Example of the calculation methods for heat pumps used in Greece

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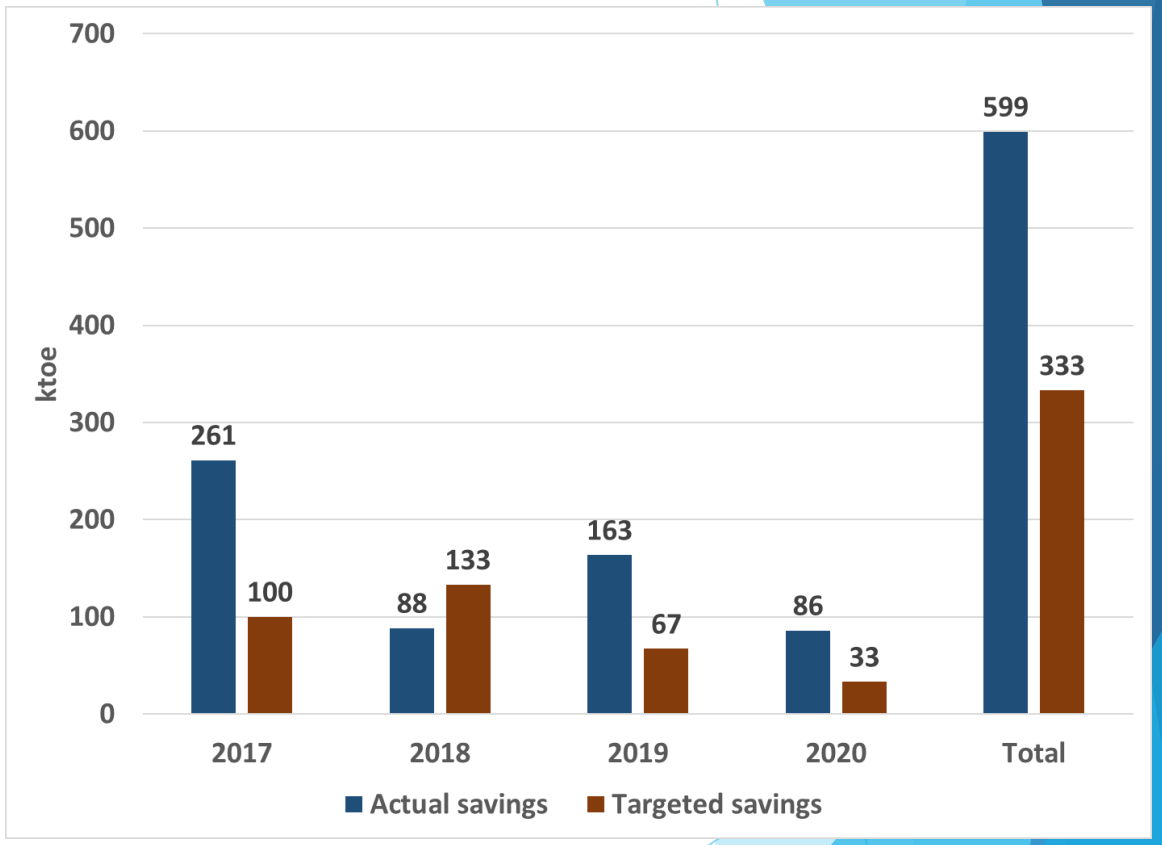
EEOs

- The EEOs started in 2017 with the participation of electricity. natural gas and petroleum products' suppliers.
- Emphasis on addressing the following challenges:
  - Confront the **adverse impacts of the economic recession**.
  - Avoid the high **increase of fuel prices**.
  - Foster the participation of the **suppliers of petroleum products** into the scheme.
  - Low maturity of **energy service market**.
  - High contribution of **behavioural measures** to the fulfilment of the imposed target.
  - Comply with the **technical requirements** of Article 7.



Type of implemented energy efficiency measures until 2020

Type of energy efficiency measure	Energy savings (ktoe)	%
Awareness raising campaigns in residential sector	138.6	23.2%
Awareness raising campaigns in tertiary sector	50.8	8.5%
Energy upgrade of the building envelope in buildings	0.3	0.0%
Energy efficiency measures in technical and industrial processes	3.1	0.5%
Introduction of energy management systems - Energy audits	0.1	0.0%
Energy efficient lighting in buildings of residential sector	8.9	1.5%
Energy efficient lighting in buildings of tertiary sector	4.0	0.7%
Promotion of new and alternative vehicle technologies	3.2	0.5%
Eco-driving	4.1	0.7%
Efficiency improvement through energy efficiency measures in transport sector	10.4	1.7%
Promotion of fuel additives	170.5	28.5%
Awareness raising campaigns in transport sector	125.0	20.9%
Promotion of high efficiency lubricants	30.5	5.1%
Promotion of LPG in transport sector	6.7	1.1%
Energy upgrade of heating systems in residential sector	14.9	2.5%
Energy upgrade of cooling systems	0.02	0.0%
Energy upgrade of heating systems in tertiary sector	0.004	0.0%
Other measures	27.9	4.7%
Total	598.7	100%

Measurement framework

Bottom-up methods for the measurement of the achieved energy savings
BU1: Awareness raising campaigns in residential and tertiary sectors
BU2: Smart Meters and informative billing
BU3: Energy upgrade of the building envelope in buildings of residential and tertiary sectors
BU4: Energy upgrade of the existing cooling systems with high-efficient in buildings of tertiary sector
BU5: Energy upgrade of the existing heating boilers with high-efficient in buildings of tertiary sector
BU6: Production of hot water with solar energy
BU7: Energy efficiency measures in technical and industrial processes
BU8: Introduction of energy management systems
BU9: Energy efficient lighting in buildings of residential sector
BU10: Energy efficient lighting in buildings of tertiary sector
BU11: Energy efficient street lighting
BU12: Promotion of new and alternative vehicle technologies
BU13: Eco-driving
BU14: Efficiency improvement through energy efficiency measures in transport sector
BU15: Promotion of LPG in transport sector
BU16: White goods
BU17: Office equipment
BU18: Standby killer in households
BU19-BU22: Energy upgrade of heating and cooling systems with high-efficient ones in residential and tertiary sectors
BU23: High efficient heating circulating pumps
BU24: Thermal insulation of pipes in the heating system
BU25: Installation of thermostatic valves on radiators
BU26: Other measures

Template of the BU equations

BU4. Energy upgrade of the building envelope in buildings of the residential and tertiary sectors

Description: The current method refers to the implementation of interventions in the building envelop improving its thermal quality and lowering the heating and cooling demand.

Method: Scaled method

Bottom-up formula	
$TFES = \sum_{1}^{n} A * (EPC_{before} - EPC_{after})$	
Definition	
TFES	Total Final Energy Savings [kWh/a]
A	Heated gross floor area of each refurbished building [m²]
EPC_{before}	Final energy consumption as estimated in the Energy Performance Certificate before the implementation of the interventions [kWh/m²]
EPC_{after}	Final energy consumption as estimated in the Energy Performance Certificate after the implementation of the interventions [kWh/m²]
n	Number of refurbished buildings
Baseline	
Final energy consumption prior to the thermal refurbishment of the building. The space heating demand values should be corrected with the relevant heating degree days.	

Each obligated party should provide all the necessary figures (A, EPC_{before}, EPC_{after}) for each building separately.

BU2. Energy audits for households

Description: The current method refers to the conduction of energy audits for households, which can lead to awareness raising and to the initiation of more rational energy consumption behavioural patterns.

Method: Deemed method

Bottom-up formula	
$TFES = n_Q * FEC_{HH} * S_Q$	
Definition	
TFES	Total Final Energy Savings [kWh/a]
n_Q	Number of energy audits
FEC_{HH}	Final Energy Consumption of household(s) (either for electricity or for electricity and heat) [kWh/a]
S_Q	Savings factor of an energy audit [%]
Baseline	
No conduction of energy audits	

Parameters	Value	Source
Savings factor of an energy audit at a specific quality level [%]	**10% (5%-20%)**	EEA 2013[16]
Final Energy Consumption of a household [kWh/a]	**9,671**	Eurostat (year 2014)
Final Electricity Consumption of a household [kWh/a]	**3,767**	Eurostat (year 2014)

Each obligated party should provide only the number of the conducted energy audits (n_Q).

Data collection for predefined values

Data collection for control and verification procedures

multEE facilitating multi-level governance for Energy Efficiency

Role of BU measurement

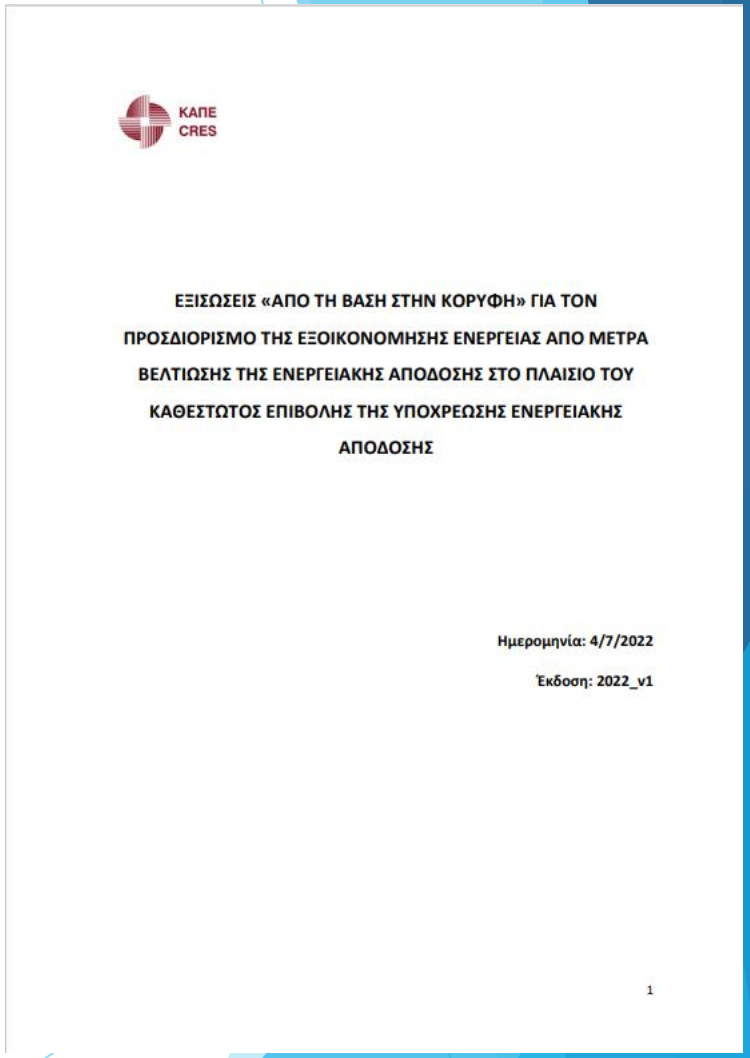
I. BU measurement & monitoring

II. Data collection

III. Control & verification

IV. Reporting

V. Evaluation



ΚΑΠΕ CRES

ΕΞΙΣΩΣΕΙΣ «ΑΠΟ ΤΗ ΒΑΣΗ ΣΤΗΝ ΚΟΡΥΦΗ» ΓΙΑ ΤΟΝ ΠΡΟΣΔΙΟΡΙΣΜΟ ΤΗΣ ΕΞΟΙΚΟΝΟΜΗΣΗΣ ΕΝΕΡΓΕΙΑΣ ΑΠΟ ΜΕΤΡΑ ΒΕΛΤΙΩΣΗΣ ΤΗΣ ΕΝΕΡΓΕΙΑΚΗΣ ΑΠΟΔΟΣΗΣ ΣΤΟ ΠΛΑΙΣΙΟ ΤΟΥ ΚΑΘΕΣΤΩΤΟΣ ΕΠΙΒΟΛΗΣ ΤΗΣ ΥΠΟΧΡΕΩΣΗΣ ΕΝΕΡΓΕΙΑΚΗΣ ΑΠΟΔΟΣΗΣ

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Bottom-up method - case 1

Replacement of heat pumps for space heating with new more efficient ones in buildings of residential sector

- This method refers to the replacement of heat pumps for space heating with new more energy efficient ones in buildings of the residential sector. This method does not include the replacement of heat pumps using air as coolant for heating purposes with new more efficient ones.
- For the baseline, the available heating systems in the market are taken into consideration in compliance with the Regulation 813/2013 of Directive 2009/125/EK.
- The BU equation has been developed so as to cover both the four different climate zones and the national level totally.

Bottom-up method - case 1

Replacement of heat pumps for space heating with new more efficient ones in buildings of residential sector

$$TFES = \sum_{1}^{i} n * (SHD + HWD) * \frac{1}{2{,}5} * \left(\frac{1}{n_{sh,Ref} + 3\%} - \frac{1}{n_{sh,Eff} + 3\%} \right)$$

Where:

TFES	Total final energy savings on a yearly basis [kWh]
i	Building category (tertiary/residential)
SHD	Average energy needed for space heating in a residential building prior to energy efficiency interventions [kWh]
HWD	Average energy needed for domestic hot water (DHW) in a residential building prior to energy efficiency interventions [kWh]
$n_{sh,Ref}$	Lowest energy efficiency for seasonal space heating based on Directive 2009/125/EK
$n_{sh,Eff}$	Energy efficiency of seasonal space heating as indicated on the energy label based on Energy labelling Directive
n	Number of buildings

Bottom-up method - case 1

Replacement of heat pumps for space heating with new more efficient ones in buildings of residential sector

SHD			[kWh]
Building type	Climatic zone	Construction year	Value
Detached dwellings	A	Before 1980	13,624
	A	1980-2010	7,384
	A	After 2010	5,970
	A	Weighted average	10,943
	B	Before 1980	15,836
	B	1980-2010	9,914
	B	After 2010	6,217
	B	Weighted average	13,228
	C	Before 1980	28,114
	C	1980-2010	18,658
	C	After 2010	13,163
	C	Weighted average	23,962
	D	Before 1980	31,008
	D	1980-2010	18,800
	D	After 2010	14,597
	D	Weighted average	25,679

SHD			[kWh]
Building type	Climatic zone	Construction year	Value
Multifamily building	A	Before 1980	60,148
	A	1980-2010	33,754
	A	After 2010	26,999
	A	Weighted average	48,796
	B	Before 1980	91,308
	B	1980-2010	48,378
	B	After 2010	39,983
	B	Weighted average	72,681
	C	Before 1980	188,036
	C	1980-2010	100,025
	C	After 2010	85,225
	C	Weighted average	149,866
	D	Before 1980	166,106
	D	1980-2010	89,901
	D	After 2010	70,634
	D	Weighted average	132,948

Bottom-up method - case 1

Replacement of heat pumps for space heating with new more efficient ones in buildings of residential sector

HWD			[kWh]
Building type	Climatic zone	Construction year	Value
Detached dwellings	A	Before 1980	1,632
	A	1980-2010	1,632
	A	After 2010	358
	A	Weighted average	1,610
	B	Before 1980	1,741
	B	1980-2010	2,175
	B	After 2010	482
	B	Weighted average	1,902
	C	Before 1980	1,873
	C	1980-2010	2,339
	C	After 2010	581
	C	Weighted average	2,051
	D	Before 1980	2,000
	D	1980-2010	2,000
	D	After 2010	655
	D	Weighted average	1,980

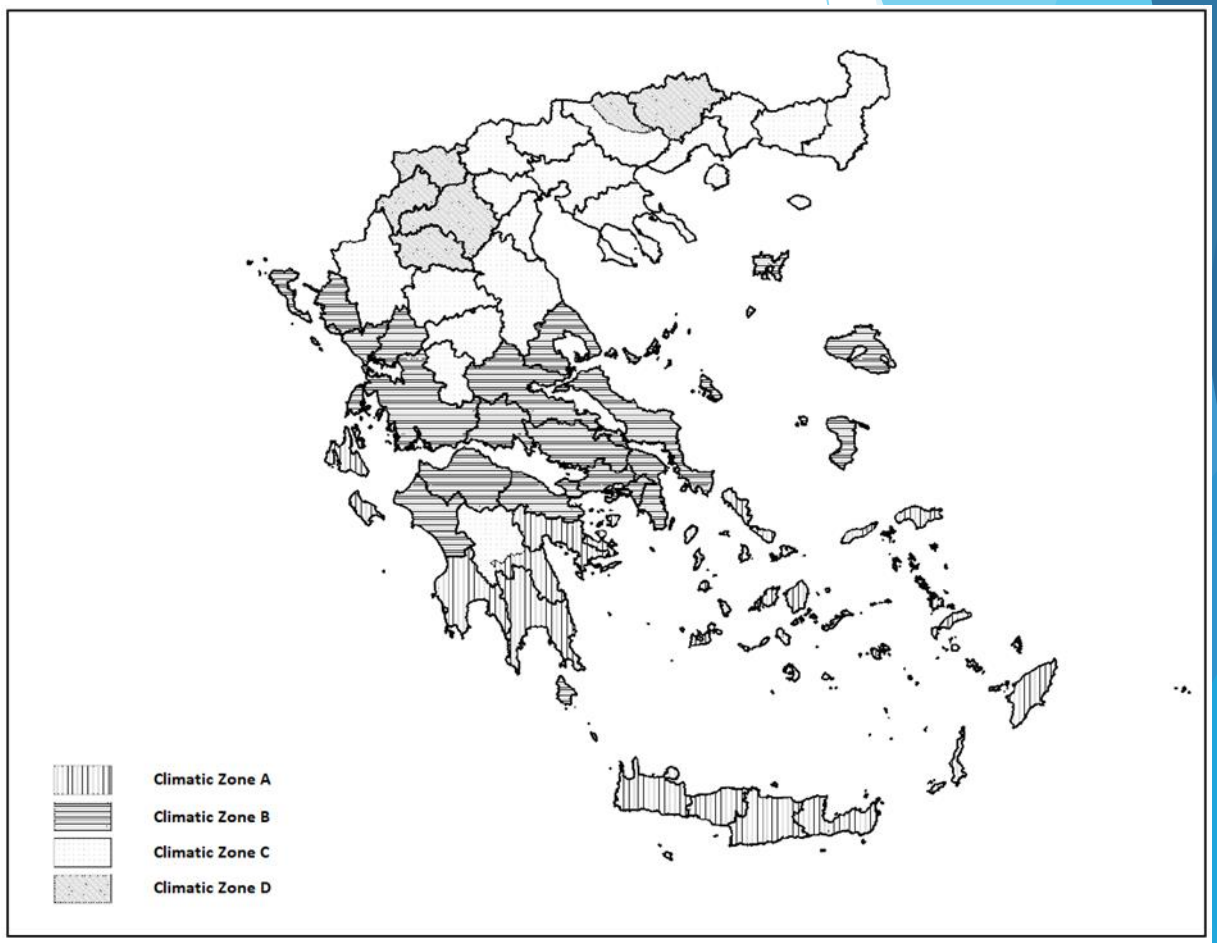
HWD			[kWh]
Multifamily building	A	Before 1980	12,187
	A	1980-2010	12,187
	A	After 2010	3,712
	A	Weighted average	12,040
	B	Before 1980	17,042
	B	1980-2010	17,042
	B	After 2010	5,903
	B	Weighted average	16,874
	C	Before 1980	18,356
	C	1980-2010	18,356
	C	After 2010	7,657
	C	Weighted average	18,216
	D	Before 1980	14,919
	D	1980-2010	14,919
	D	After 2010	6,023
	D	Weighted average	14,785

Bottom-up method - case 1

Replacement of heat pumps for space heating with new more efficient ones in buildings of residential sector

$n_{sh,Ref}$	Value
Room space heaters with heat pump and room space heaters with combined operation with heat pump (55^{0}C) according to the minimum requirements of Regulation 813/2013	1.10
Low temperature heat pump (35^{0}C) according to the minimum requirements of Regulation 813/2013	1.25

Lifetime of savings	[a]
Lifetime of savings	10



Bottom-up method - case 2

Energy up-grading of existing air-heating systems in buildings of residential sector

- This method refers to the replacement of air-heating systems with new more efficient systems in residential buildings.
- For the baseline, the available heating systems in the market are taken into consideration in compliance with the Regulation 2281/2013 of Directive 2009/125/EK.
- The BU equation has been developed so as to cover both the four different climate zones and the national level totally.

$\eta s,h_{Ref}$	Value
Air to water heat pumps driven by electric motor, except rooftop heat pumps	133
Rooftop heat pumps	115
Air to air heat pumps driven by internal combustion engine	120
Lifetime of savings	[a]
Lifetime of savings	15

$$TFES = \sum_{1}^{i} n * (SHD + HWD) * \frac{1}{2,5} * \left(\frac{1}{n_{sh,Ref} + 3\%} - \frac{1}{n_{sh,Eff} + 3\%} \right)$$

Where:

TFES	Total final energy savings on a yearly basis [kWh]
i	Building category (tertiary/residential)
SHD	Average energy needed for space heating in a residential building prior to energy efficiency interventions [kWh]
HWD	Average energy needed for domestic hot water (DHW) in a residential building prior to energy efficiency interventions [kWh]
$n_{sh,Ref}$	Lowest energy efficiency for seasonal space heating based on Directive 2009/125/EK
$n_{sh,Eff}$	Energy efficiency of seasonal space heating as indicated on the energy label based on Energy labelling Directive
n	Number of buildings

Bottom-up method - case 2

Energy up-grading of existing air-heating systems in office buildings of tertiary sector

$$TFES = \sum_{1}^{i} n * A * SHD * \frac{1}{2,5} * \left(\frac{1}{\eta s, h_{Ref} + 3\%} - \frac{1}{\eta s, h_{Eff} + 3\%}\right)$$

Where:

TFES	Total final energy savings on a yearly basis [kWh]
i	Building category (offices/tertiary)
SHD	Average energy needed for space heating in office buildings of tertiary sector prior to energy efficiency interventions [kWh/m2]
A	Heated surface area of each renovated building [m2]
$\eta_{s,hRef}$	Lowest seasonal space cooling efficiency based on Directive 2009/125/EK
$\eta_{s,hEff}$	Energy efficiency of seasonal space cooling efficiency based on Directive 2009/125/EK
n	Number of buildings

SHD			[kWh/m^2]
Building type	Climatic zone	Construction year	Value
Offices	A	Before 1980	17.8
	A	1980-2010	9.3
	A	After 2010	3.9
	A	Weighted average	13.4
	B	Before 1980	20.3
	B	1980-2010	7.6
	B	After 2010	4.4
	B	Weighted average	14.1
	C	Before 1980	57.9
	C	1980-2010	27.7
	C	After 2010	18.4
	C	Weighted average	43.4
	D	Before 1980	76.7
	D	1980-2010	38.3
	D	After 2010	25.2
	D	Weighted average	59.5

Bottom-up method – case 3

Energy up-grading of existing heating systems of up to 12 kW in buildings of residential sector

- This method refers to the replacement of air to air heating systems of up to 12 kW power output with new more efficient systems (only in the case of split units) in residential buildings.
- For the baseline, the available heating systems in the market are taken into consideration in compliance with the Regulation 206/2013 of Directive 2009/125/EK.
- The BU equation has been developed so as to cover both the four different climate zones and the national level totally.

Bottom-up method - case 3

Energy up-grading of existing heating systems of up to 12 kW in buildings of residential sector

$$TFES = \sum_{1}^{i} n * SHD * \left(\frac{1}{SCOP_{Ref}} - \frac{1}{SCOP_{Eff}}\right)$$

Where:

TFES	Total final energy savings on a yearly basis [kWh]
i	Building category (residential)
SHD	Average energy needed for space heating in residential buildings prior to energy efficiency interventions [kWh]
$SCOP_{Ref}$	Lowest seasonal performance factor based on Directive 2009/125/EK.
$SCOP_{Eff}$	Most efficient seasonal performance factor based on Energy label Regulation
n	Number of buildings

Bottom-up method - case 3

Energy up-grading of existing heating systems of up to 12 kW in buildings of residential sector

$SCOP_{Ref}$	Value
Reference system	3.6
Lifetime of savings	[a]
Lifetime of savings	15

Bottom-up method - case 3

Energy up-grading of existing heating systems of up to 12 kW in office buildings of tertiary sector

$$TFES = \sum_{1}^{i} n * A * SHD * (\frac{1}{SCOP_{Ref}} - \frac{1}{SCOP_{Eff}})$$

Where:

TFES	Total final energy savings on a yearly basis [kWh]
i	Building category (residential)
SHD	Average energy needed for space heating in office buildings of tertiary sector prior to energy efficiency interventions [kWh/m^2]
A	Heated surface area of each of the renovated building [m^2]
$SCOP_{Ref}$	Lowest seasonal performance factor based on Directive 2009/125/EK.
$SCOP_{Eff}$	Most efficient seasonal performance factor based on Energy label Regulation
n	Number of buildings

SHD			[kWh/m^2]
Building type	Climatic zone	Construction year	Value
Offices	A	Before 1980	17.8
	A	1980-2010	9.3
	A	After 2010	3.9
	A	Weighted average	13.4
	B	Before 1980	20.3
	B	1980-2010	7.6
	B	After 2010	4.4
	B	Weighted average	14.1
	C	Before 1980	57.9
	C	1980-2010	27.7
	C	After 2010	18.4
	C	Weighted average	43.4
	D	Before 1980	76.7
	D	1980-2010	38.3
	D	After 2010	25.2
	D	Weighted average	59.5

Bottom-up method – case 4

Energy up-grading of existing air-conditioning systems of up to 12 kW in office buildings of residential sector

- This method refers to the replacement of air-to-air air-conditioning systems/units (cooling) of up to 12 kW power output with new more efficient cooling systems (only in the case of split units) in residential buildings.
- For the baseline, the available cooling systems in the market are taken into consideration in compliance with the Regulation 206/2012 of Directive 2009/125/EK.
- The BU equation has been developed so as to cover both the four different climate zones and the national level totally.

Bottom-up method - case 4

Energy up-grading of existing air-conditioning systems of up to 12 kW in buildings of residential sector

$$TFES = \sum_{1}^{i} n * SCD * (\frac{1}{SEER_{Ref}} - \frac{1}{SEER_{Eff}})$$

Where:

TFES	Total final energy savings on a yearly basis [kWh]
i	Building category (residential)
SCD	Average energy needed for space cooling in a residential building prior to energy efficiency interventions [kWh]
$SEER_{Ref}$	Lowest seasonal cooling efficiency ratio based on Directive 2009/125/EK
$SEER_{Eff}$	Seasonal efficiency of the new cooling system based on Energy Labelling Regulation

Bottom-up method - case 4

Energy up-grading of existing air-conditioning systems of up to 12 kW in buildings of residential sector

SCD			[kWh]
Building type	Climatic zone	Construction year	Value
Detached dwellings	A	Before 1980	3,700
	A	1980-2010	4,993
	A	After 2010	6,321
	A	Weighted average	10,404
	B	Before 1980	5,562
	B	1980-2010	6,267
	B	After 2010	8,328
	B	Weighted average	4,090
	C	Before 1980	2,964
	C	1980-2010	3,547
	C	After 2010	3,612
	C	Weighted average	3,416
	D	Before 1980	2,156
	D	1980-2010	2,756
	D	After 2010	2,882
	D	Weighted average	33,522

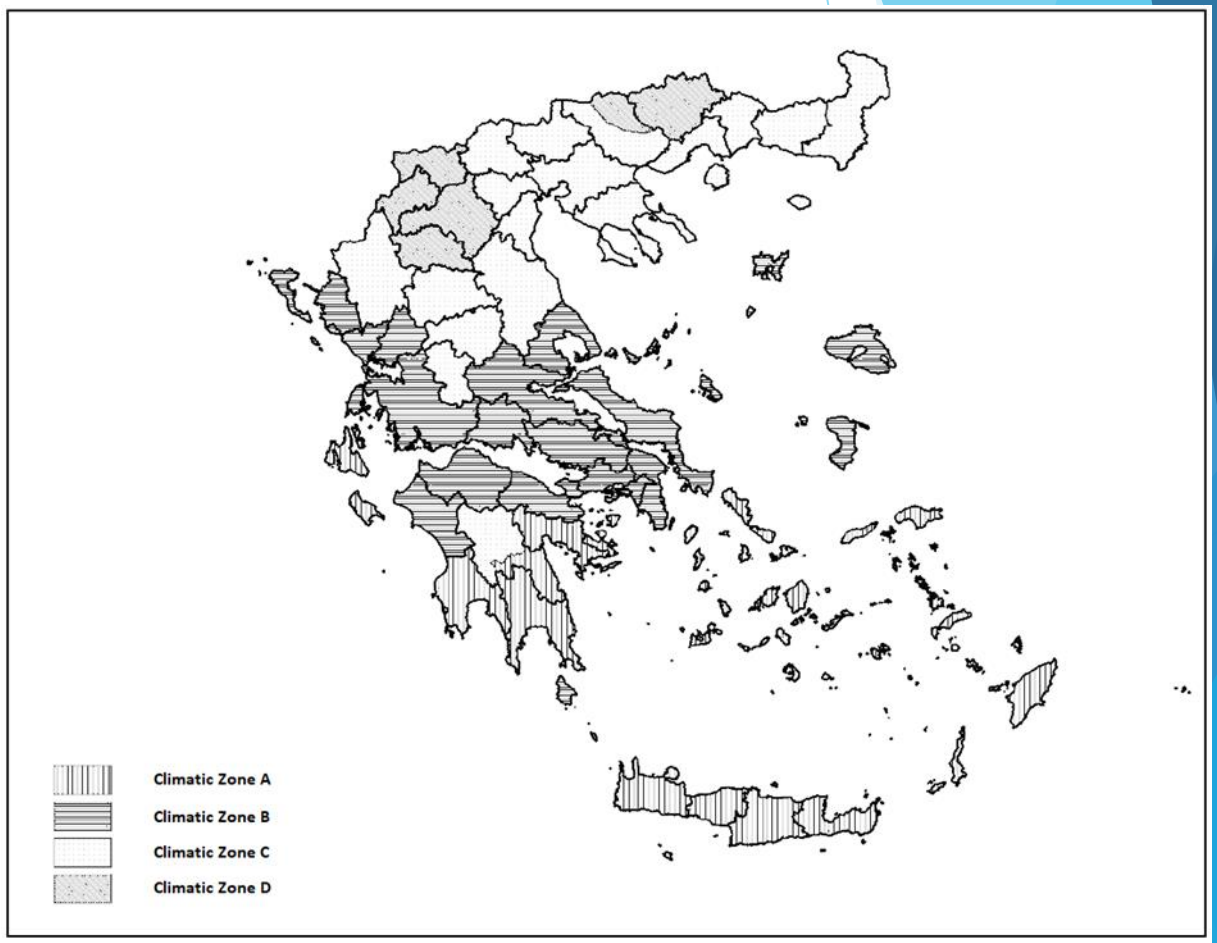
SCD			[kWh]
Building type	Climatic zone	Construction year	Value
Multifamily building	A	Before 1980	19,930
	A	1980-2010	21,480
	A	After 2010	27,763
	A	Weighted average	61,464
	B	Before 1980	37,618
	B	1980-2010	35,686
	B	After 2010	51,159
	B	Weighted average	32,196
	C	Before 1980	20,487
	C	1980-2010	19,881
	C	After 2010	27,136
	C	Weighted average	17,465
	D	Before 1980	10,740
	D	1980-2010	12,324
	D	After 2010	14,588
	D	Weighted average	3,700

Bottom-up method - case 4

Energy up-grading of existing air-conditioning systems of up to 12 kW in buildings of residential sector

$SEER_{REF}$	Value
Air-to-air heat exchanger cooling system of less than 6 kW	4.3
Air-to-air heat exchanger cooling system of between 6 - 12 kW	4.1

Lifetime of savings	[a]
Lifetime of savings	15



Bottom-up method - case 4

Energy up-grading of existing air-conditioning systems of up to 12 kW in office buildings of tertiary sector

$$TFES = \sum_{1}^{i} n * A * SCD * \left(\frac{1}{SEER_{Ref}} - \frac{1}{SEER_{Eff}}\right)$$

Where:

TFES	Total final energy savings on a yearly basis [kWh]
i	Building category (Tertiary)
A	Cooled space surface area of each renovated building [m2]
SCD	Average energy needed for space cooling in a residential building prior to energy efficiency interventions [kWh]
$SEER_{Ref}$	Lowest seasonal cooling efficiency ratio based on Directive 2009/125/EK
$SEER_{Eff}$	Seasonal efficiency of the new cooling system based on Energy Labelling Regulation

SCD			[kWh/m²]
Building type	Climatic zone	Construction year	Value
Offices	A	Before 1980	61.2
	A	1980-2010	37.4
	A	After 2010	40.2
	A	Weighted average	49.0
	B	Before 1980	73.9
	B	1980-2010	48.9
	B	After 2010	46.0
	B	Weighted average	61.8
	C	Before 1980	36.3
	C	1980-2010	25.4
	C	After 2010	24.5
	C	Weighted average	31.1
	D	Before 1980	30.5
	D	1980-2010	21.9
	D	After 2010	21.6
	D	Weighted average	26.7

Bottom-up method – case 5

Energy up-grading of existing cooling systems in buildings of residential sector

- This method refers to the replacement of air-conditioning system/ units with new energy efficient ones in residential buildings.
- For the baseline, the available cooling systems in the market are taken into consideration in compliance with the Regulation 2281/2012 of Directive 2009/125/EK.
- The BU equation has been developed so as to cover both the four different climate zones and the national level totally.

Bottom-up method - case 5

Energy up-grading of existing cooling systems in buildings of residential sector

$$TFES = \sum_{1}^{i} n * SCD * \frac{1}{2{,}5} * \left(\frac{1}{\eta s, c_{Ref} + 3\%} - \frac{1}{\eta s, c_{Eff} + 3\%}\right)$$

Where:

TFES	Total final energy savings on a yearly basis [kWh]
i	Building category (residential)
SCD	Average energy needed for space cooling in a residential building prior to energy efficiency interventions [kWh]
$\eta_{s,cRef}$	Lowest seasonal space cooling efficiency based on Directive 2009/125/EK
$\eta_{s,cEff}$	Energy efficiency of seasonal space cooling based on Energy Labeling regulation
n	Number of buildings

Bottom-up method - case 5

Energy up-grading of existing cooling systems in buildings of residential sector

$SEER_{REf}$	Value
Air to water cooler with rated output power <400 kW when having electric motor drive	149
Air to water cooler with rated output power >=400 kW when having electric motor drive	161
Water to water cooler with rated output power <400 kW when having electric motor drive	196
Water to water cooler with rated output power >=400 kW and <1,500 kW when having electric motor drive	227
Water to water cooler with rated output power >=1,500 kW when having electric motor drive	245
Air to air air-containing driven by electric motors with the exception of rooftop air-conditioning	181
Rooftop air-conditioning	117

Lifetime of savings	[a]
Lifetime of savings	15

Bottom-up method - case 5

Energy up-grading of existing cooling systems in office buildings of tertiary sector

$$TFES = \sum_{1}^{i} n * A * SHD * \frac{1}{2,5} * \left(\frac{1}{\eta s, h_{Ref} + 3\%} - \frac{1}{\eta s, h_{Eff} + 3\%}\right)$$

Where:

TFES	Total final energy savings on a yearly basis [kWh]
i	Building category (tertiary)
SCD	Average energy needed for space cooling in office buildings of the tertiary sector prior to energy efficiency interventions [kWh/m2]
A	Cooled space surface area of each renovated building [m2]
$\eta_{s,cRef}$	Lowest seasonal space cooling efficiency based on Directive 2009/125/EK
$\eta_{s,cEff}$	Energy efficiency of seasonal space cooling based on Energy Labeling Regulation.
n	Number of buildings

SCD			[kWh/m²]
Building type	Climatic zone	Construction year	Value
Offices	A	Before 1980	61.2
	A	1980-2010	37.4
	A	After 2010	40.2
	A	Weighted average	49.0
	B	Before 1980	73.9
	B	1980-2010	48.9
	B	After 2010	46.0
	B	Weighted average	61.8
	C	Before 1980	36.3
	C	1980-2010	25.4
	C	After 2010	24.5
	C	Weighted average	31.1
	D	Before 1980	30.5
	D	1980-2010	21.9
	D	After 2010	21.6
	D	Weighted average	26.7

Improvements

Energy up-grading of existing heating systems of up to 12 kW in buildings of residential and tertiary sector

Μέθοδος

$$TFES_{yr} = \sum_{1}^{i_{ctg\_residential}} n_{residential} * C_{eff} * h_{op\_H} * \left(\frac{1}{SCOP_{Ref}} - \frac{1}{SCOP_{Eff}}\right) * A_{poor-res}$$

Where:

TFES	Total final energy savings on a yearly basis [kWh]
i	Building category (residential)
SHD	Average energy needed for space heating in residential buildings prior to energy efficiency interventions [kWh]
$SCOP_{Ref}$	Lowest seasonal performance factor based on Directive 2009/125/EK.
$SCOP_{Eff}$	Most efficient seasonal performance factor based on Energy label Regulation
n	Number of buildings

hop_H: Annual hours of operation [h/έτος]
$Ceff$: Installed capacity [kW]

Climate zone	hop_H (h/year)
A	684
B	827
C	1498
D	1605
Weighted average Greece	1267

Μέθοδος

$$TFES_{yr} = \sum_{1}^{i_{ctg\_offices}} n_{building\_offices} * C_{eff} * h_{op\_offices\_H} * \left(\frac{1}{SCOP_{Ref}} - \frac{1}{SCOP_{Eff}}\right) * A_{res}$$

Where:

TFES	Total final energy savings on a yearly basis [kWh]
i	Building category (residential)
SHD	Average energy needed for space heating in office buildings of tertiary sector prior to energy efficiency interventions [kWh/m²]
A	Heated surface area of each of the renovated building [m²]
$SCOP_{Ref}$	Lowest seasonal performance factor based on Directive 2009/125/EK.
$SCOP_{Eff}$	Most efficient seasonal performance factor based on Energy label Regulation
n	Number of buildings

$hop\_offices\_H$: Annual hours of operation [h/έτος]
$Ceff$: Installed capacity [kW]

Climate zone	hop_H (h/year)
A	684
B	827
C	1498
D	1605
Weighted average Greece	1267

Improvements-2

Energy up-grading of existing air-conditioning systems of up to 12 kW in buildings of residential and tertiary sector

Μέθοδος

$$TFES_{yr} = \sum_{1}^{i_{ctg\_residential}} n_{residential} * C_{eff} * h_{op\_C} * \left(\frac{1}{SEER_{Ref}} - \frac{1}{SEER_{Eff}}\right) * A_{poor-res}$$

Where:

TFES	Total final energy savings on a yearly basis [kWh]
i	Building category (residential)
SCD	Average energy needed for space cooling in a residential building prior to energy efficiency interventions [kWh]
$SEER_{Ref}$	Lowest seasonal cooling efficiency ratio based on Directive 2009/125/EK
$SEER_{Eff}$	Seasonal efficiency of the new cooling system based on Energy Labelling Regulation

hop_C: Annual hours of operation [h/έτος]
$Ceff$: Installed capacity [kW]

Climate zone	hop_H (h/year)
A	395
B	521
C	226
D	180
Weighted average Greece	330

Μέθοδος

$$TFES_{yr} = \sum_{1}^{i_{ctg\_offices}} n_{building\_offices} * C_{eff} * h_{op\_offices\_C} * \left(\frac{1}{SEER_{Ref}} - \frac{1}{SEER_{Eff}}\right) * A_{res}$$

Where:

TFES	Total final energy savings on a yearly basis [kWh]
i	Building category (Tertiary)
A	Cooled space surface area of each renovated building [m2]
SCD	Average energy needed for space cooling in a residential building prior to energy efficiency interventions [kWh]
$SEER_{Ref}$	Lowest seasonal cooling efficiency ratio based on Directive 2009/125/EK
$SEER_{Eff}$	Seasonal efficiency of the new cooling system based on Energy Labelling Regulation

$hop\_offices\_C$: Annual hours of operation [h/έτος]
$Ceff$: Installed capacity [kW]

Climate zone	hop_H (h/year)
A	577
B	728
C	366
D	314
Weighted average Greece	496

Improvements-3

Utilization of unitary metrics for the case of residential buildings

SCD			[kWh/m²]
Building type	Climatic zone	Construction year	Value
Detached dwellings	A	Weighted average	18.5
	B	Weighted average	21.1
	C	Weighted average	14.1
	D	Weighted average	9.7
	Greece	Weighted average	18.1
Multifamily buildings	A	Weighted average	13.2
	B	Weighted average	13.1
	C	Weighted average	8.6
	D	Weighted average	6.2
	Greece	Weighted average	11.6

SHD			[kWh/m²]
Building type	Climatic zone	Construction year	Value
Detached dwellings	A	Weighted average	145.3
	B	Weighted average	198.8
	C	Weighted average	320.9
	D	Weighted average	379.6
	Greece	Weighted average	225.2
Multifamily buildings	A	Weighted average	88.8
	B	Weighted average	101.5
	C	Weighted average	157.2
	D	Weighted average	179.9
	Greece	Weighted average	118.4

Thank you for your attention!

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More information about the MRV activities within the EEO scheme in Greece at: www.cres.gr/obs