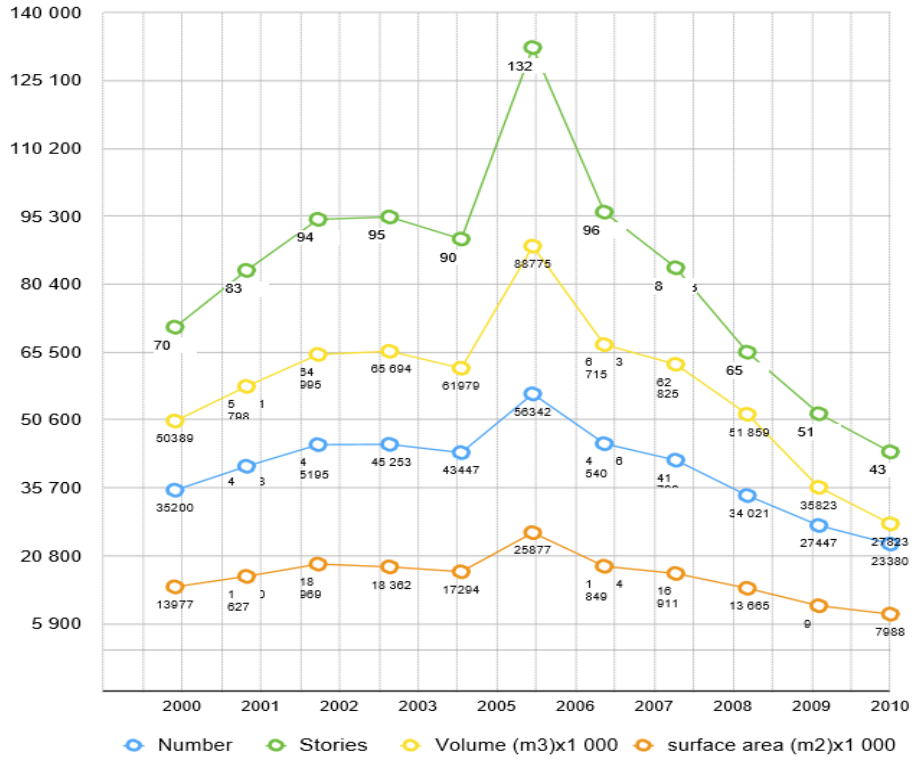
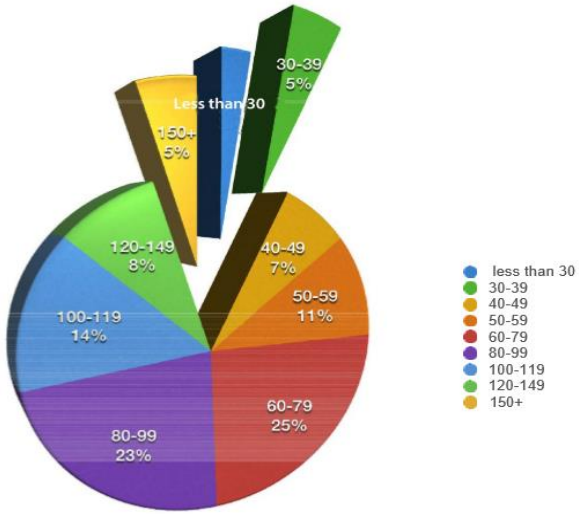


Figure 5: New building permits 2000-2011, [ELSTAT database]

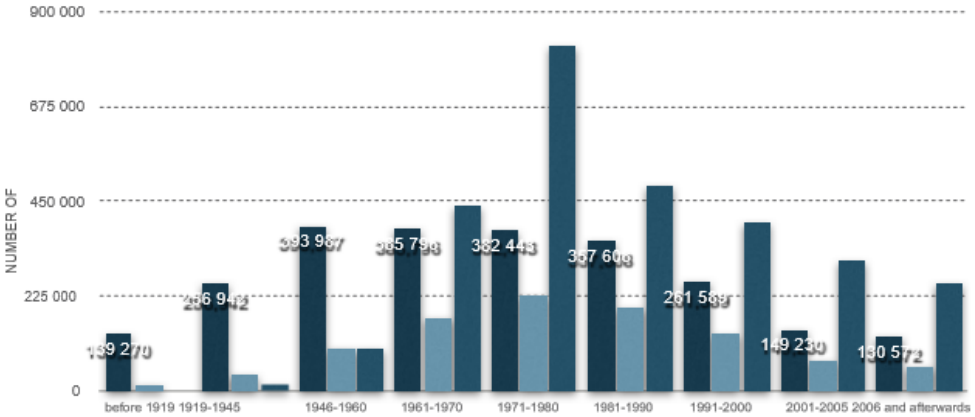
Review of the building stock

Other significant information for potential investors

size of buildings

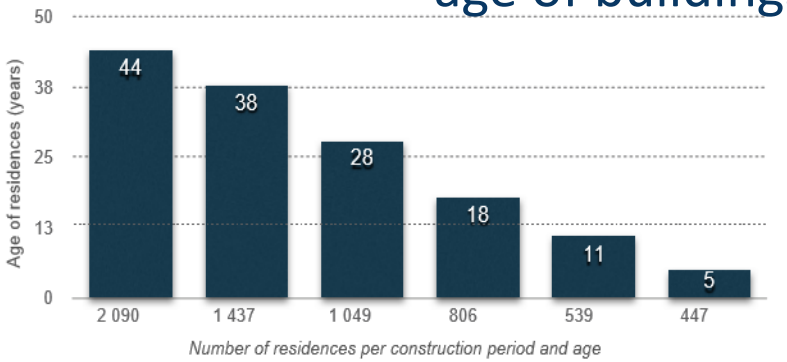


construction period



	detached residence	semi-detached residence	block of flats
before 1919	139 270	18 952	5 016
1919-1945	256 942	43 748	16 902
1946-1960	393 987	105 838	104 431
1961-1970	385 796	174 220	440 342
1971-1980	382 443	229 831	820 853
1981-1990	357 608	202 350	486 189
1991-2000	261 589	138 610	403 882
2001-2005	149 230	76 783	311 497
2006 onwards	130 572	58 669	256 971

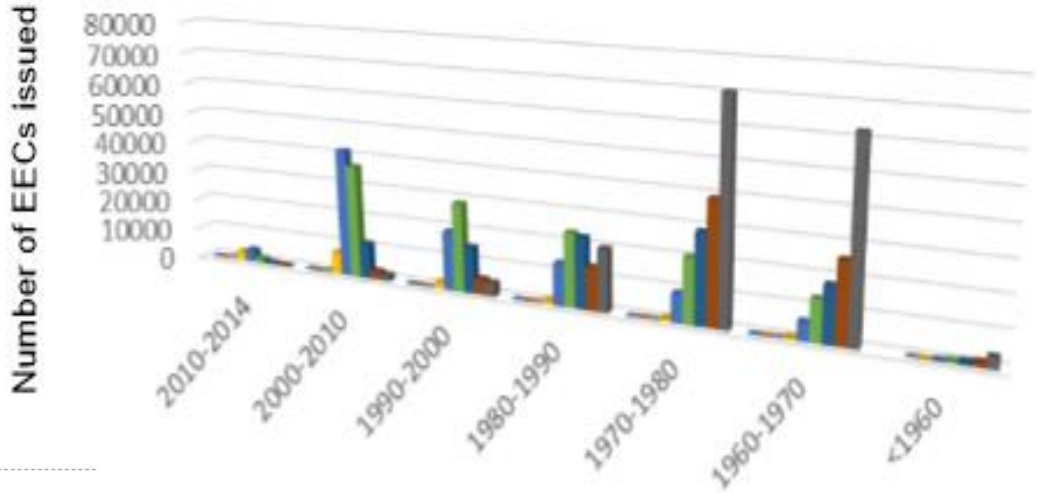
age of buildings

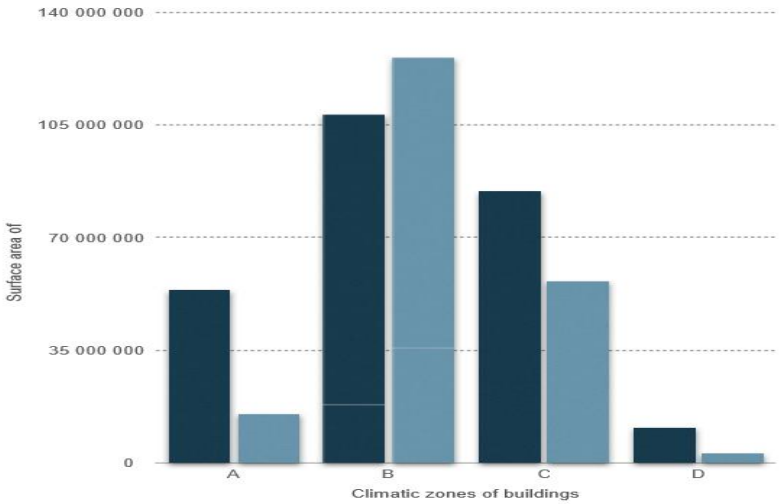


Review of the building stock

Other significant information for potential investors

Energy category per construction period

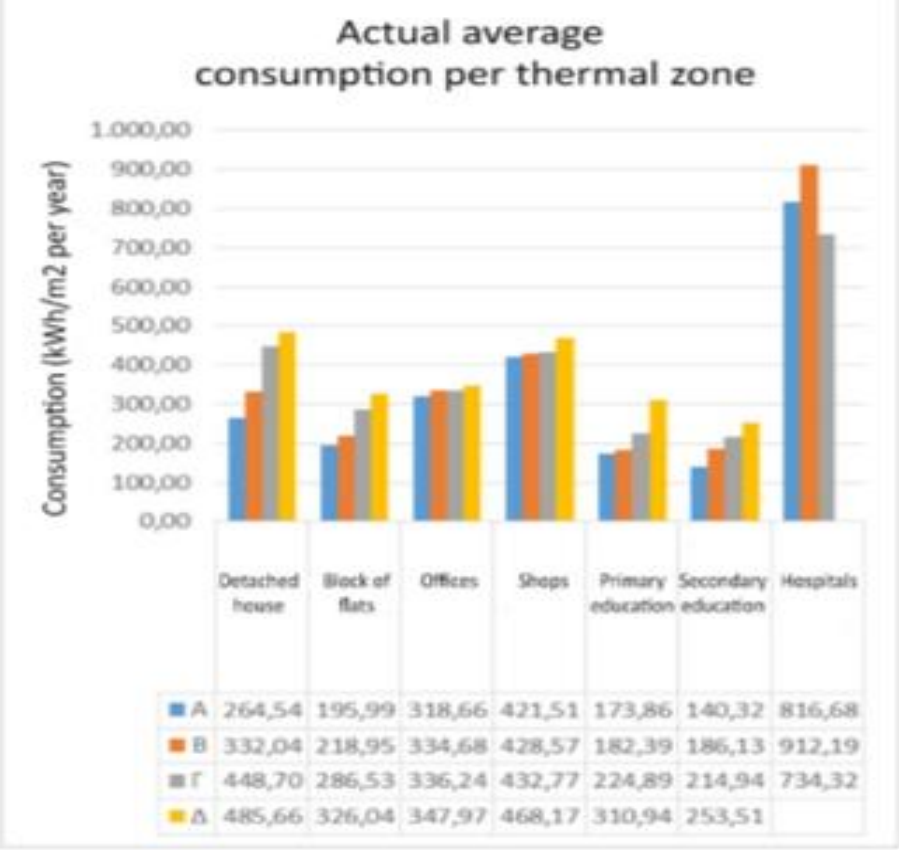


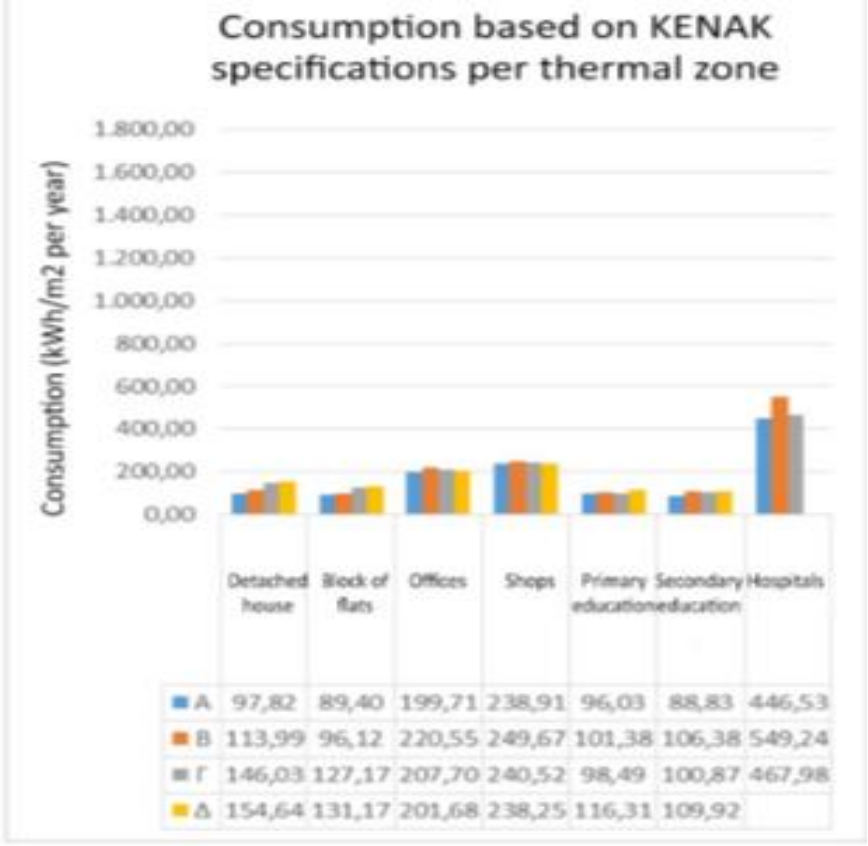


Buildings per climatic zone

Energy consumption of the building stock

Other significant information for potential investors

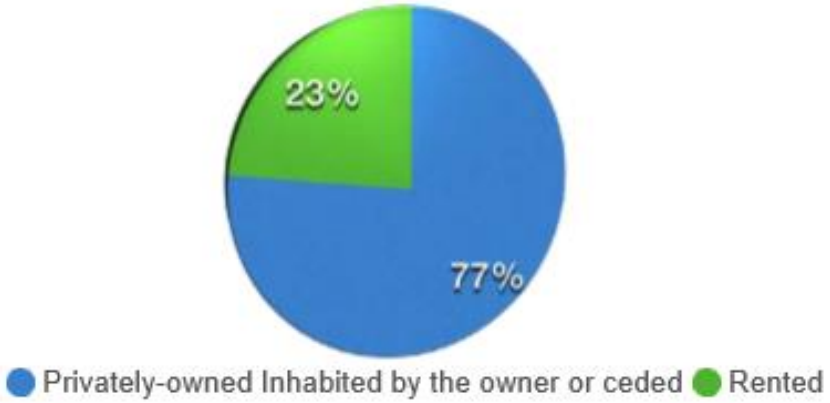




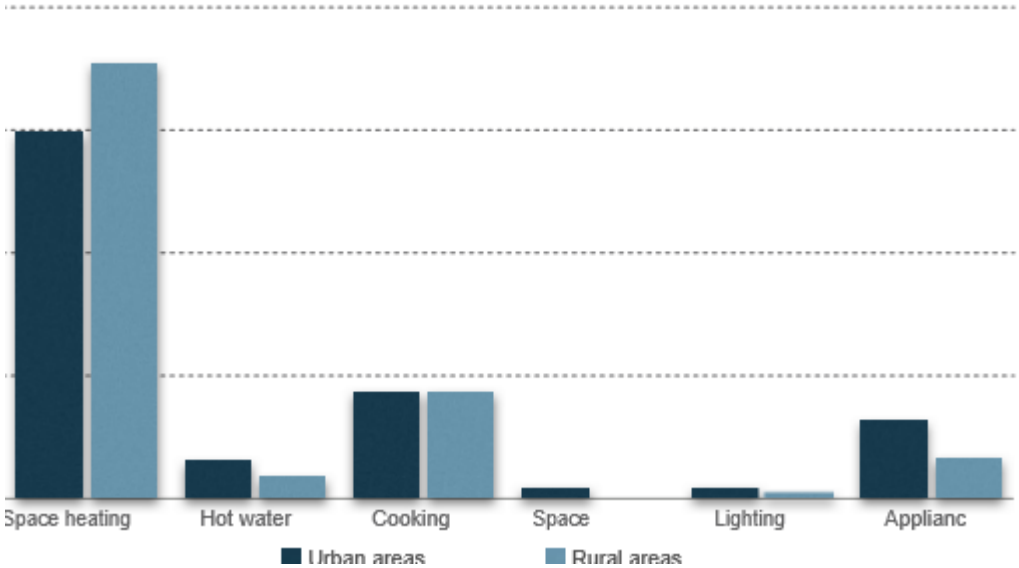
Average consumption per building use and per climatic zone

Review of the building stock

Other significant information for potential investors



Ownership of buildings:
only 23% of the buildings are rented



Urbanization:
74% of the residences are located in urban areas and 26% are located in rural areas

Energy characteristics of buildings

Other significant information for potential investors

Breakdown of the average **annual total energy consumption** per

- type of fuel used and
- per type of use was determined

Breakdown of **thermal energy consumption** per

- fuel type

Breakdown of **electricity consumption** per

- end use

Characteristics of the shells (U-value: kWh/m2.K, etc.) as determined from existing structures and based on weighted averages per

- climatic zone

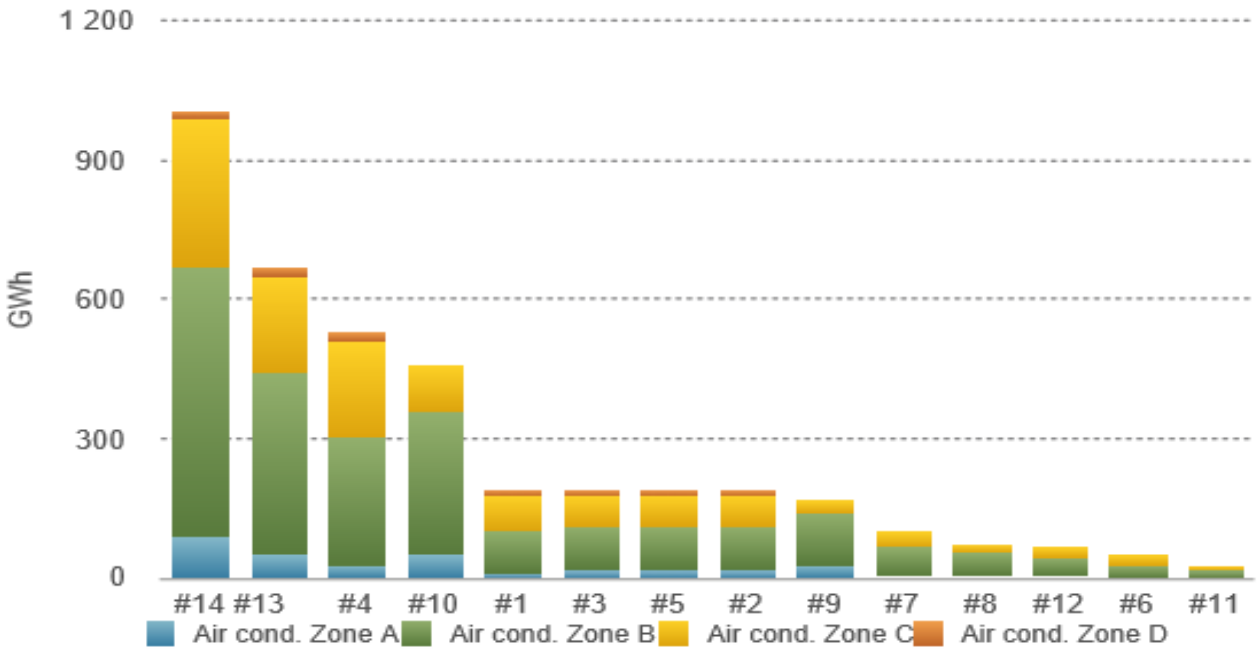
Identification of energy saving measures

No	Energy-saving measures in the building stock	Savings percentage (%)	
		Thermal energy	Electricity
1	Exterior wall thermal insulation	33-60	
2	Thermal insulation on roofs - floors	2-14	
3	Restoration of glazed units (windows, doors and frames)	14-20	
4	Maintenance of central heating systems	10-12	
5	Installation of new high-efficiency, oil-fired central heating systems	Up to 17	
6	Installation of a gas-fired central heating system	up to	
7	Installation of compensating thermostats	3-6	
8	Installation of space thermostats	3-6	
9	Installation of external shading	10-20	
10	Installation of ceiling fans		Up to 60
11	Night ventilation		Up to 10
12	Installation of solar collectors for hot water		50-80
13	Installation of high-efficiency lighting systems		Up to 60
14	Installation of a building management system (BMS)	Up to	Up to 30
15	Airtightness	16-21	
16	Replacement of air conditioners with high-efficiency heat pumps		65-75
17	Use of geothermal pumps	Up to	
18	Installation of a planted roof	Up to	Up to 30
19	Use of cool materials	Up to	

Relevant information:

- Use of RES (photovoltaics, solar hot water)
- Connection with district heating networks

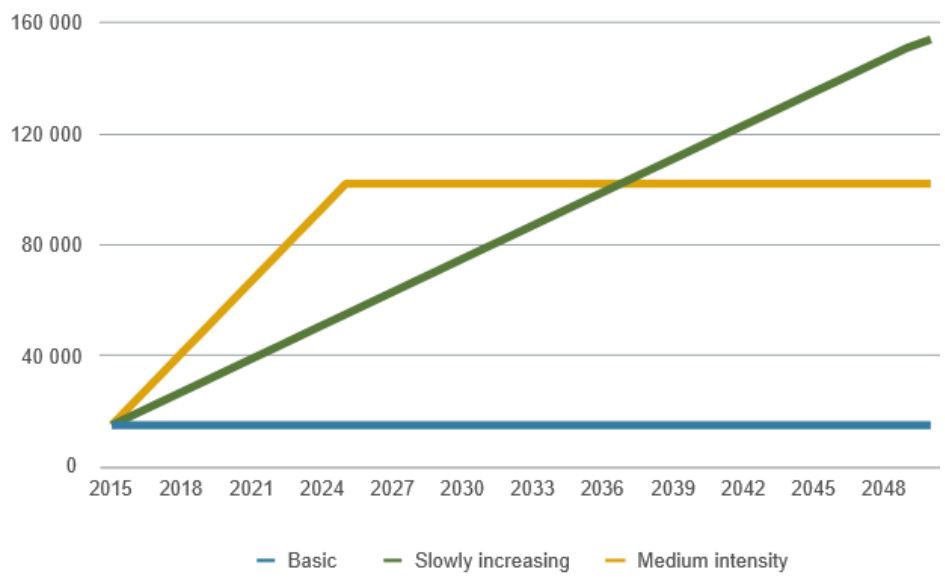
Energy saving potential



Total energy-saving potential based on the most appropriate measures per

- building use category
- climatic zone (total floor area)

Renovation rate: 3 intensity levels



- **basic rate:** fixed annual quantities, rate under current practice, without any additional measures implemented
- **slowly increasing rate:** fixed annual increased rate
- **medium intensity rate:** direct significant increase, which is meant to remain at fixed levels afterwards

	RENOVATION RATE	2015	2020	2025	2030	2040	2050	TOTAL NUMBER OF RENOVATED RESIDENCES
		NUMBER OF BUILDINGS						
1	BASIC	25 000	25 000	25 000	25 000	22 000	25 000	900 000
2	SLOWLY INCREASING	28 000	65 200	78 000	90 000	108 000	160 000	3 408 800
3	MEDIUM INTENSITY	25 000	68 800	116 000	116 000	116 000	116 000	3 686 000

4 types of renovation

TYPE OF RENOVATION	SAVINGS PERCENTAGE
Minor	20%
Medium	40%
Major	60%
Nearly zero energy	80%

The cost of typical renovations is estimated at

- EUR 1 / kWh for residences
- EUR 1.2 / kWh for schools
- EUR 1.5 / kWh for offices, shops, hospitals and hotels

5 Renovation scenarios

Basic scenario (S1): fixed renovation rate, describes the business as usual case

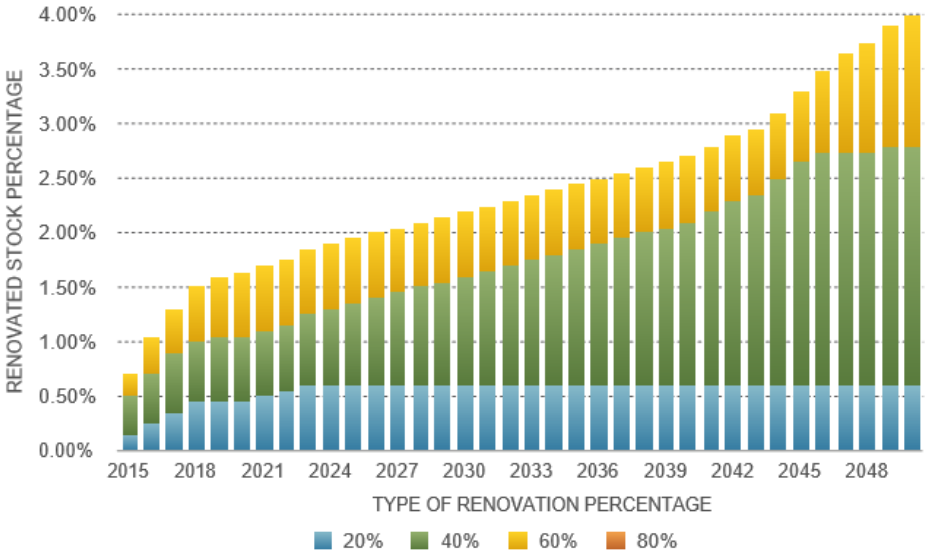
Medium scenario (S2): the renovation rate changes slowly, combining different types of renovation

Strong scenario (S3): based on a medium intensity renovation rate and includes more in-depth renovations

Ambitious scenario (S4): describes a medium intensity rate too, involving different types of renovation, which has also included nearly nZEBs

Targets scenario (S5): also describes a medium intensity rate, involving different types of renovation, also achieving the targets set through NEEAP

Renovation scenarios: 5



CHANGES OF RENOVATION DEPTH OVER TIME (2015-2050) - HOUSEHOLD RESIDENCES										
	RENOVATION RATE			RENOVATION PERCENTAGE - START YEAR 2015			RENOVATION PERCENTAGE - END YEAR 2050			
Scenarios	2015	2025	2050	Minor 20%	Medium 40%	Major 60%	Minor 20%	Medium 40%	Major 60%	nZEB 80%
S1 - BASIC	25 000	25 000	62 000	12 000	2 250	750	12 000	2 250	750	0
S2 - MEDIUM	25 000	62 000	176 000	12 000	2 200	800	52 800	88 000	34 800	0
S3 - STRONG	25 000	62 000	176 000	12 000	2 240	760	6 000	40 800	70 00	0
S4 - AMBITIOUS	25 000	62 000	176 000	12 000	2 100	900	6 000	11 600	81 600	17 600
S5-TARGETS	28 000	62 000	160 000	6 000	14 000	8 000	24 000	88 000	48 000	0

Economic assumptions

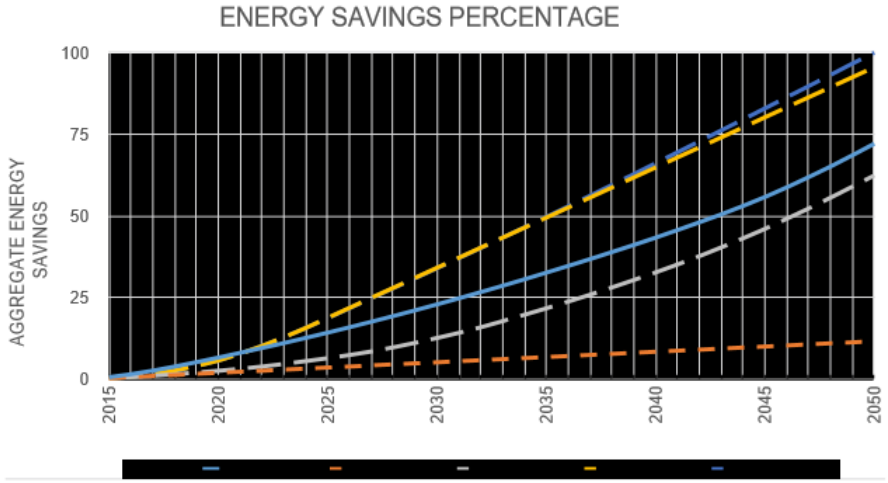
KEY ASSUMPTIONS OF THE CALCULATION MODEL					
	Residences	Offices/shops	Schools	Hospitals	Hotels
Number of buildings in the stock	4 000 000	161 000	16 000	1 700	9 000
Total surface area of the building stock (million m^2)	360	93	23	5	21
Typical building surface area (m^2)	90	580	1 440	2 940	2 330
Typical primary energy consumption (kWh/m^2/year)	360 = (56*2.9+170*1.1)	400 = (95*2.9+113*1.1)	146 = (20*2.9+80*1.1)	550 = (80*2.9+290*1.1)	277 = (50*2.9+120*1.1)
Electricity to final thermal energy consumption ratio (kWhe/ kWhth)	56/170	95/113	20/80	80/290	50/120
Renovation cost - reference year 2015 (EUR/kWh)	1	1.5	1.2	1.5	1.5
Discount rate	8%				
Annual inflation rate of electricity	0.5%				
Annual inflation rate of heat	0.55%				
Cost of electricity (p)	EUR 0.10/kWh				
Cost of heat (h)	EUR 0.14/kWh				
Lifecycle of energy interventions tmax	10-30 years				
Annual inflation rate of the economy	The model may be changed to take inflation into account. In this case, the calculations made are net of inflation.				

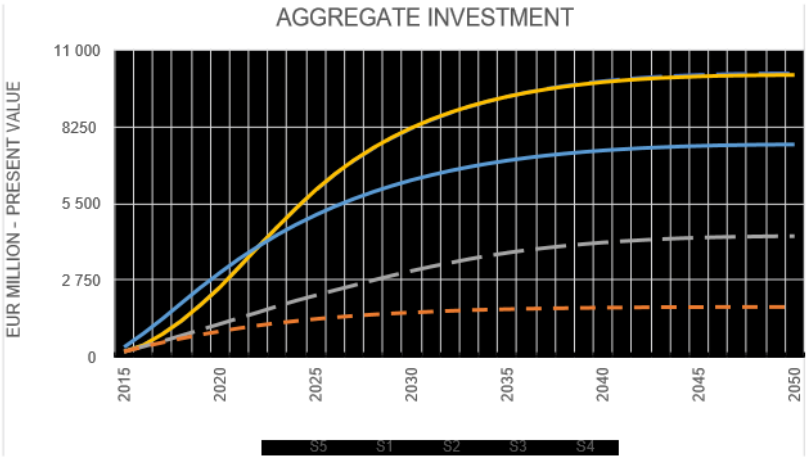
Additional Benefits

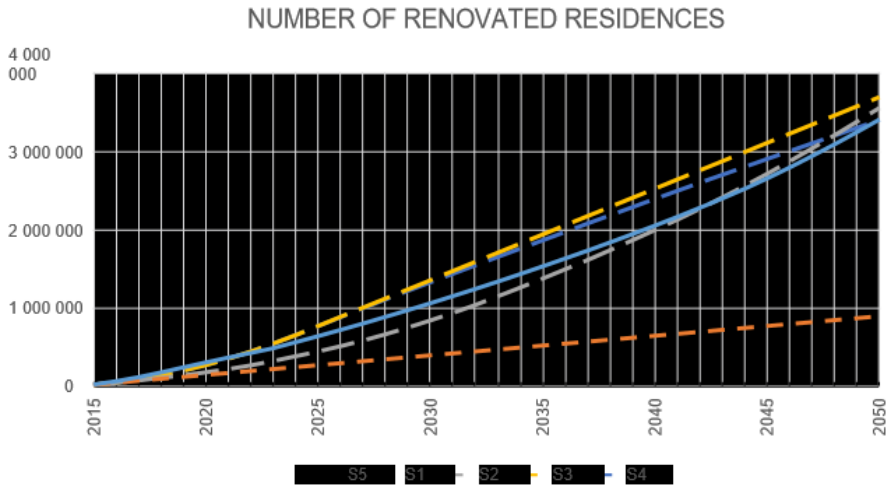
- Environmental benefits
- Health benefits
- Impact on employment
- Energy security
- Property value increase

ADDITIONAL BENEFIT	MULTIPLIER
Employment	0.3
Public health	1.0
Environment	0.1
Energy security	0.6
TOTAL	2.0

Results: expected energy savings and broader benefits







Results: expected energy savings and broader benefits

RESULTS OF SCENARIOS - BENEFITS		SCENARIO									
		S1		S2		S3		S4		S5	
		2020	2050	2020	2050	2020	2050	2020	2050	2020	2050
ENERGY-RELATED	Energy savings (TWh)	0.2	0.2	0.34	2.16	1.04	1.93	1.04	2.23	878	2.29
	Aggregate energy savings (ktoe)	105	828	138	3 371	308	5 161	308	5 400	357	3 895
	Energy savings percentage compared to 2011	1.9%	11.6%	2.6%	62.4%	5.7%	95.6%	6%	100%	6.6%	72%
FINANCIAL	Aggregate cost (million)	1 185	6 017	1 563	30 043	3 460	48 107	3 460	50 197	4 036	35 820
	Aggregate benefit (million)	356	9 917	427	42 083	846	78 116	996	100 257	7 746	53 740

Results: expected energy savings and broader benefits

RESULTS OF SCENARIOS - BENEFITS		SCENARIO									
		S1		S2		S3		S4		S5	
	Aggregate profit (million)	-829	3 900	-1 136	12 040	-2 614	30 009	-2 463	50 060	-2 964	17 719
ADDITIONAL PARAMETERS FOR ASSESSING THE SCENARIOS	IRR (%)	8.78		10.15		9.72		13.13		9.39	
	Jobs	3 657	2 502	6 176	26 665	18 855	23 816	18 855	27 562	15 860	27 530
	Aggregate reduction in CO_2 Mt	1.4	8.4	1.8	45	4.1	69	4.1	72	4.77	52
	Total cost per energy savings unit (EUR million / ktoe)	11.3	9.6	11.3	8.9	11.2	9.3	11.2	9.3	11.3	9.19
	Benefit based on the multiplier from additional benefits (health, employment, etc.)	7 800		24 080		60 018		100 120		35 440	

Target scenario S5:

aggregate investment amount (present value) EUR 7.6 billion

energy savings of 72% compared to the reference year 2011 (3895 ktoe)

Policies and measures

Existing measures and policies

- Regulation
- Programs (Saving at home)
- Mandatory installation of solar thermal systems in new buildings
- Tax incentives
- Upgrade of public building
- Town planning incentives
- Replacement of oil-fired installations with gas-fired ones

Analysis of obstacles

- Building stock condition
- Lack of energy awareness
- Immature market
- Technical obstacles
- Institutional obstacles
- Economic crisis – financial obstacles
- Lack of information

Future oriented prospects - policy

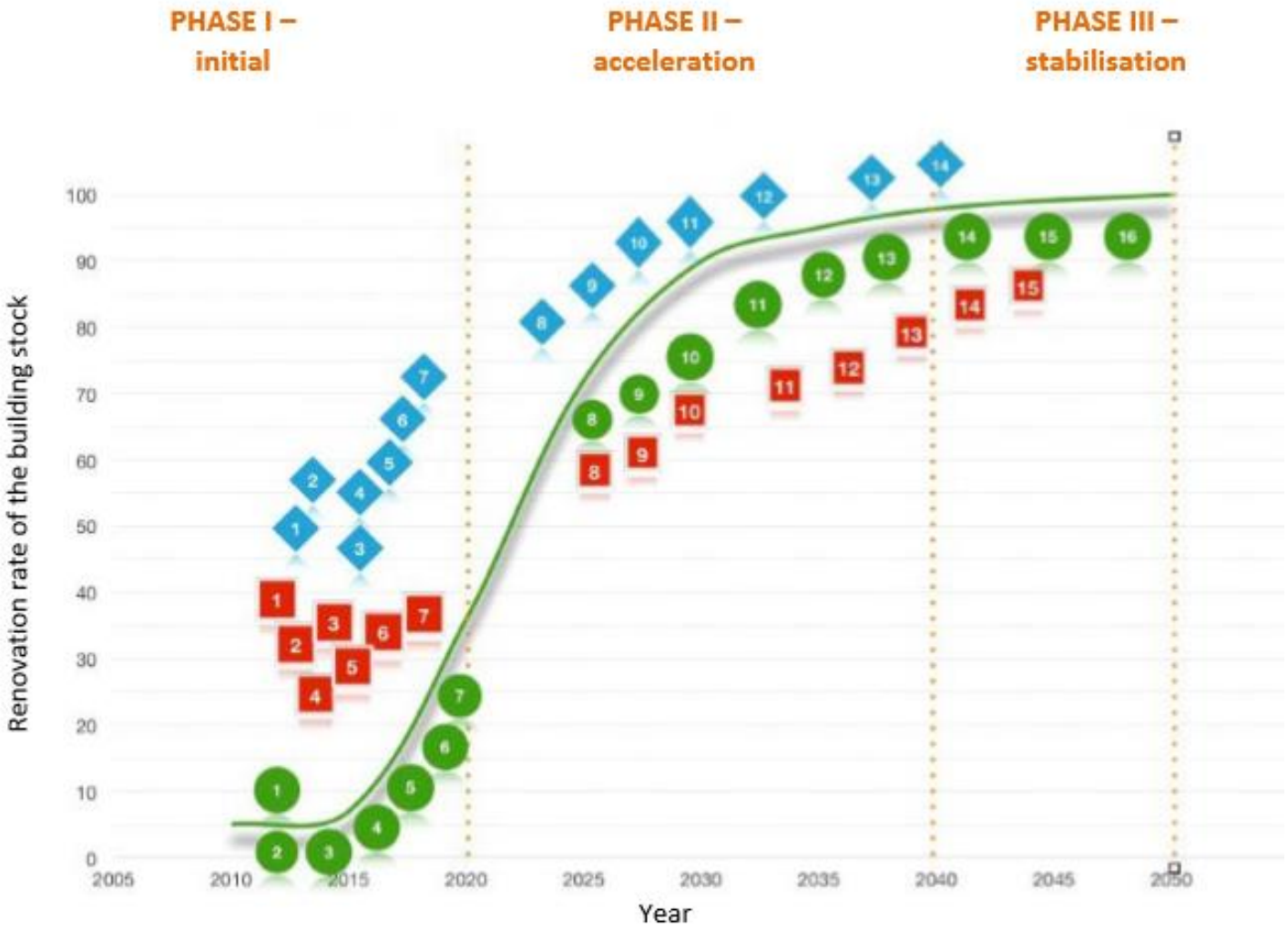
The social and technological transitions required for the energy upgrade of the building stock can be described in three phases:

- **Initial phase (PI)** for a period of five (5) years (up until 2020)
  (modernise the institutional framework, implement the necessary structures, raise energy awareness, provide incentives)
- **Speed-up Phase (PII)** for a period of twenty (20) years (2020-2040)
  (technological and innovation-oriented development of products, drop in the costs, etablishment of additional benefits)
- **Stabilisation phase (PIII)** for a period of ten (10) years (2040-2050)
  (Market maturity, private investments)

The corresponding actions required for achieving long-term strategy transition at three levels:

- **Governance**
- **Structure**
- **Practices**

S-curve of the transition path to the 'sustainable building stock' vision by 2050



Required actions

MINISTRY OF ENVIRONMENT ENERGY & CLIMATE CHANGE

2014-2020

2014-2020

2040-2050

	Governance		Structure		Practices
1	Improvement of the legislative framework through cost-optimal minimum energy requirements concerning energy performance	1	Strengthening audit mechanisms for energy inspections	1	Carrying out energy savings campaigns in schools, universities, private workplaces
2	Setting the requirements for nearly zero-energy buildings	2	Strengthening audit mechanisms to make sure that certified products are installed and to prevent the import of illegal products	2	Training consumers to adopt energy-efficient materials in their properties
3	Securing resources for financing energy upgrades in the new programming period	3	Promoting Energy Service Companies (ESCOs)	3	Training of contractors and technicians on the installation and maintenance of energy-efficient technologies and materials in the building stock
4	Encouraging – reducing taxation for – consumers/residential users where they adopt energy-efficient methods and/or carry out renovation works	4	Setting up structures for recording the households classified within the energy poverty category (energy poverty monitor)	4	Implementing pilot renovation programmes for public buildings through ESCOs
5	Encouraging – reducing taxation for – energy services	5	Appointing energy managers in each public building and adopting an incentive ('green bonus') for the achievement of specific targets	5	Utilising financing tools and mechanisms (e.g. Funds for granting subsidies and loans, etc.)
6	Adopting incentives ('green bonus') for public servants - energy managers of public buildings that save energy and resources	6	Setting up databases for the energy mapping of public buildings	6	Green loans with more favourable terms

	Governance		Structure		Practices
7	Adopting incentives for subsidising green materials	7	Including the installation of smart meters in each energy saving intervention	7	Implementing programmes for subsidising energy upgrades in domestic residences, public and tertiary sector buildings
8	Including external costs in the pricing of energy	8	Setting up local smart grids	8	Implementing pilot energy and technological programmes, modernising neighbourhoods and blocks of buildings
9	Adopting policies and measures for speeding up and facilitating the penetration of energy-efficient practices and nearly zero-energy buildings	9	Carrying out research and development for new construction materials (that require less energy and are more environmentally friendly)	9	Linking the energy consumption of a building to its objective value
10	Adopting incentives for renovating buildings with several owners, instead of individual properties/apartments	10	Setting up a market - register of green materials	10	Creating flexible financing - bank products for the energy upgrade of buildings
11	Adopting incentives for renovating building complexes	11	Expanding the natural gas network	11	Upgrading public and tertiary sector buildings through ESCOs and public- private partnerships (PPPs)
12	Providing incentives for purchasing/ leasing energy-efficient buildings	12	Mechanisms for direct measurement of the energy footprint in the area	12	Implementing energy manageme systems in public buildings and organisations
13	Adopting stricter requirements concerning the energy efficiency of new buildings	13	Promoting RES systems	13	Utilising financing tools and mechanisms (e.g. funds for granting loans, guarantees, etc.)
14	Adopting stricter requirements concerning the energy efficiency of new buildings	14	Expanding geothermal energy and high efficiency cogeneration of heat and power networks	14	The energy upgrade of degraded settlements
		15	Expanding the natural gas network all over Greece	15	Expanding the ESCOs scheme to include the energy upgrade of
				16	The energy upgrade of all public buildings

Sources of financing

Source of financing	Schemes/mechanisms	Total available financing	Financing for energy efficiency (EE)
Financing under the cohesion policy	Operational programmes, including financing schemes (e.g. JESSICA)	EUR 9.4 billion intended for sustainable energy (RES & EE)	EUR 4.6 billion intended for EE, cogeneration and energy management
Financing of research	HORIZON 2020 programme	EUR 6.5 billion for 'Safe, clean and efficient energy' in the period 2014-2020	EUR 100 million for buildings from programmes in the years 2014 and 2015
Financing under the enlargement policy	Facilities from IFIs (SMEFF, MFF, EEFF)	EUR 552.3 million (381.5 + 117.8 + 53 respectively)	Approximately one third of the total financing for projects in the industrial and building sector
European energy programme for recovery (EEPR)	European Energy Efficiency Fund (EEEF)	EUR 265 million	70% of the financing will be spent on energy efficiency
Financing granted to local bodies (local authorities, etc.) for the provision of technical assistance under the competitiveness and innovation programme	ELENA programme, with support from the European Investment Bank (EIB)	Financing granted based on the project leverage coefficient Aid financing of the order of EUR 2 million, with funds available amounting	Mobilisation of investments with a leverage coefficient of more than 20.
Financing under the section of the new LIFE programme -action for the environment and the climate	Private financing for energy efficiency instrument (PF4EE)	EUR 80 million available in cooperation with the European Investment Bank	Targeted to SMEs as well as larger enterprises and small local authorities

- Private funds
- Bank products
- ESCOs market

Conclusions (up to2050)

Residences

- energy savings of 11% to 100%
- investment costs ranged between EUR 6 billion to EUR 50 billion
- Renovating of a stock of 0.9 to 3.7 million typical residences
- IRR ranged between 8% and 13%
- 23 to 27 thousand jobs per year

Tertiary sector buildings (offices, shops, school buildings, hospitals, hotels)

- energy savings 72%
- relevant investment costs stood at EUR 26 billion
- renovating approximately 170 thousand buildings
- IRR is quite low, ranging, depending on the type of building, between 2% and 8.5%, mainly due to the higher renovation costs required for tertiary sector
- 10 thousand jobs per year

Conclusions (up to2050)

Significant benefits for the economy from the reactivation of the construction sector: The energy upgrade of residences and tertiary and public sector buildings can bring about an actual and substantial recovery in the construction and real estate markets

The relevant benefits include more than the purely economic advantages and the direct energy savings relationship in the form of the return on the capital invested. **Additional benefits**, such as employment, health, energy security and reduction in the energy dependence have to be communicated

Thank you for your attention

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