Experience in applying EE1st procedure in Greece

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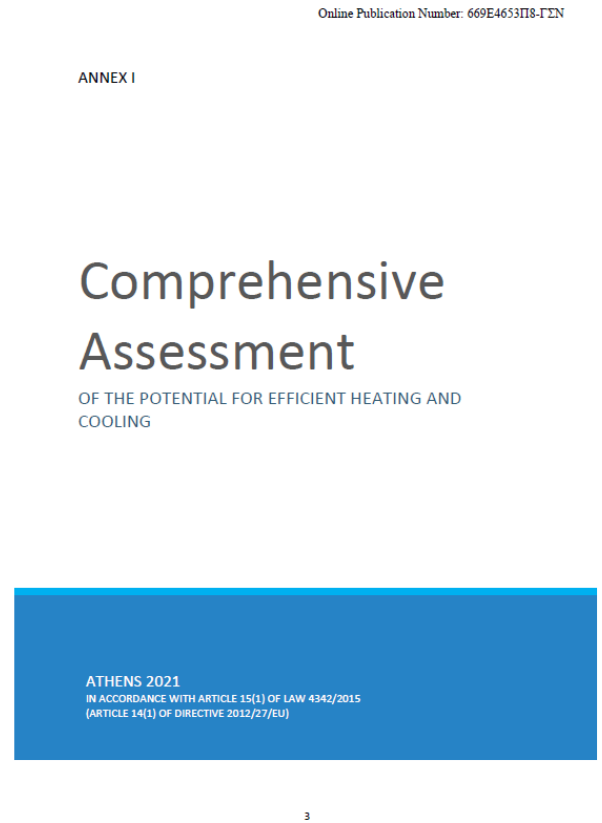
I. Comprehesive Assessment Study (2021)

❑ Cost-benefit analysis at a nationwide level

- **Scenario 1**: The thermal demand per settlement type is covered by district heating systems using available waste heat from existing facilities.
- **Scenario 2**: The thermal demand per settlement type is covered by district heating systems using heat generated from new heat generation facilities by use of natural gas and biomass.
- **Scenario 3**: The thermal demand per settlement type is covered by district heating systems using heat generated from high-efficiency co-generation systems fuelled with natural gas.
- **Scenario 4**: Penetration of various technologies for individual installations in the residential, tertiary, and industrial sectors.
- **Scenario 5**: Penetration of heat pumps for individual installations in the residential and tertiary sectors, with a baseline scenario involving natural gas-fired boilers.
- **Scenario 6**: Penetration of heat pumps for individual installations in the residential sector, with a baseline scenario involving biomass-fired boilers.



I. Comprehesive Assessment Study (2021)

❑ Scenario 5: Methodology and results

The cost and benefit components that are taken into account in the cost-benefit analysis, are as follows:

(-) Operating costs of heat pumps: They include the cost of electricity consumed and the maintenance costs for air-heated heat pumps.

(+) Operating benefit from the substitution of natural gas: It includes the natural gas costs and NG-fired boiler maintenance costs which are avoided.

(-) External cost of heat pumps: It includes the external cost of the electricity consumed and relates to the impact on climate change, health, ecosystems, etc.

(+) External benefit from the substitution of natural gas: It includes the external benefit from the substitution of natural gas and relates to the impact on climate change, health, ecosystems, etc.

Table 20 – Results regarding the substitution of NG-fired boiler with air-to-air heat pumps for space heating

Heat Pumps Air-to-air	Economic analysis		Cost-benefit analysis			B/C variation	Economic aid rate
	FNPV (€)	FIRR (%)	ENPV (€)	EIRR (%)	B/C		%
Residence	-€2 323	-5 %	-€545	2 %	0.86	0.86–1.54	46 %
Private office buildings	-€4 557	-16 %	-€3 052	-7 %	0.71	0.71–1.27	67 %
Public office buildings	-€32 655	N/A	-€23 406	-15 %	0.63	0.63–1.15	6 %
Hospitals	€11 545	5 %	€331 417	22 %	1.12	1.12–1.98	N/A
Hotels	-€16 600	N/A	-€9 265	-5 %	0.78	0.78–1.41	N/A
Schools	-€13 849	-13 %	-€3 630	0 %	0.87	0.87–1.56	N/A

II. PRODESA project

❑ Aim of the project:

- Launch showcase energy efficiency and renewable energy projects in seven major municipalities within the Athens Metropolitan Area through the utilization of innovative financial tools and attracting private investments.
- Conduction of a Cost Benefit Analysis in order to examine the social profitability of the examined energy efficiency projects in buildings and street lighting, justifying the potential utilization of specific financial schemes in relation with the results of the economic evaluation.

ProDeSA

ENERGY EFFICIENCY PROJECT DEVELOPMENT ASSISTANCE FOR SOUTH ATTICA

Economic evaluation of the energy efficiency projects

Deliverable D2.6

Date: 30/07/2021

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 754171

II. PRODESA project

❑ Methodological aspects and results

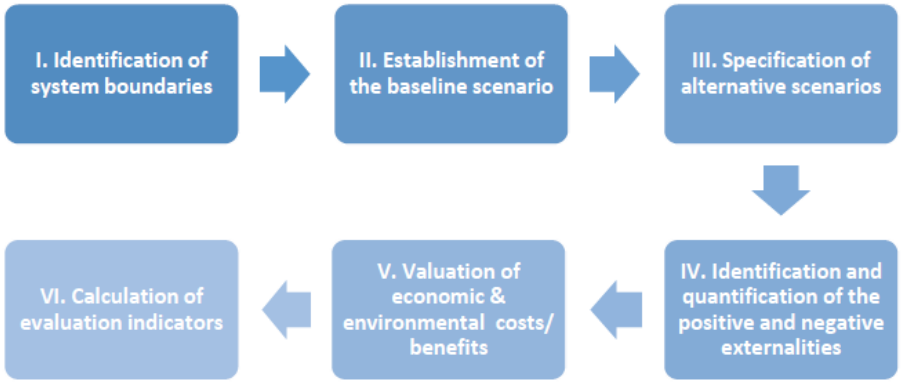


Figure 4.1 Basic steps for performing a CBA

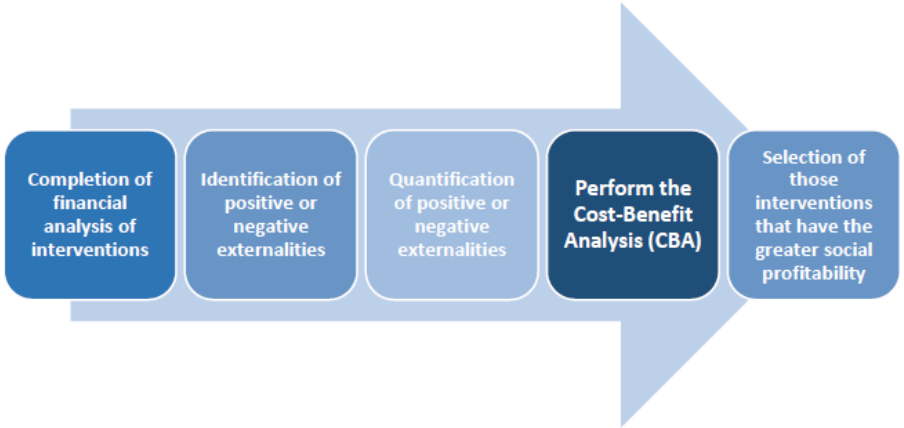


Figure 4.2 Steps for performing a CBA within the framework of PRODESA project CBA tool

Table 4.1 Quantified categories of costs and benefits in the CBA

O&M costs	Operational and maintenance cost of the new energy efficient equipment/technology
O&M benefits	Avoided operational and maintenance cost of the existing equipment/technology
Fuel costs	Fuel cost of the new energy efficient equipment/technology
Fuel benefits	Avoided fuel cost of the existing equipment/technology
External costs	Environmental and health cost of the new energy efficient equipment/technology
External benefits	Avoided environmental and health cost of the existing equip-ment/technology Macroeconomic effects triggered by the new energy efficient equipment/technology Effects due to the improved comfort levels triggered by the new energy efficient equipment/technology Increased market value of the renovated buildings
Capital costs	Capital cost of the new energy efficient equipment/technology

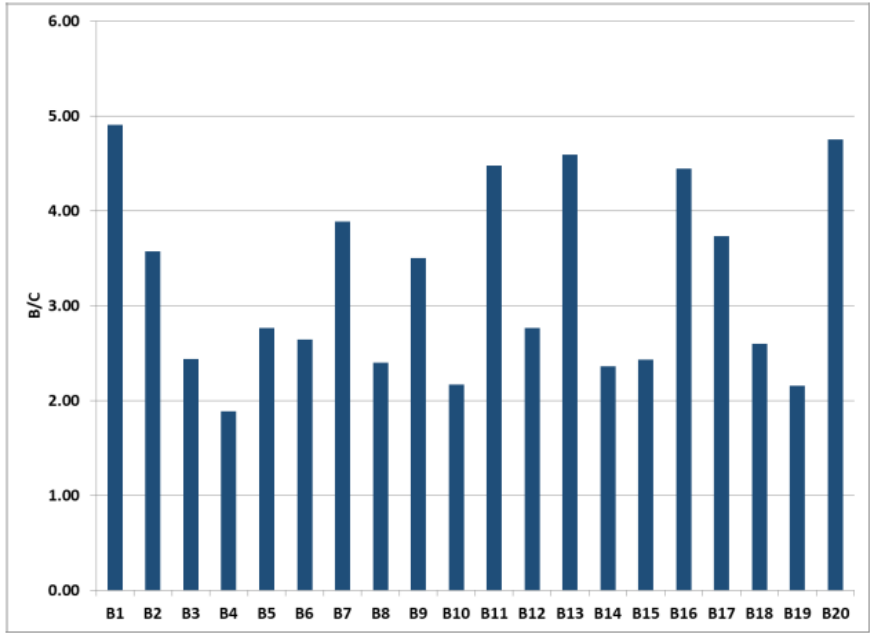


Figure 5.1 Results of the CBA in the buildings of Alimos Municipality

IEECP study

❑ Study – economic viability of subsidizing natural gas burners to households in Corinth and Tripoli

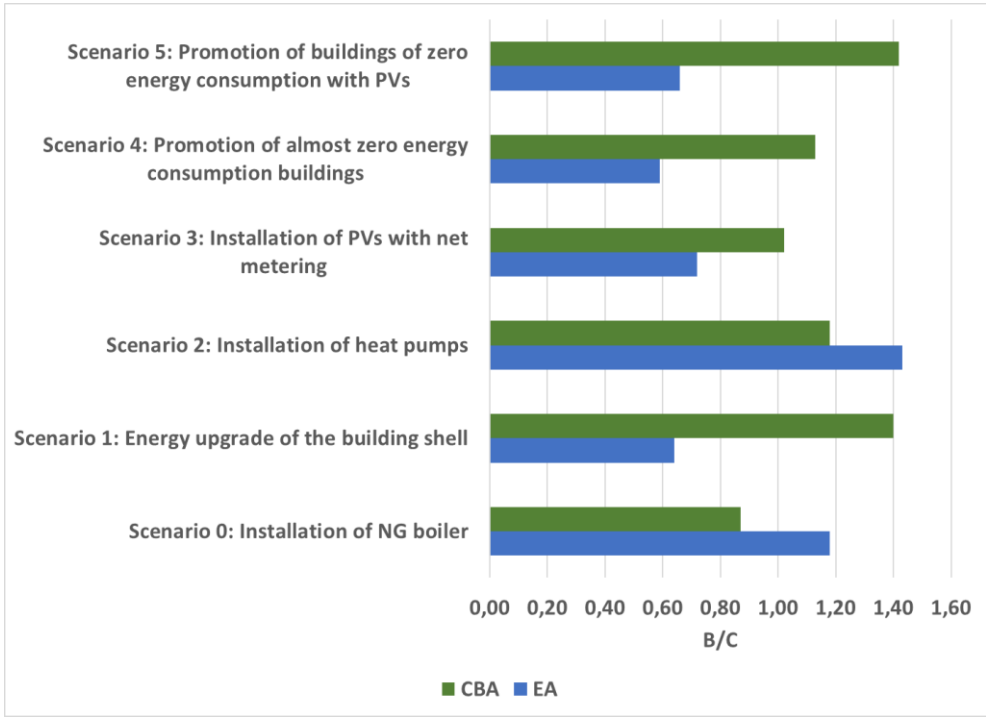
- **Scenario 1**: Energy upgrade of the building shell
- **Scenario 2**: Installation of heat pumps
- **Scenario 3**: Installation of photovoltaic systems with net metering
- **Scenario 4**: Promotion of almost zero energy consumption buildings
- **Scenario 5**: Promotion of buildings of zero energy consumption with photovoltaic systems

Cost	Description
Operational and maintenance costs	• Operational and maintenance cost of the new energy efficient equipment/technology
Operational and maintenance benefits	• Avoided operational and maintenance cost of the existing technology for the average-income group of households
Fuel costs	• Fuel cost of the new energy efficient equipment/technology
Fuel benefits	• Avoided fuel cost of the existing equipment/technology
External costs	• Environmental and health cost of the new energy efficient equipment/technology
External benefits	• Avoided environmental and health cost of the existing equipment/technology • Macroeconomic effects due to the new energy efficient equipment/technology • Effects due to the improved comfort levels due to the new energy efficient equipment/technology • Increased market value of the renovated buildings
Capital costs	• Capital cost of the new energy efficient equipment/technology

IEECP study

- **Study – economic viability of subsidizing natural gas burners to households in Corinth and Tripoli**

Potential result of calculations	Financial NPV	Social NPV	Conclusions	Next steps
1st	≥ 0	≥ 0	Economically and socially beneficial to invest/implement projects/interventions.	Promoting these types of investments/interventions
2nd	≤ 0	≥ 0	Economically is not beneficial. However, socially is important to invest/implement the project/intervention.	Providing financial supports, e.g., subsidies, increasing municipality's equity share in the investment
3rd	≥ 0	≤ 0	Economically is beneficial to invest on a project and not socially beneficial.	Penalty for the investors and imposing the incentives that distribute the economic benefits among different groups, such as tax.
4rth	≤ 0	≤ 0	Economically and socially is not beneficial.	Stop the investments/interventions



Greek pilot cases within EE1st+ project

❑ Objective

- Design heating and cooling strategies and the development of the respective investment plans at the different administrative levels.
- Comply with the provisions of Article 3 of the Directive 1791/2023/EE
- Provide useful insights and a robust methodological basis for the effective implementation of Article 25 of the Directive 1791/2023/EE in order to carry out the foreseen heating and cooling assessment and planning in accordance to the EE1st principle.
- Enhance the NECP

Greek pilot cases within EE1st+ project

❑ **Objective**

Aim 1

- Assess the contribution of the energy efficiency and RES interventions compared to additional investments for natural gas or other conventional fuel infrastructure in terms of costs and benefits avoiding the potential problem of stranded assets and the triggered consequences in the case that the cost-benefit impacts of the natural gas or other conventional fuel infrastructure would not be justified

Aim 2

- Identify the demand-side resources that could partly or fully substitute the natural gas or other conventional fuel infrastructure and compare them with other types of planned infrastructures more energy efficient and beneficially for the whole society

Greek pilot cases within EE1st+ project

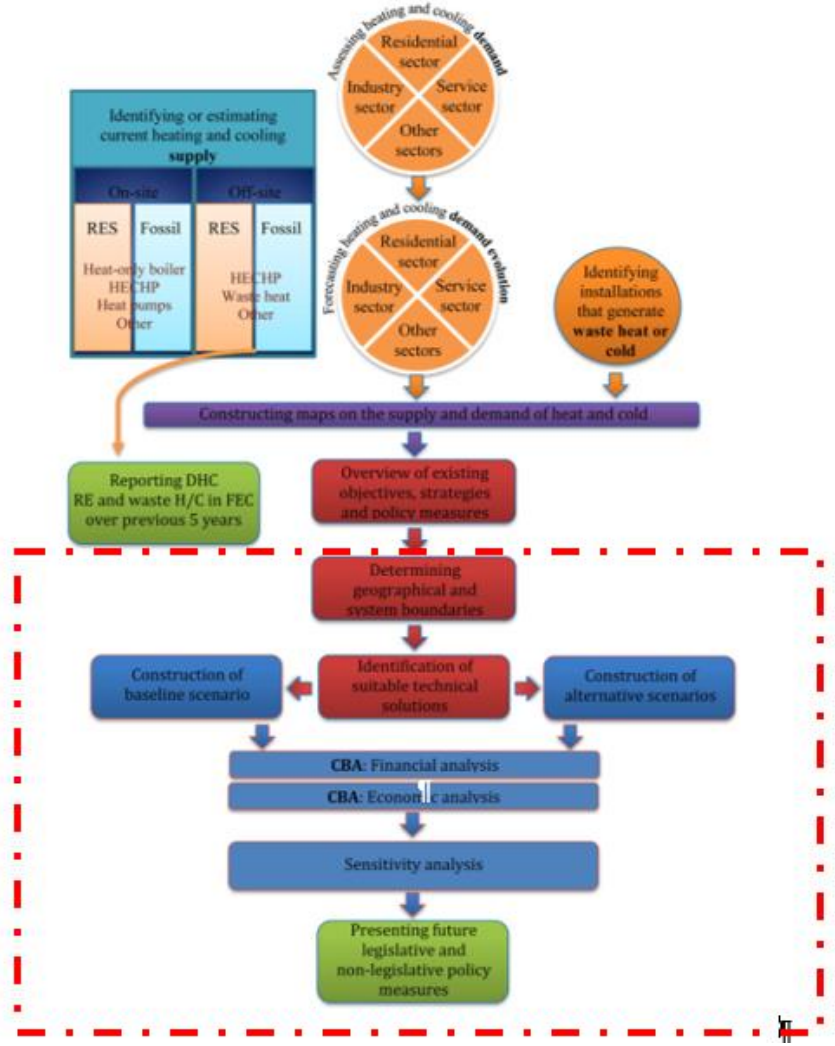
- **Incorporation of the developed methodological approach into the procedure for the conduction of the comprehensive assessment**

I. Determining the geographical and system boundaries

Typical buildings of the residential and tertiary sectors constructed before 1980 and between 1981-2010
Typical industrial units as have been identified by the conducted energy audits

II. Constructing the baseline scenario

Planned expansion of the natural gas transmission and distribution networks and the construction of hydrogen infrastructure as estimated within the revised NECP.
Planned promotion of heat pumps in the building sector as estimated within the revised NECP
Planned expansion of the natural gas transmission and distribution networks as estimated within the submitted development plans by the respective operators



Commission Recommendation (EU) 2019/1659 of 25 September 2019 on the content of the comprehensive assessment

Greek pilot cases within EE1st+ project

III. Constructing the alternative solutions

Building sector

Option 1: Interventions in the building envelope so as to reduce the energy demand
Option 2: Installation of aerothermal heat pumps
Option 3: Installation of geothermal heat pumps
Option 4: Installation of biomass boiler
Option 5: Installation of PV system for auto consumption
Option 6: Installation of aerothermal heat pump combined with PV system for auto consumption
Option 7: Installation of geothermal heat pump combined with PV system for auto consumption
Option 8: Installation of aerothermal heat pump combined with interventions in the building envelope
Option 9: Installation of geothermal heat pump combined with interventions in the building envelope
Option 10: Installation of aerothermal heat pump combined with interventions in the building envelope and PV system for auto consumption
Option 11: Installation of geothermal heat pump combined with interventions in the building envelope PV system for auto consumption

Industrial sector

Option 1: Implementation of energy efficiency technologies
Option 2: Exploitation of waste heat
Option 3: Installation of PV system for auto consumption

Greek pilot cases within EE1st+ project

IV. Types of tested resources

- Preparation of guidelines for conducting the financial CBA
- Preparation of guidelines for conducting the economic CBA
- Calculation of positive and negative types of externalities
- Determination of financial and social discount rates

- Standardization of the procedure for applying the EE1st principle
- Plug-in for the conduction of the CBA methodology
- Data sources and the applied assumptions
- Development of an excel-based tool

Greek pilot cases within EE1st+ project

❑ Co-creation and co-implementation of the Greek pilot case through working group meetings

- Ministry of Environment of Energy
- Regulatory Authority of Energy
- Regional Authorities
- Association of Greek Regions
- Local Authorities
- Central Union of Municipalities of Greece
- CRES
- Technical Champer of Greece
- Hellenic Agency for Local Development and Local Self-Government
- National Technical University of Athens
- National Observatory of Athens
- Natural Gas Transmission Network Operator
- Natural Gas Distribution Network Operator
- NGOs

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EIHP ENERGY INSTITUTE HRVOJE POŽAR

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ENEA Italian National Agency for New Technologies, Energy and Sustainable Economic Development

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Thank you!

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