EUROPEAN HEALTHCARE DESIGN 2018

Towards a quantitative sustainability assessment of hospital buildings in Belgium

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Summary

Objectives

1. **develop** a new **sustainability assessment tool** for hospital buildings in Flemish region from the **life cycle thinking approach**, applicable in the **early design phase**

2. **energy consumption** calculation using the **parametric design** in the **early design phase**
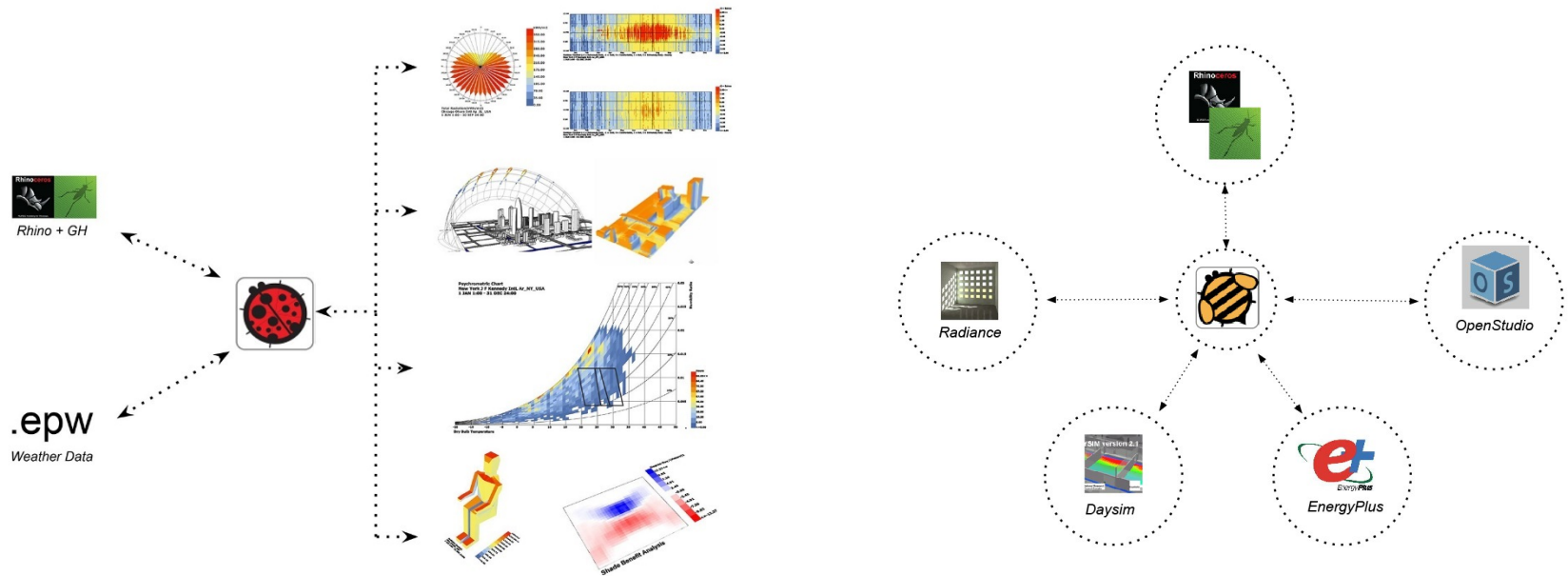
Methodology

1. **Life cycle assessment** (LCA) - MMG method converted into an Excel-based tool at the Architectural Engineering division (KUL)

2. **Life cycle costing (LCC)** - Excel-based tool developed at the Architectural Engineering division (KUL)
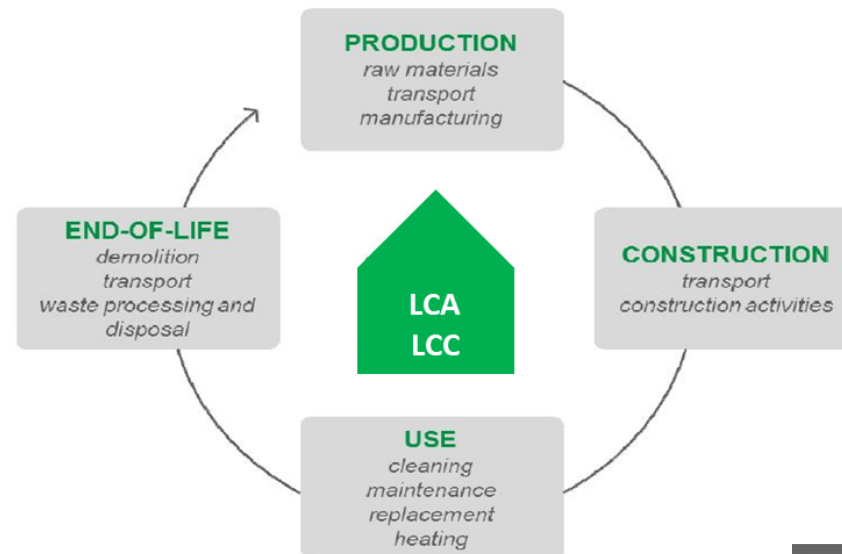
Methodology

3. **Parametric design** (Rhinoceros + Grasshopper + Honeybee and Ladybug) – **energy consumption calculation**
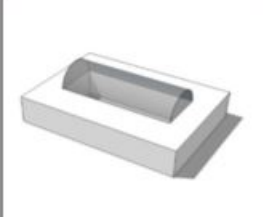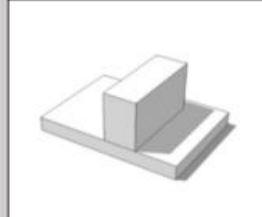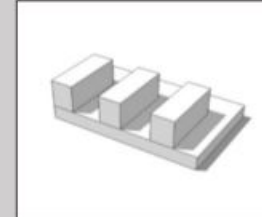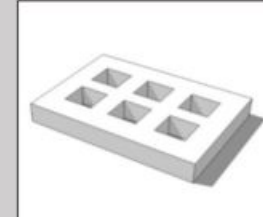
Tool description

Tool's interface – 2 Excel-based spreadsheets, "Concept" and "one_building_scenario"

"Concept" dashboard

Building layout

| Linked pavilion | Atrium | Podium with tower | Podium with 2 or more towers | Monoblock |

Method for energy calculation — Gross heating demand
Efficiency of installations (in %) — 87,44%
Energy source heating — Natural gas, burned in boiler condensing modulating >100kW/RER
Electricity source — Electricity, low voltage, production Electrabel green
Water souce — Water, tap water, at user/RER U_H
Ventilation rate (/h)

Energy for heating — 115 — kWh/m².year
Electricity (ventilation, lighting — 150 — kWh/m².year
Water consumption — 400 — l/bed.day
Eq'D

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Tool description

"Concept" dashboard

|		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Scenario 1		floor2_argex30_PE_polished con	floor6_argex18_PE_screed ceme	floor7_argex13_PE_screed ceme	floor3_ergex31.5_PE_screed cem	floor6_argex18_PE_screed ceme	floor6_argex18_PE_screed cement7
		floor8_argex30_polished concret	floor8_argex30_polished concret	floor1_argex32.5_PE_screed cem	floor1_argex32.5_PE_screed cem	floor8_argex30_polished concret	floor8_argex30_polished concrete-2
Scenario 2							
		Lblw_05_prefab_concrete 14.5 c	Lblw_05_prefab_concrete 14.5 c	Lblw_05_prefab_concrete 14.5 c	Lblw_02_concrete 27 cm	Lblw_05_prefab_concrete 14.5 c	Lblw_05_prefab_concrete 14.5 cm
		EW_16_brick_PUR14_arch concre	EW_15_brick_PUR10_arch concre	EW_01_precast conc 24_PUR12_a	EW_12_concrete block_PUR11_fa	EW_15_brick_PUR10_arch concre	EW_15_brick_PUR10_arch concrete
Scenario 3		Lblw_02_concrete 27 cm	Lblw_04_prefab_concrete 16 cm	Lblw_02_concrete 27 cm	Lblw_04_prefab_concrete 16 cm	Lblw_04_prefab_concrete 16 cm	Lblw_04_prefab_concrete 16 cm
		nLblw_10_gypsum wall 12.5 cm	nLblw_05_sandwich panel 12.5 c	nLblw_10_gypsum wall 12.5 cm	nLblw_05_sandwich panel 12.5 c	nLblw_05_sandwich panel 12.5 c	nLblw_05_sandwich panel 12.5 cm
		nLblw_09_gypsum wall 11 cm	nLblw_11_gypsum wall 15 cm	nLblw_09_gypsum wall 11 cm	nLblw_08_gypsum wall 10 cm	nLblw_11_gypsum wall 15 cm	nLblw_11_gypsum wall 15 cm
Scenario 4		SF_02_mineral fibre + PVC cover	SF_06_mineral fibre + ceramic til	SF_02_mineral fibre + PVC cover	SF_08_mineral fibre + PVC cover	SF_06_mineral fibre + ceramic til	SF_06_mineral fibre + ceramic tiles
		SF_20_mineral fibre + PVC on ca	SF_18_MDF suspended ceiling + i	SF_20_mineral fibre + PVC on ca	SF_14_mineral fibres + ceramic t	SF_18_MDF suspended ceiling + i	SF_18_MDF suspended ceiling + ind
		staircase_01	staircase_01	staircase_01	staircase_01	staircase_01	staircase_01
Scenario 5		Flat roof_6_green roof - extensiv	Flat roof_03_minerale fibres+con	Flat roof_6_green roof - extensiv	Flat roof_05_MDF+concrete	Flat roof_03_minerale fibres+con	Flat roof_03_minerale fibres+concre
		Concrete column	Concrete column	Concrete column	Concrete column	Concrete column	Concrete column
		PVC_glass1.1	wood painted_glass2.9	ALU_glass1.1	ALU_glass1.1	wood painted_glass2.9	wood painted_glass2.9
Scenario 6		door_01_98 x 211.5	sliding_door_01_123 x 248.5	door_01_98 x 211.5	door_01_98 x 211.5	door_01_98 x 211.5	sliding_door_01_123 x 248.5
		AP - REF - high-rise elevator, 20	AP - REF - high-rise elevator, 20	AP - REF - high-rise elevator, 20	AP - REF - high-rise elevator, 20	AP - REF - high-rise elevator, 20	AP - REF - high-rise elevator, 20 sto
		AP - REF - low-rise elevator, 8 st	AP - REF - low-rise elevator, 8 st	AP - REF - low-rise elevator, 8 st	AP - REF - low-rise elevator, 8 st	AP - REF - low-rise elevator, 8 st	AP - REF - low-rise elevator, 8 stops
Reset materials		SFH - REF - electrical services, ca	SFH - REF - electrical services, ca	SFH - REF - electrical services, ca	SFH - REF - electrical services, ca	SFH - REF - electrical services, ca	SFH - REF - electrical services, cable
Eq'D		0	0	0	0	0	0
Energy for heating and cooling		115	135	115	90	124	100
Electricity (ventilation, lighting,		150	140	150	120	135	130
Water consumption		400	500	400	350	300	298

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Tool description
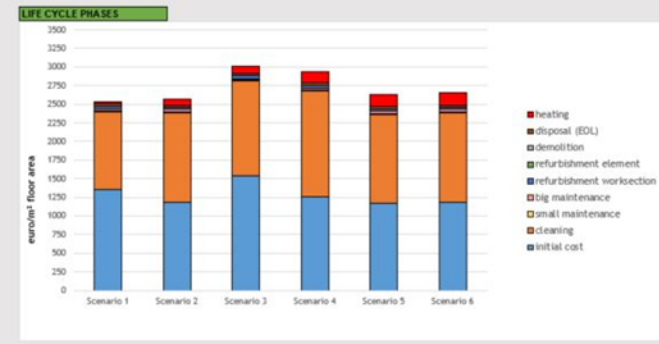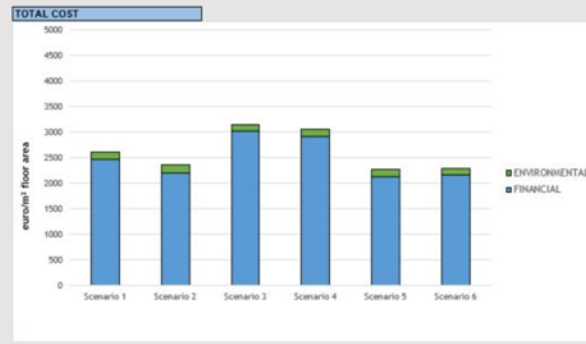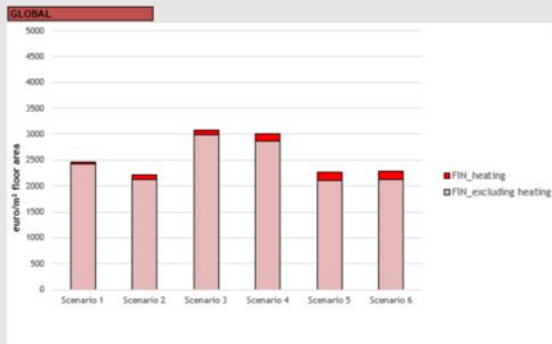
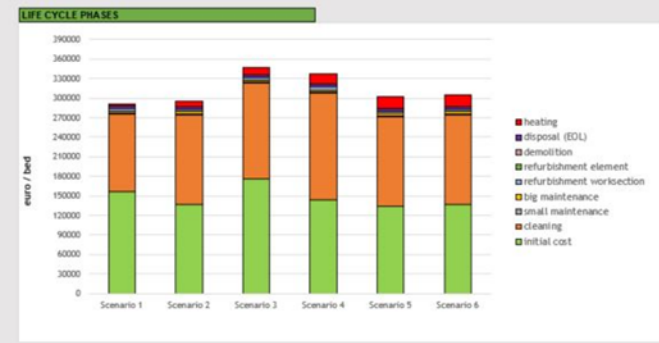Rhino + Grasshopper + Honeybee + Ladybug
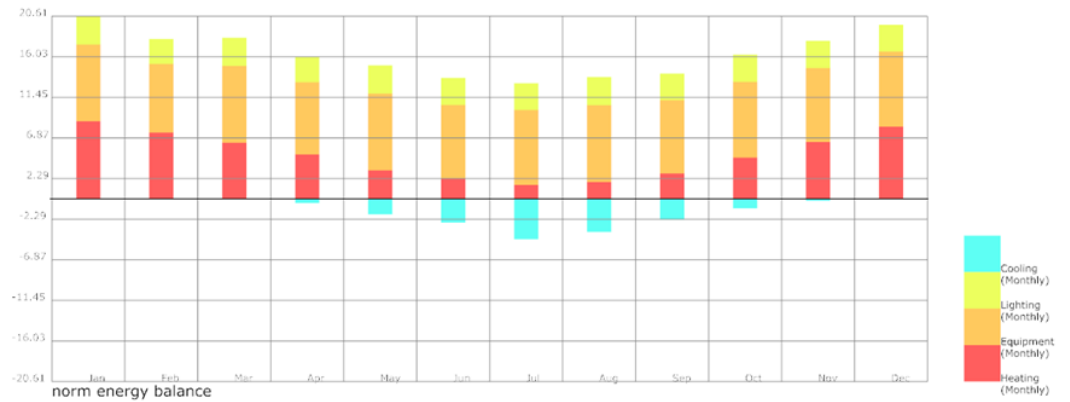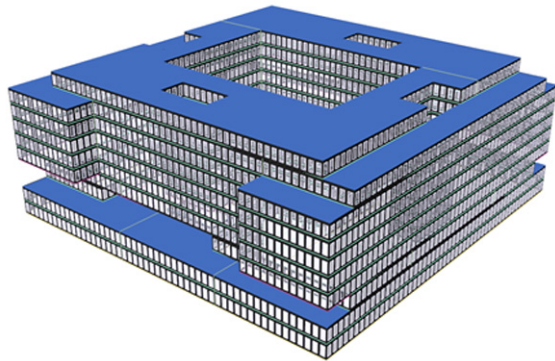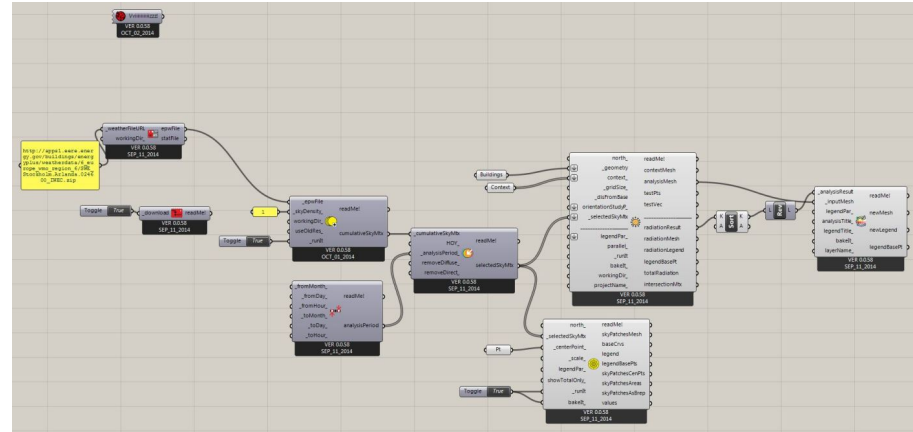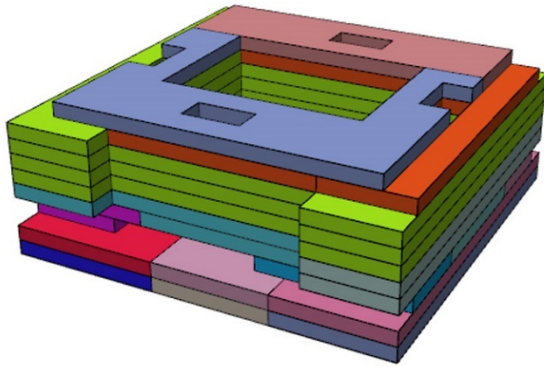
Results

"Concept" dashboard
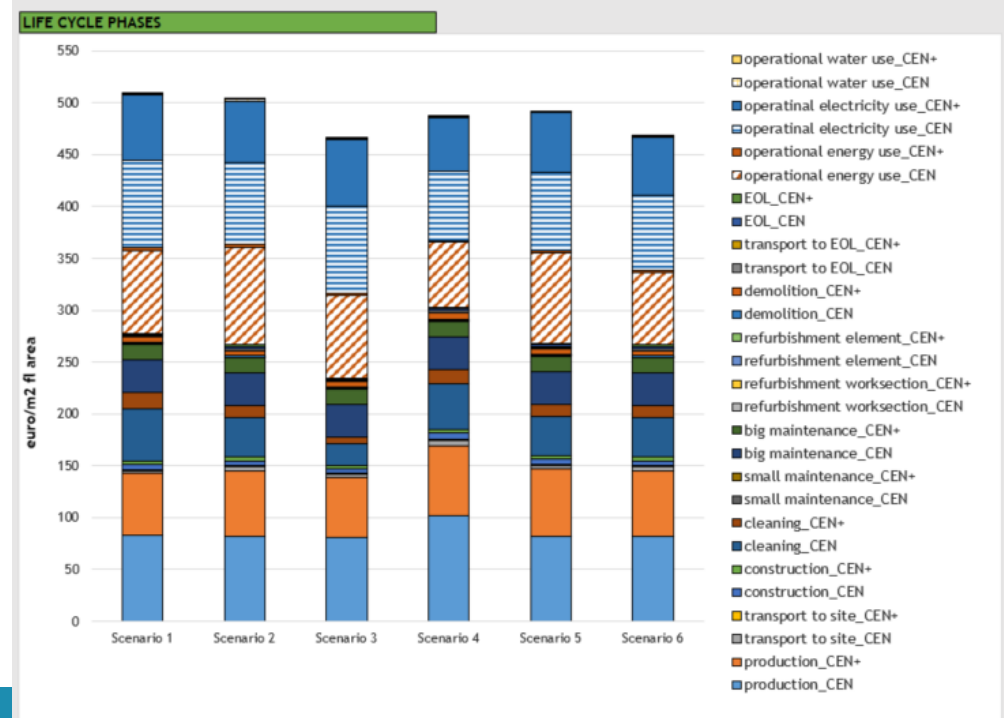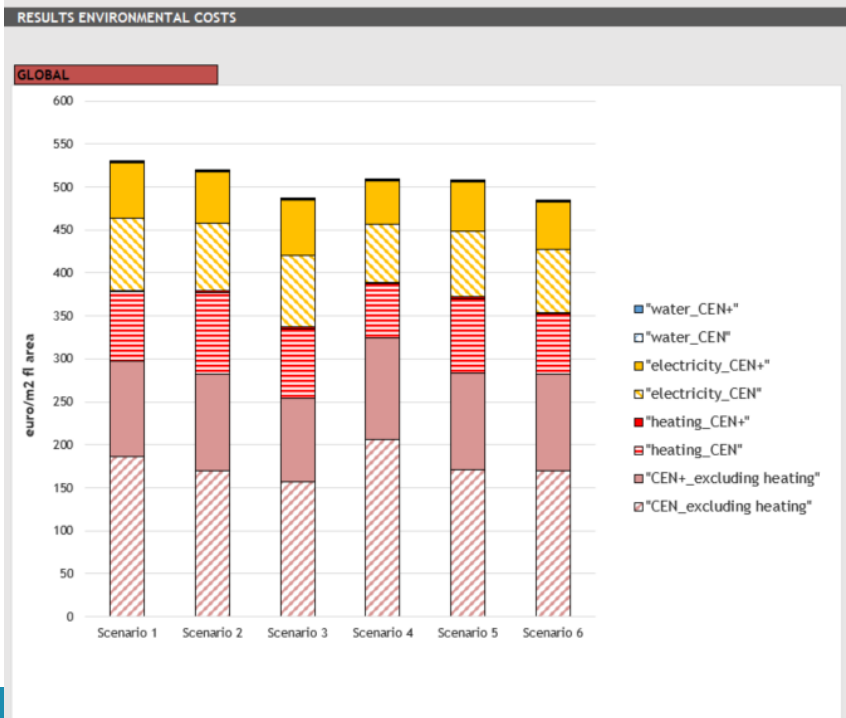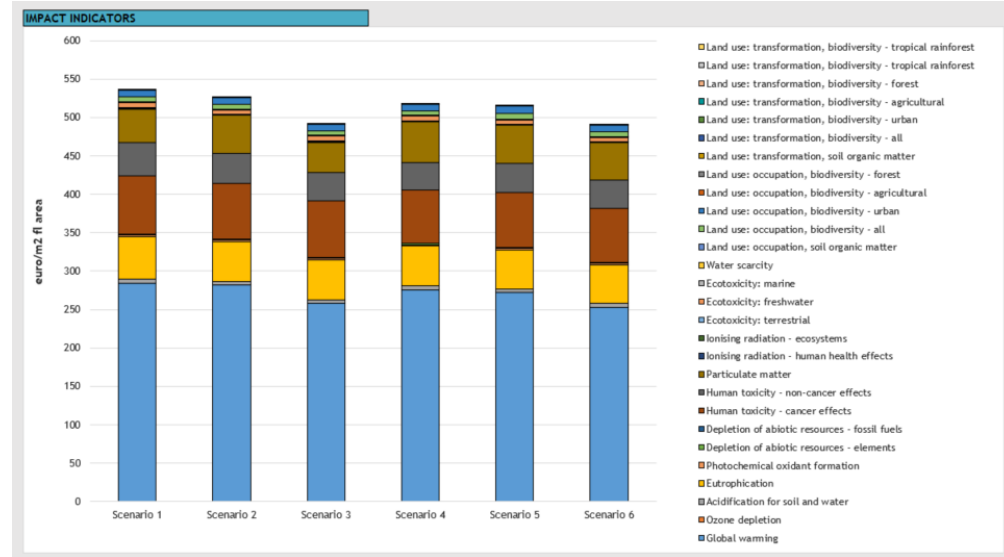
Results

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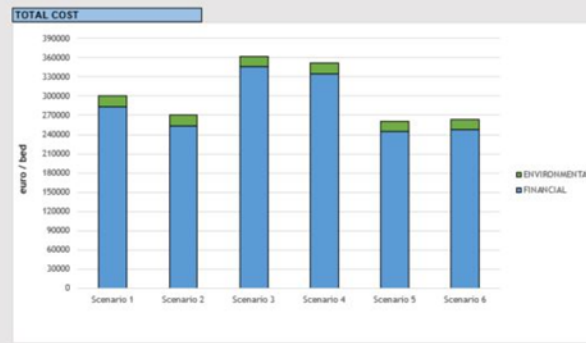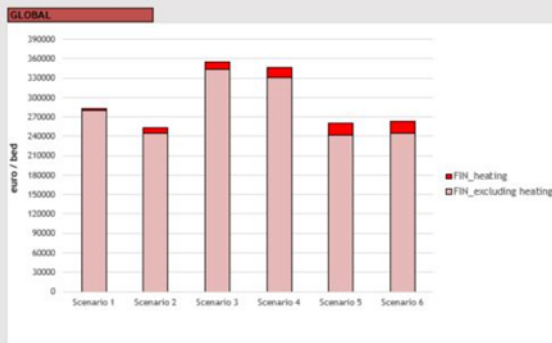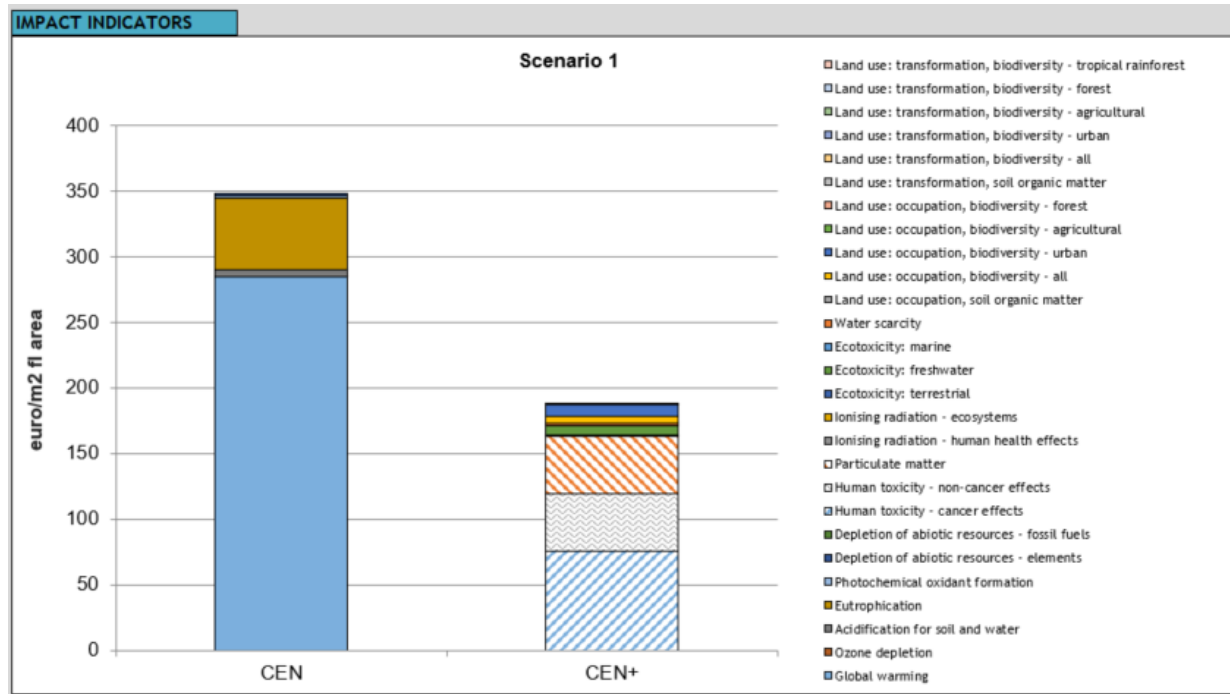
Results

"one_building_scenario" dashboard

Results

"one_building_scenario" dashboard
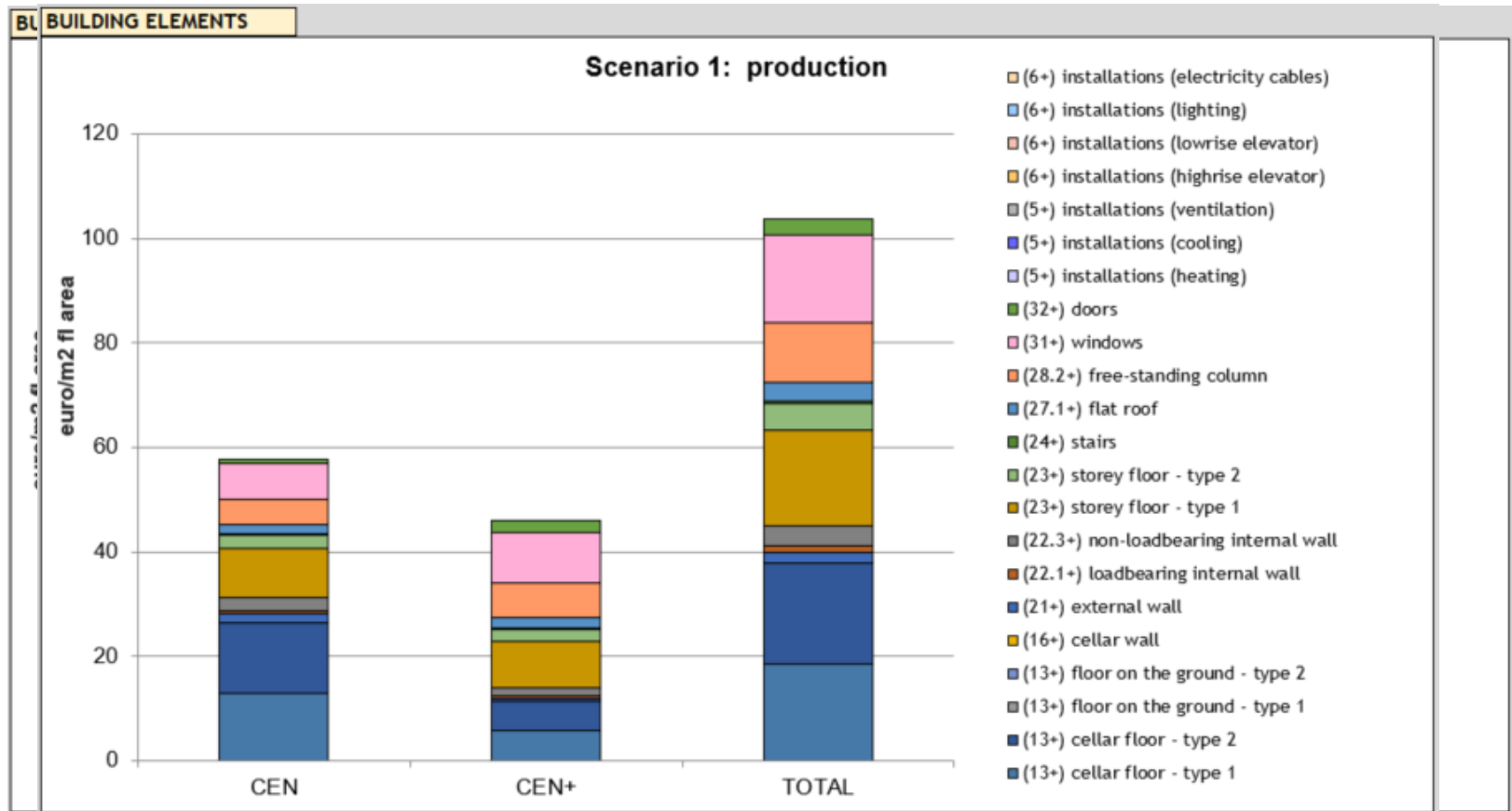
Conclusions and further steps

Developed tool – advantage lies in ability to **apply LCA and LCC** on hospital building from an **early design phase**

Combining with **Rhinoceros** and plugins **Ladybug** and **Honeybee** allows for **modelling the energy consumption** from a **concept phase** – applicable in different climatic contexts

The **combination** of the **LCA, LCC and parametric design** for energy calculation - a **powerful tool to optimise a hospital building**

Conclusions and further steps

Include the electricity calculation (ventilation, lighting, cooling, medical technical equipment)

Refine the energy calculation for spatial heating to be in line with the **EPB norms** in Flanders

Include the HVAC installations in LCA and LCC analysis

Validation of the developed tool through its application in upcoming competitions

Thank you !

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