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Life cycle environmental impact of refurbishment of social housing

SBE 2019
Graz

Els Van de moortel
Karen Allacker
Frank De Troyer
Luc Stijnen
Erik Schoofs

Speaker Luc Stijnen

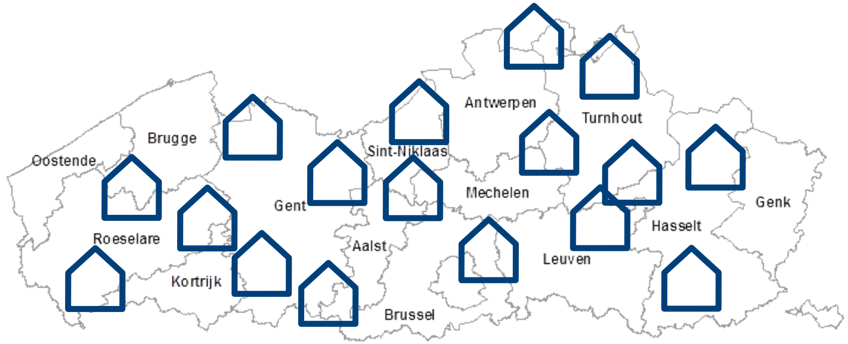
Introduction

©Volker, Z., Simons, J., Reller, A., Ashfield, M., Rennie, C. (BP), 2014, *'Materials critical to the energy industry — An introduction'*

Introduction

ENERGY

- 76 %

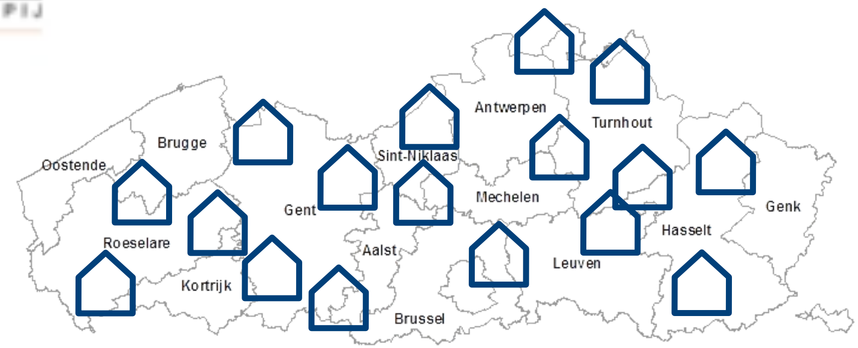


2050

$A^+ \leq 0$ kWh /(m² year)
$0 < A \leq 100$ kWh /(m² year)
$100 < B \leq 200$ kWh /(m² year)
$200 < C \leq 300$ kWh /(m² year)
$300 < D \leq 400$ kWh /(m² year)
$400 < E \leq 500$ kWh /(m² year)
$500 < F$

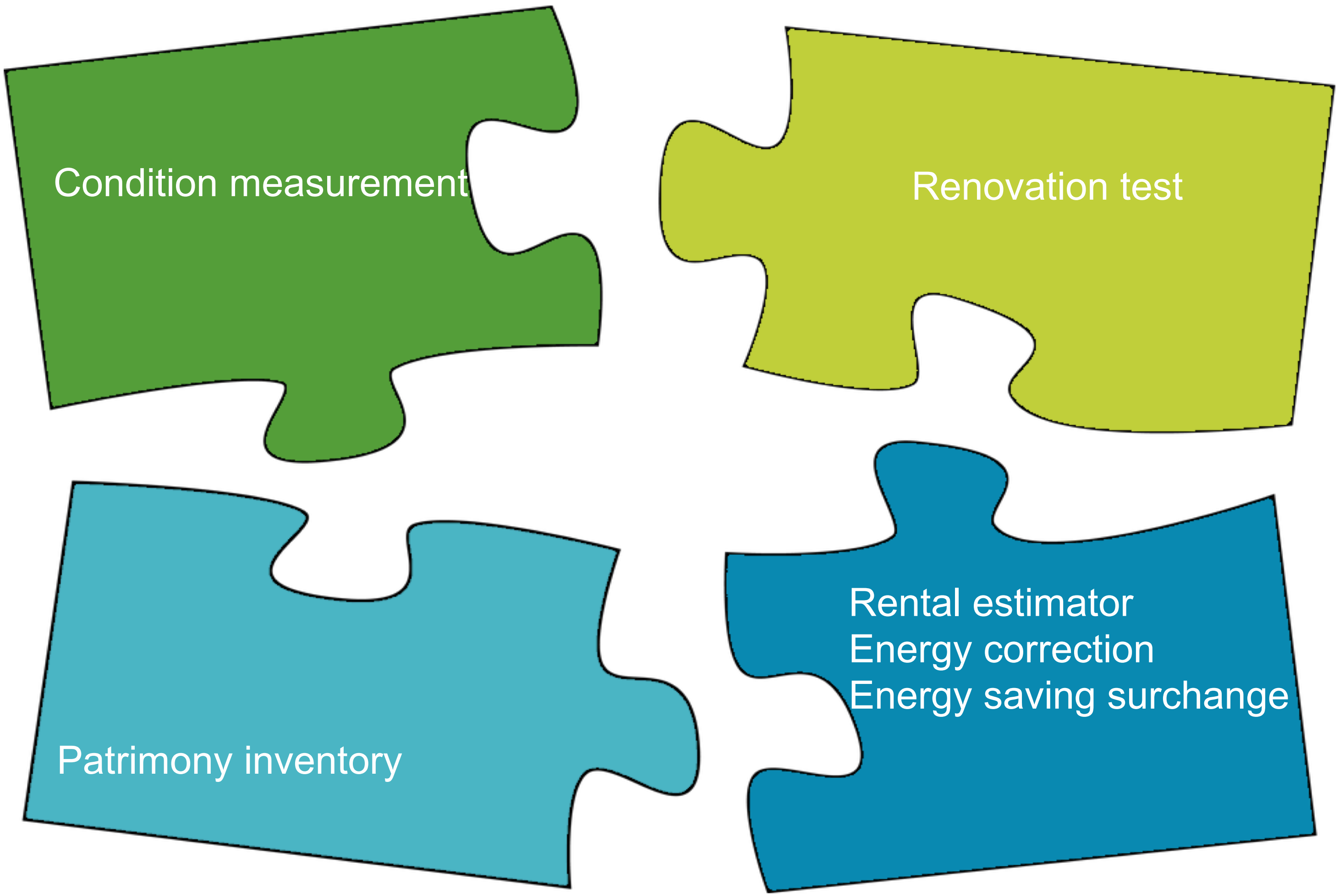
Introduction

MOLSE BOUWMAATSCHAPPIJ



ZONNIGE KEMPEN

Housing characteristics



Condition measurement – Scorecard

Condition measurement

A – GEBOUWSTAAT
1 EXTERNE STAAT

1.1 GEVELS

1.1.1 Geveloppervlak

Zichtbare gevelvlakken van metselwerk, beton, hout, gevelbekledingen, schilderwerk, bepleistering, …

1.1.1.1 Score 1

Uitstekende staat:

- Functionele levensduur:
  - gevelmetselwerk: 0-10/60 jaar of nog goed voor minstens 50 jaar
  - gevelbekledingen: 0-7/35 jaar of nog goed voor minstens 25 jaar
  - gevelpleisters: 0-7/35 jaar of nog goed voor minstens 25 jaar
- Schadebeeld:
  - bijna nieuwstaat zonder noemenswaardige gebreken (jonge of gerenoveerde gebouwen)
  - lichte vervuiling, zeer plaatselijke / makkelijk herstelbare schade wordt toegestaan bv. een gebarsten gevelplaat, krassporen van fietsen tegen gevel, …
  - geen gevaarlijke stoffen of asbesthoudende producten aanwezig (gevelbeplatingen)
- Actie:
  - geen nood aan dringend onderhoud of herstel

VLAAMSE MAATSCHAPPIJ VOOR SOCIAAL WONEN
Vlaanderen is sociaal wonen

initiatiefnemer xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxx
referentienummer xxxxxxx
datum dd maand jaar

SCORECARD GEBOUWSTAAT

omschrijving project: ______

EXTERN		SCORE	# 1	# 2	# 3	# 4	# 5	# 6	RESULTAAT		WEGING	
Gevels	geveloppervlak	2,5		12	12				70%		8%	
Gevelopeningen	raam- & deurprofielen	2,5		12	12				70%		6%	
Daken	dakoppervlak	2,5		12	12				70%	70%	10%	30%
	hemelwaterafvoer	2,5		12	12				70%		2%	
	dakranden- & kroonlijsten	2,5		12	12				70%		4%	
ISOLATIE		**SCORE**	**# 1**	**# 2**	**# 3**	**# 4**	**# 5**	**# 6**	**RESULTAAT**		**WEGING**	
Isolatie gebouwschil	beglazing	3,5			12	12			50%		8%	
	dakisolatie	4,0				24			40%	57%	8%	30%
	gevelisolatie	2,0		24					80%		8%	
Energieprestatie	energieprestatiecertificaat	3,0			24				60%		6%	
INTERN		**SCORE**	**# 1**	**# 2**	**# 3**	**# 4**	**# 5**	**# 6**	**RESULTAAT**		**WEGING**	
Binnenafwerking	vloerafwerking	1,0	24						100%		6%	
Binnenuitrusting	badkamer & toilet	3,0			24				60%	72%	7%	20%
	keukenuitrusting	3,0			24				60%		7%	
TECHNIEKEN		**SCORE**	**# 1**	**# 2**	**# 3**	**# 4**	**# 5**	**# 6**	**RESULTAAT**		**WEGING**	
Verwarming & SWW	verwarmingstoestel	2,0		24					80%		6%	
	sanitair WW	2,5		12	12				70%		2%	
Ventilatie & rookgasafvoer	ventilatiesysteem	6,0						24	0%	62%	5%	20%
Elektro & liften	elektrische installatie	2,0		24					80%		5%	
	personenliften								0%		0%	
		GEWOGEN CONDITIESCORE GEBOUWSTAAT							65%		100%	

VEILIGHEID & GEZONDHEID		# 1	# 2	# 3	# 4	# 5	# 6	% (-)		WEGING	
Stabiliteit	stabiliteit algemeen	24						0%	0,0%	-10%	-10%
Brandveiligheid	brandweerverslag	24						0%		-2%	
	brandblusvoorzieningen	24						0%	-4,0%	-4%	-10%
	branddetectie & -melding			24				100%		-4%	
Veiligheid installaties	elektrische installatie			24				100%		-5%	
	CO-risico	24						0%	-5,0%	-5%	-15%
	gasinstallatie	24						0%		-5%	
Gevaarlijke stoffen	aanwezigheid asbest		12	12				71%	-3,1%	-3%	-5%
	loden leidingen	12		12				50%		-2%	
Valbeveiliging	borstweringen & leuningen	12		12				50%	-2,5%	-5%	-5%
Binnenklimaat	Vocht	12		10	2			50%	-2,5%	-5%	-5%
		MINPUNTEN CHECKLIST						-17%		-50%	
		CONDITIESCORE NA AFTREK MINPUNTEN							48%		

Interreg
2 Seas Mers Zeeën

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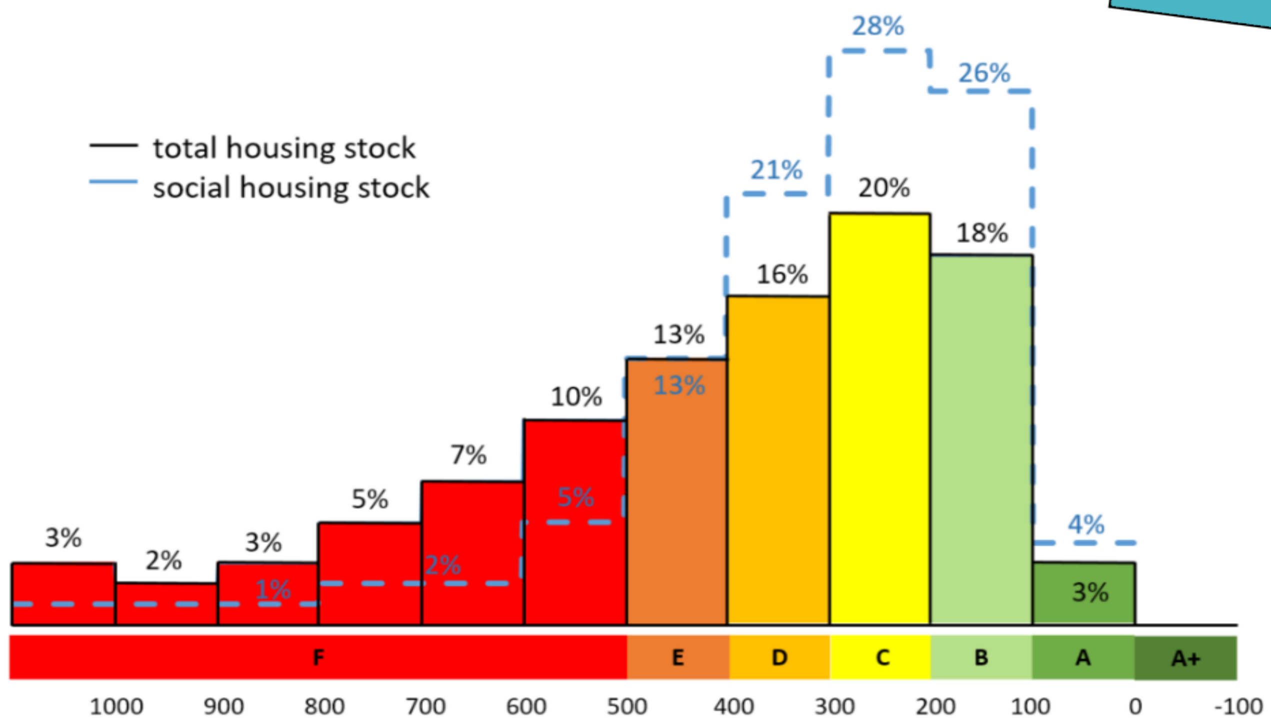
Existing Housing stock

Partrimony inventory



EPC score
← kWh/m²a

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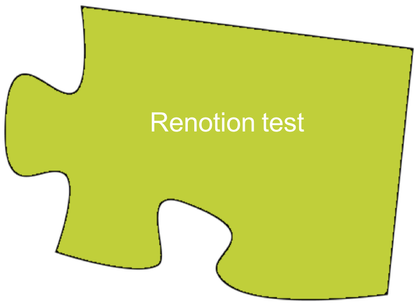
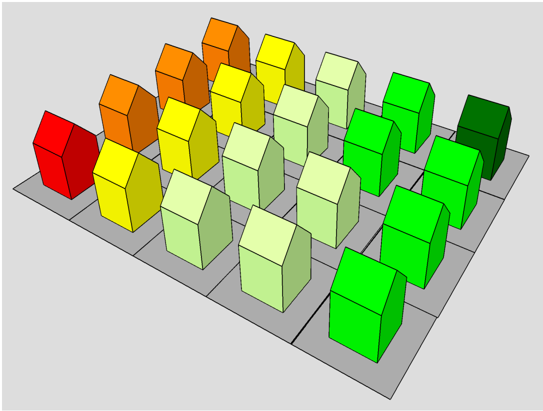
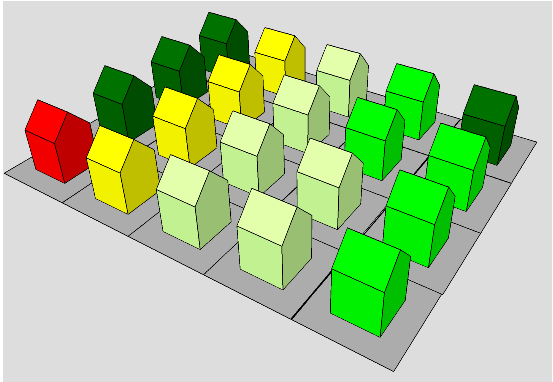
What to do and When?

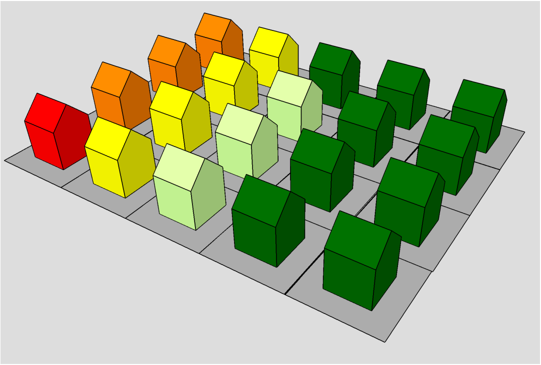




Existing stock

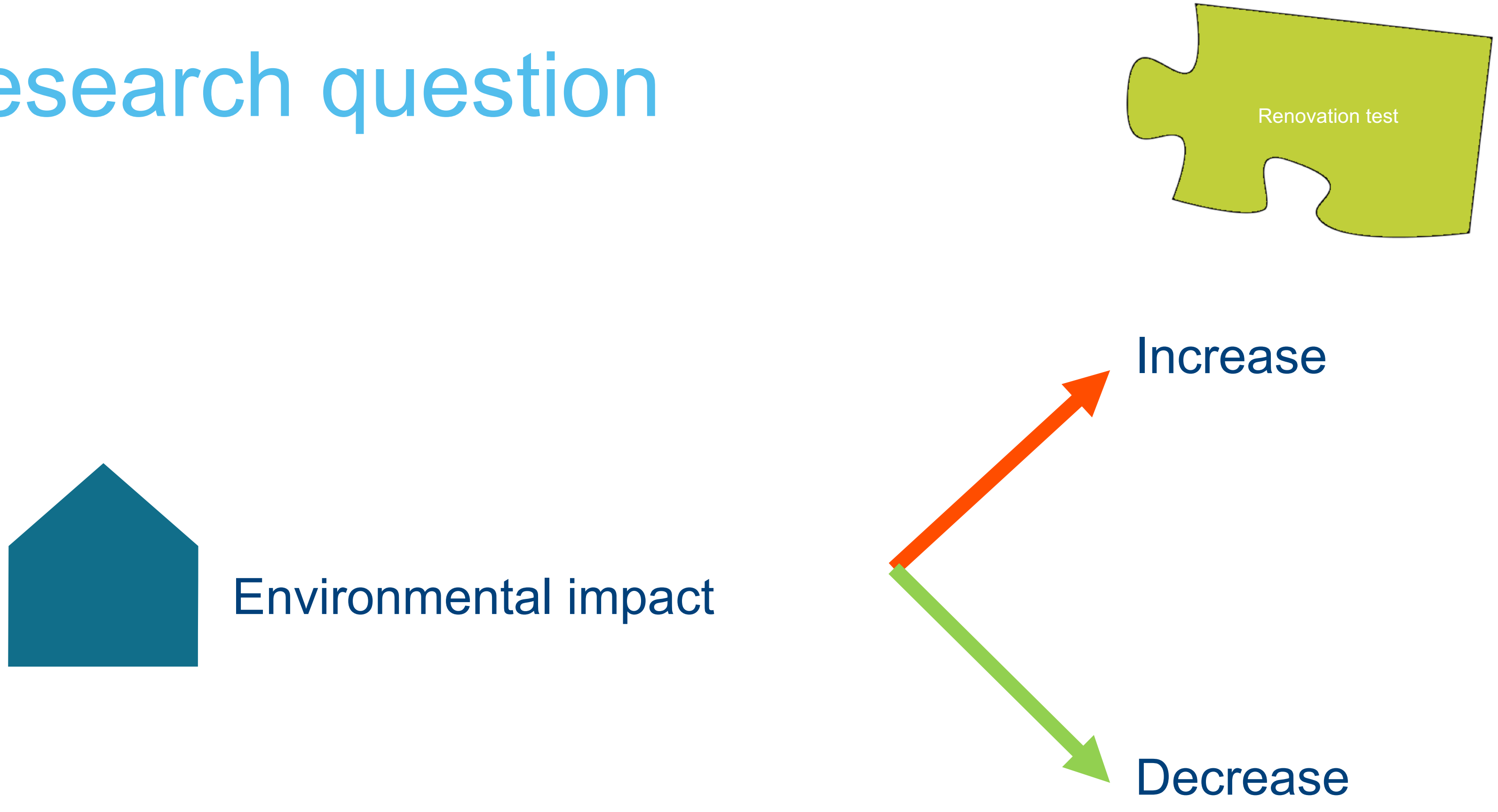


First relatively bad cases (orange)?



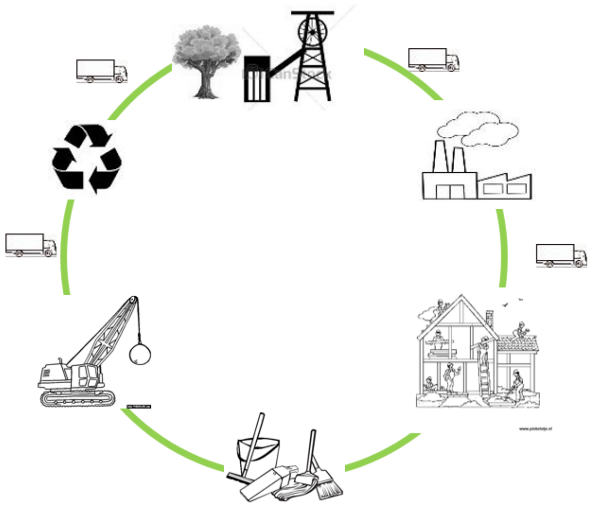
Upgrade of what is already good?

Research question



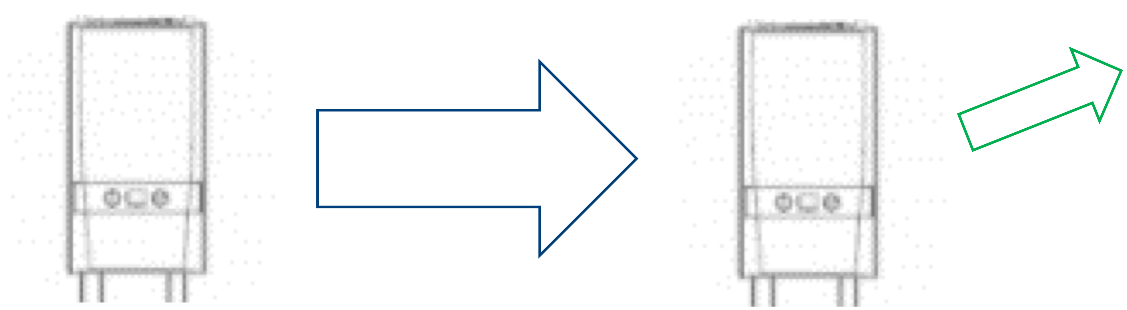
Method

Life Cycle Assessment



Dynamic approach:

include efficiency increase for future heating system



Higher efficiency

⇩

Lower energy use

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Method

Energy use for spatial heating

→ equivalent degree day method

→ 1200 equivalent degree days

Assumption for the growth rate of the heating system

→ 0,5 %

Method

Energy use for spatial heating

→ equivalent degree day method

→ 1200 equivalent degree days

→ Assumption growth rate heating system efficiency

→ 0,5 %

Environmental impact

Belgian LCA method (17 impact categories + monetisation)

→ inventory of the data: Ecoinvent 3.3

→ scenarios transport, installation, cleaning, maintenance, sorting, transport to EOL, EOL: Belgian LCA method

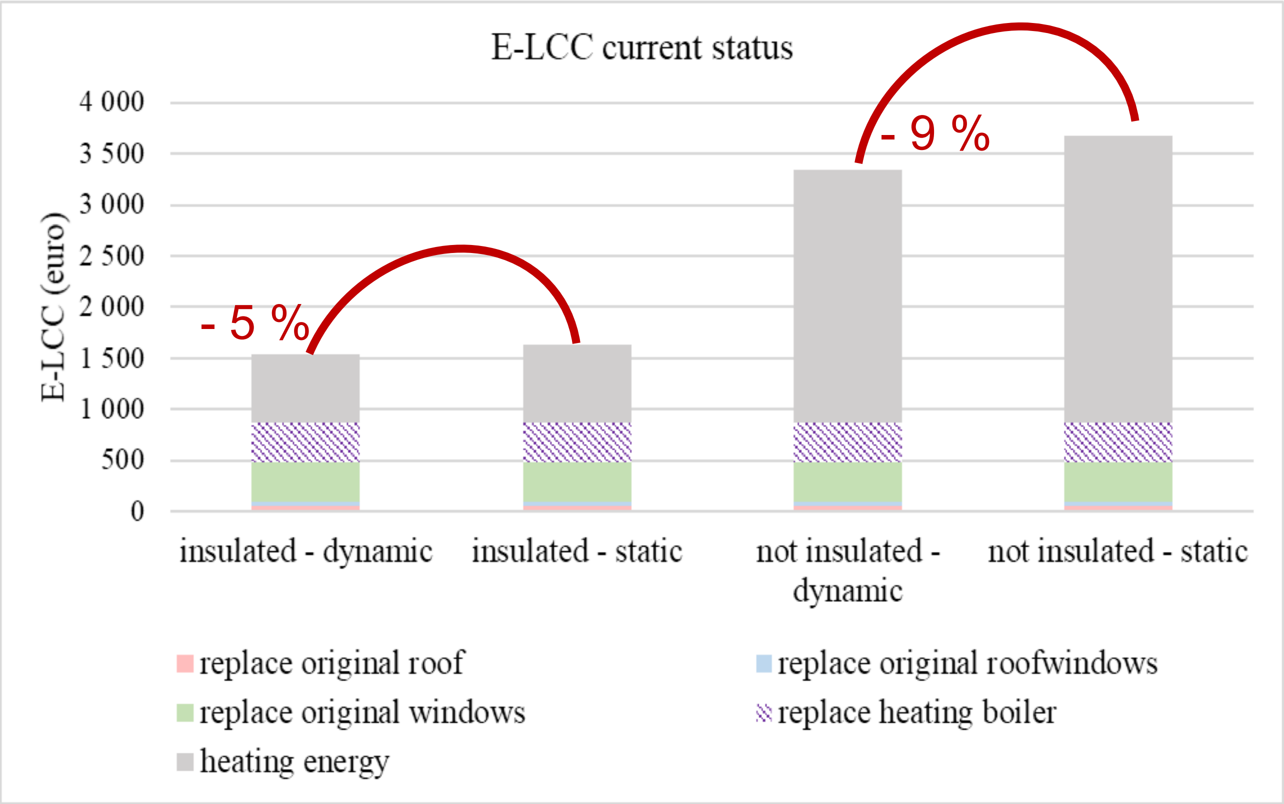
→ service life of the building: 60 years

Method

Environmental indicator	Unit	Monetary value (€/unit)	Environmental indicator	Unit	Monetary value (€/unit)
Global warming	kg CO2 eqv.	0.100	Ecotoxicity: freshwater	CTUe	3.70E-05
Depletion of the stratospheric ozone layer	kg CFC-11 eqv.	49.10	Water scarcity	m3 water eqv.	0.067
Acidification of land and water sources	kg SO2 eqv.	0.43	Land use: occupation: a. soil organic matter	kg C deficit	2.7E-06
Eutrophication kg	(PO4)3- eqv.	20	Land use: occupation: a. b. biodiversity - urban: loss ES - agricultural - forest: biodiversity	m2.a m2.a m2.a	0.30 6.0E-03 2.2E-04
Formation of tropospheric ozone photochemical oxidants	kg etheen eqv.	0.48			
Abiotic depletion of nonfossil resources	kg Sb eqv.	1.56			
Abiotic depletion of fossil resources	MJ, net caloric value	0	Land use: transformation: a. soil organic matter	kg C deficit	2.7E-06
Human toxicity a. cancer effects b. non-cancer effects	CTUh CTUh	665109 144081	Land use: transformation: a. biodiversity - urban: - agricultural - forest, excl. tropical - tropical rainforest	m2 m2 m2 m2	n.a. n.a. n.a. n.a.
Particulate matter	kg PM2,5 eqv.	34			
Ionising radiation, a. human health b. ecosystems	kg U235 eqv. CTUe (per kBq)	9.7E-04 3.70E-05			

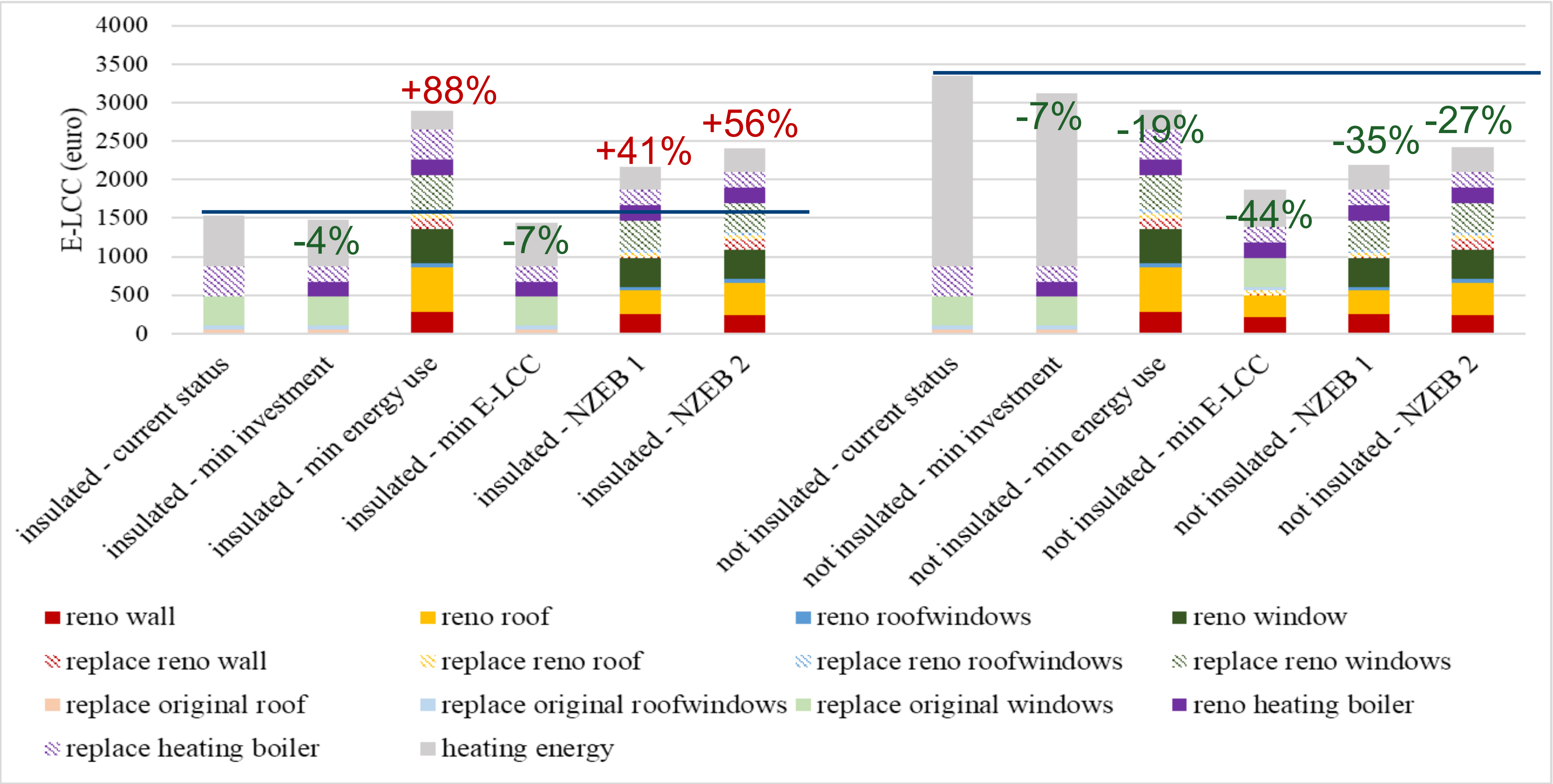
Results

Dynamic versus static approach



Results

Environmental Life Cycle Cost of renovation



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Conclusion and further outlook

Including future efficiency increase of heating systems seems interesting, especially for the coupling with other systems, e.g. heat pumps.

The most preferred renovation strategy is different for a non-insulated than for a poorly insulated building. Applying identical scenario to all buildings might even lead to an increase of the Environmental Life Cycle Cost.

Striving for a minimal energy use might result in a higher Environmental Life Cycle Cost. It seems therefore more efficient to focus in the E-LCC of renovation scenarios.

As the impact on global warming is linked to the amount of energy from natural gas, it seems interesting to study the effects of a shift to renewable energy in future research.

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Thank you for your attention!

Questions?

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els.vandemoortel@kuleuven.be