

Multicriteria Analysis of the Energy Upgrade of a Heritage, Office Building

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To energy upgrade or not to energy upgrade?

1

Tertiary sector buildings in the Municipality of Athens pollute more (38% of GHG) than residential (31%) [Skoula, 2017]

2

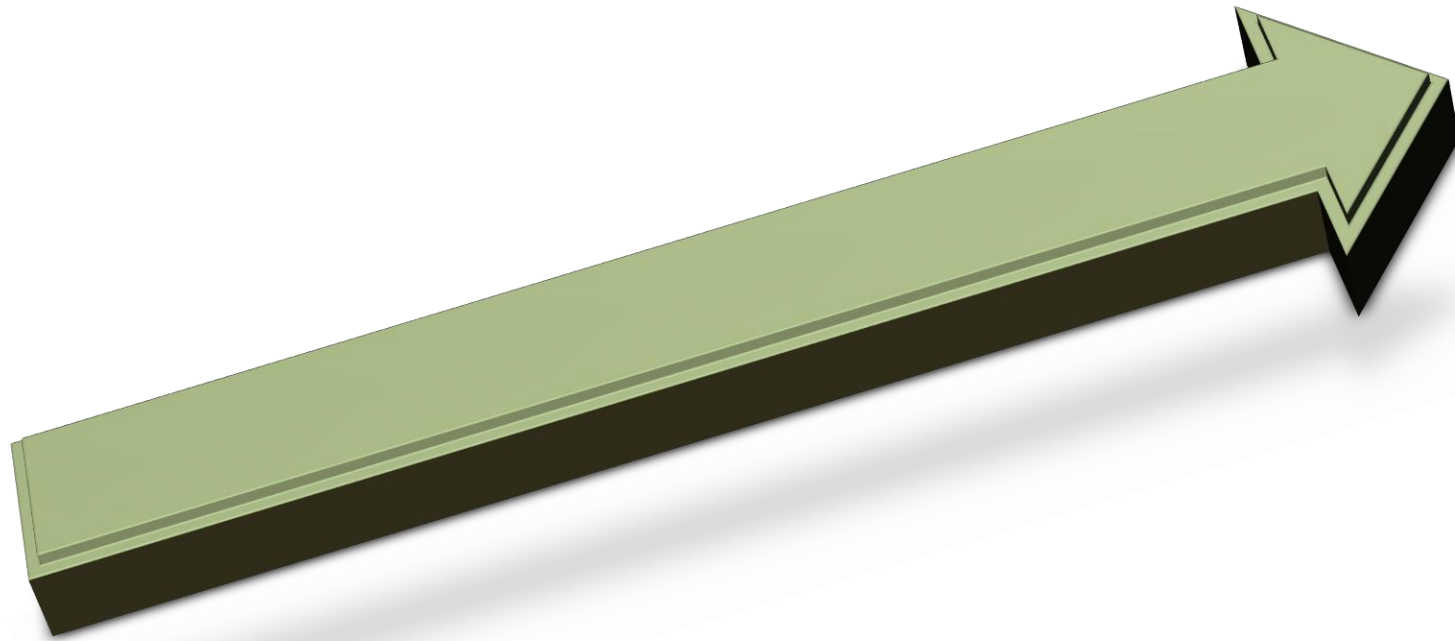
Most energy upgrade materials have a negative effect on the environment

[Berge, 2009]

3

What should be made to reduce GHG emissions from tertiary buildings and how?

Research target



Which energy upgrade techniques of the building envelope should be put forward and which should be avoided, from a holistic point of view

Methodology



Choice of scenarios /
Simulations of
operational, energy
consumption
[software TEE KENAK]



Life Cycle Analysis of
building as is and
scenarios
[ATHENA software]



Choice of criteria to
express sustainability /
hierarchy of scenarios
[multicriteria analysis –
Multi Attribute Utility
Theory]

The building and the scenarios

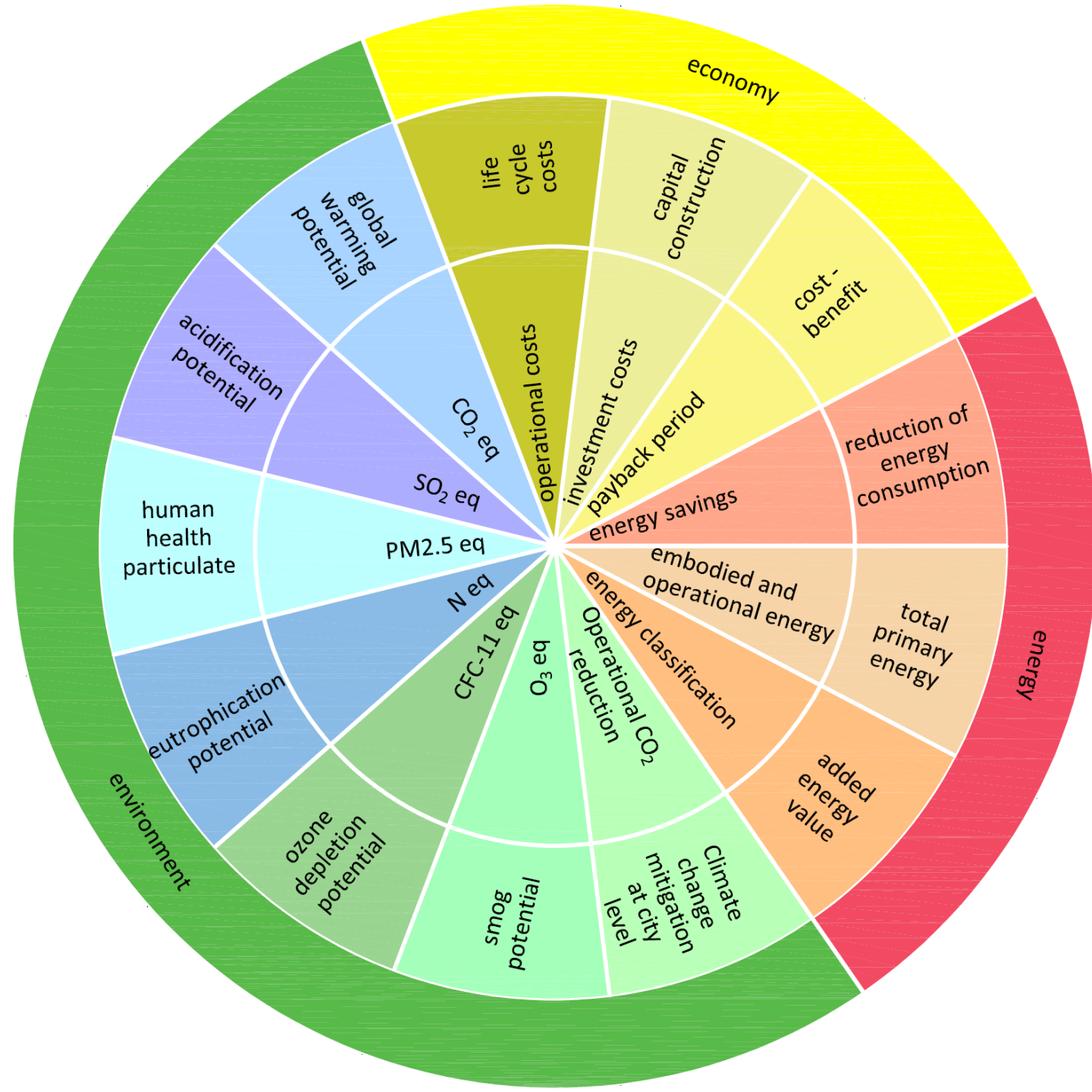


Athens City Hall

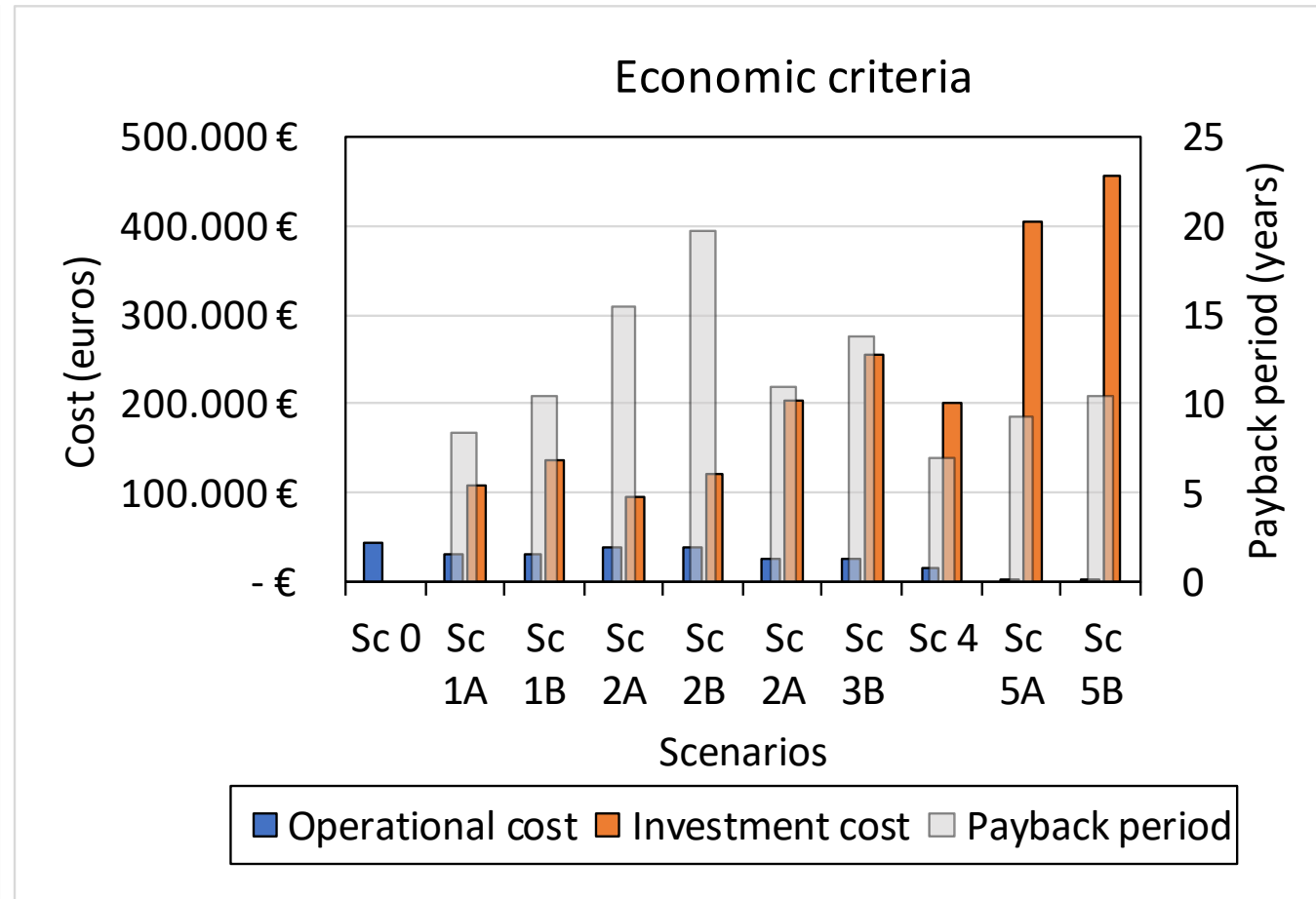
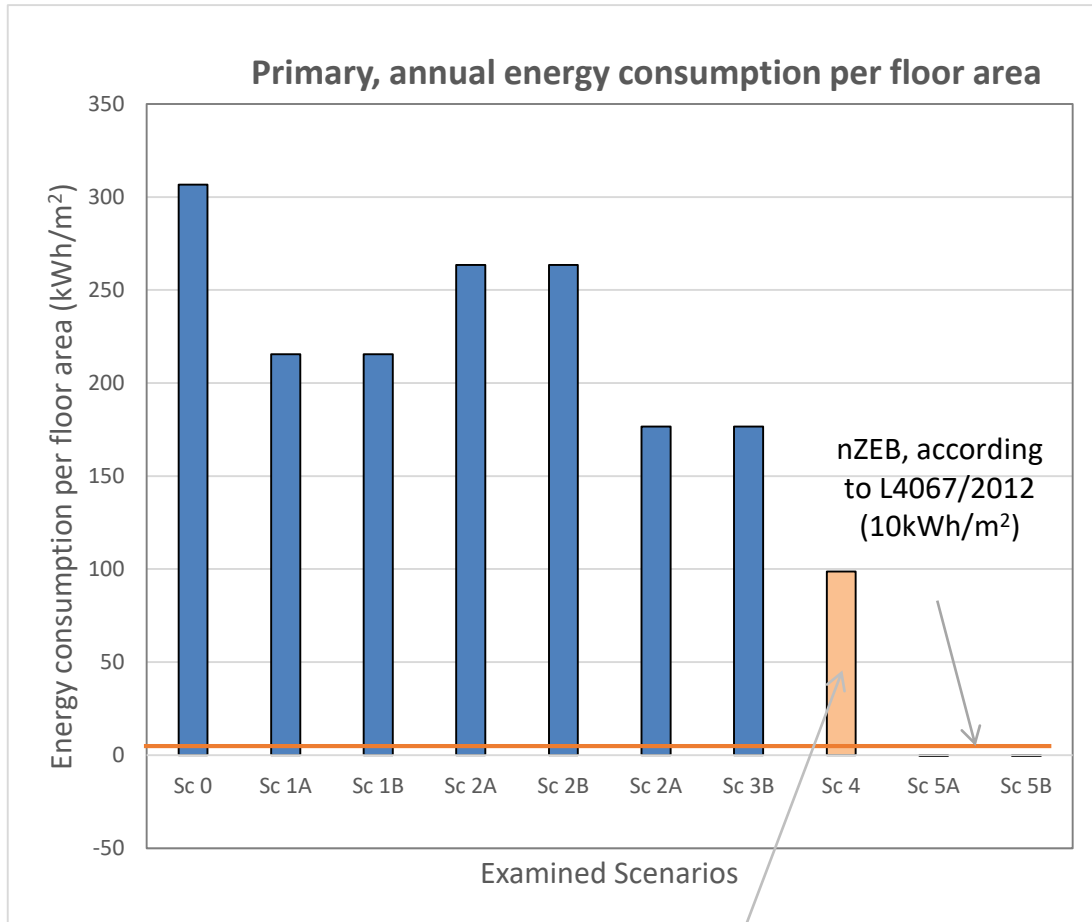
Scenarios	Short description
Scenario 0	Building as is
Scenario 1A	Vertical, opaque elements: conventional insulation
Scenario 1B	Vertical, opaque elements: ecological insulation
Scenario 2A	Horizontal, opaque elements: conventional insulation
Scenario 2B	Horizontal, opaque elements: ecological insulation
Scenario 3A	All opaque elements: conventional insulation
Scenario 3B	All opaque elements: ecological insulation
Scenario 4	Photovoltaic panels on the roof and above atriums
Scenario 5A	Combination of Scenarios 3a and 4
Scenario 5B	Combination of Scenarios 3b and 4

Multicriteria analysis

Choice of criteria and indicators to express the sustainability of the examined scenarios:



Results



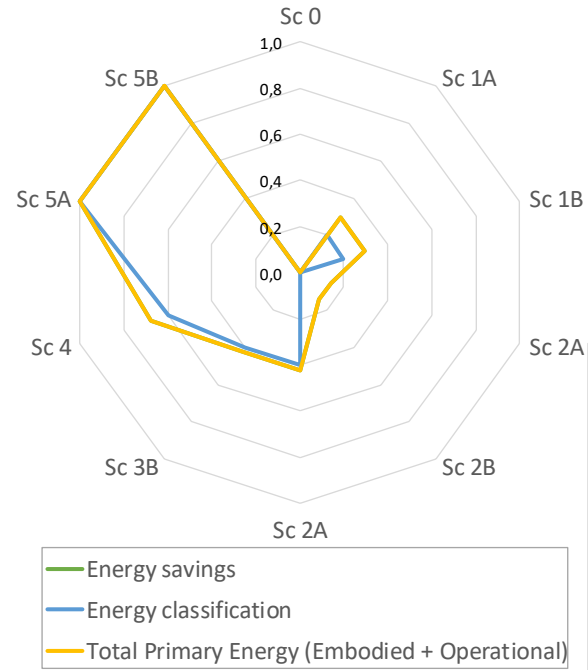
nZEB according to Decision 85251/242/2018 (>B+)

Energy classification

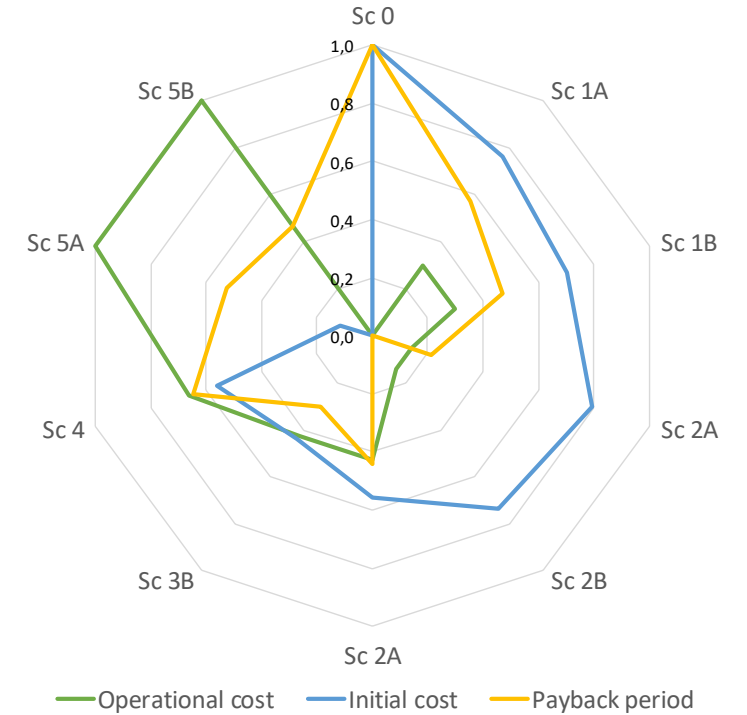
Sc0	Sc1a	Sc1b	Sc2a	Sc2b	Sc3a	Sc3b	Sc4	Sc5a	Sc5b
D	C	C	D	D	B	B	B+	A+	A+

Results

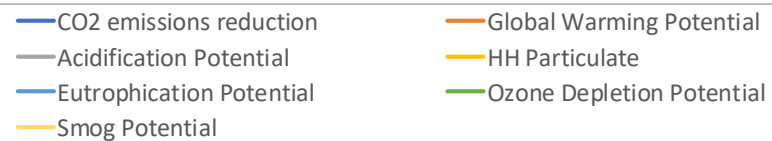
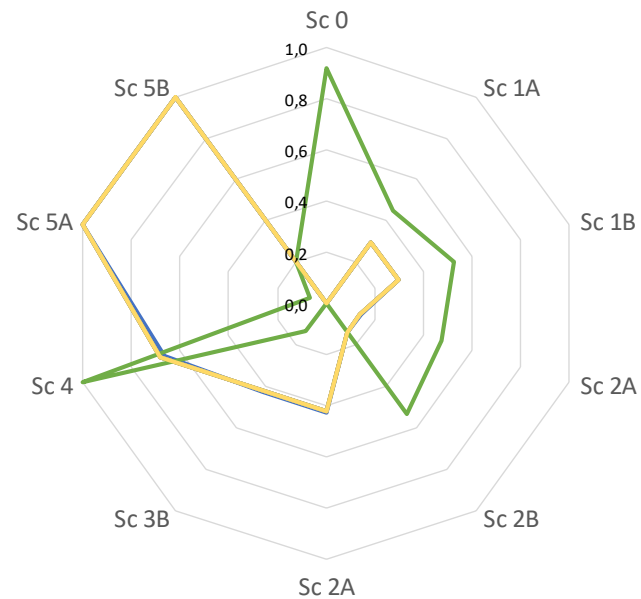
Scenarios ranking, regarding energy criteria



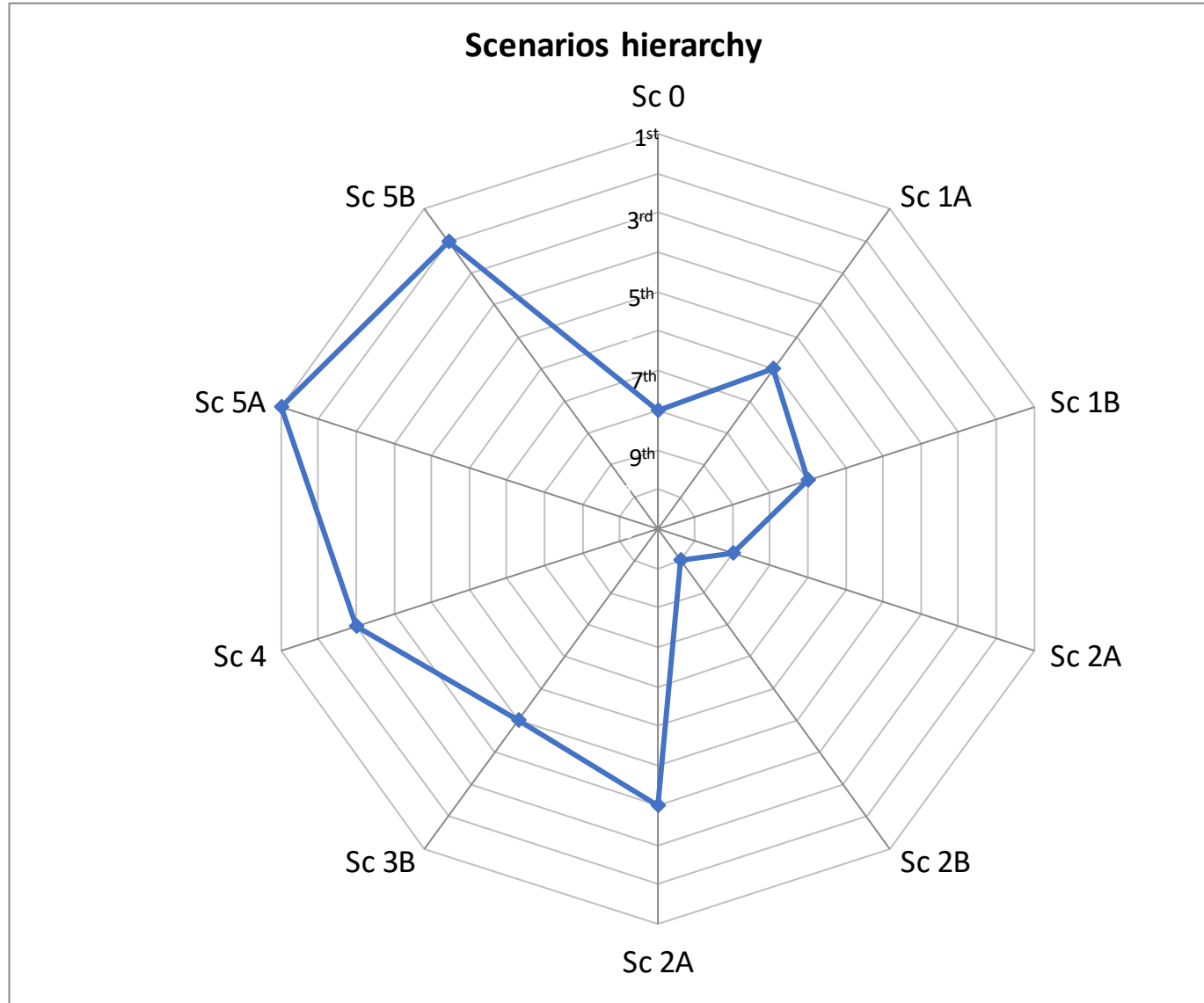
Scenarios ranking, regarding economic criteria



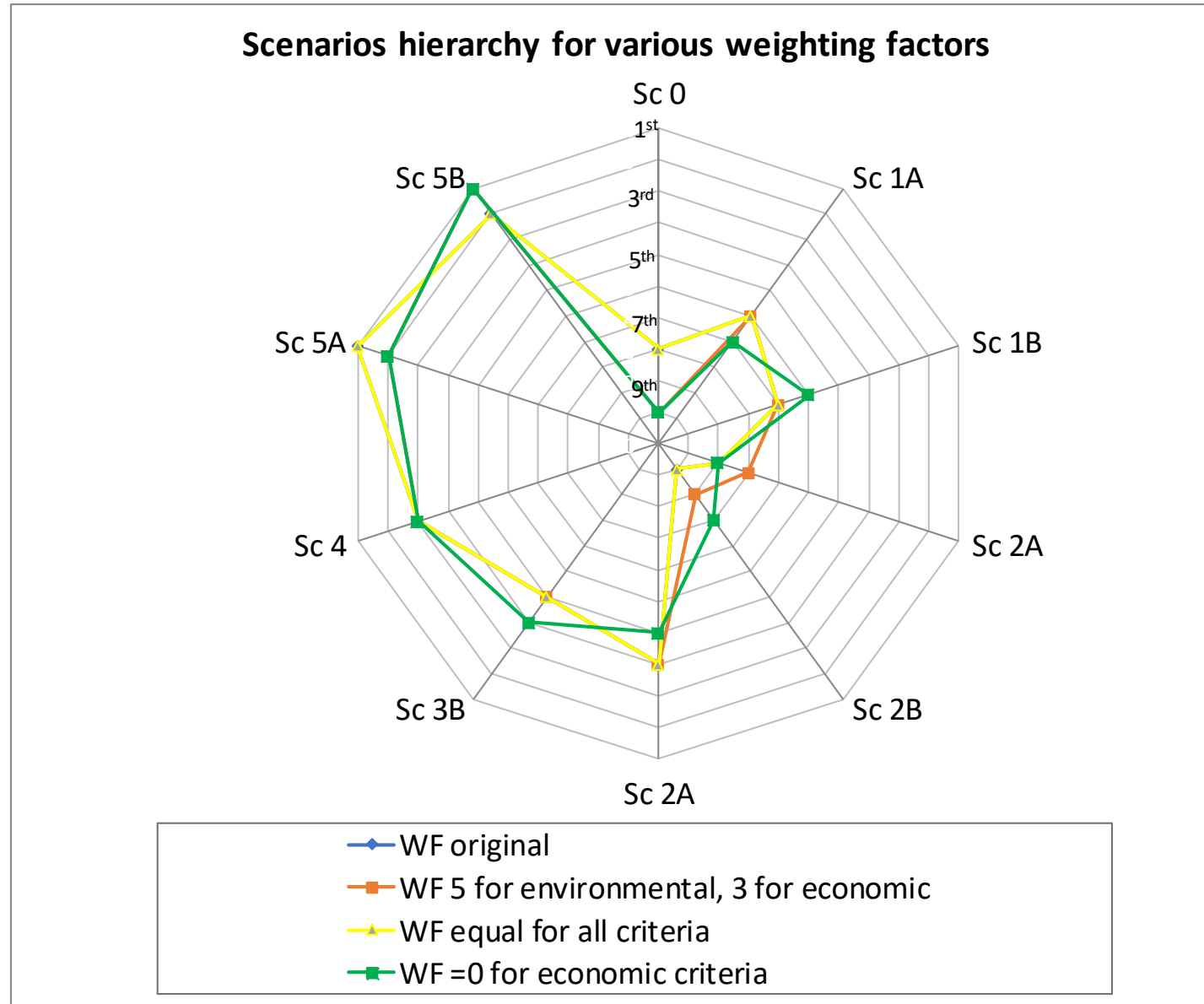
Scenarios ranking, regarding environmental criteria



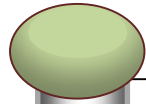
Scenarios hierarchy



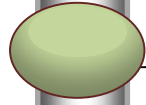
Sensitivity analysis



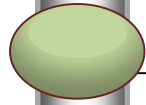
Conclusions



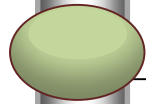
Low energy saving scenarios should be avoided



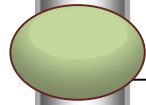
Eco materials are the best option, when economic criteria are not taken into consideration



Internalisation of externalised costs?



Synergies of RES and building envelope upgrade should be put forward



National definition of nZEB on relative or on absolute values?

References

- Berge, B. 2009. *The Ecology of Building Materials*. 2nd ed., Architectural Press, Burlington.
- Skoula, E. 2017. *Climate Action Plan, Part A: Mitigating Climate Change: Reducing Greenhouse Gas Emissions in the City of Athens*. Municipality of Athens, Athens. Available from: <https://resilientathens.files.wordpress.com/2017/06/cap-part-a-mitigation-plan.pdf> [Accessed: 05.06.2017]

