



**SB13
Graz**

SUSTAINABLE BUILDING CONFERENCE 2013
25.-28. SEPTEMBER 2013, TU GRAZ, AUSTRIA



bbri.be
Researches • Develops • Informs

INNOVIRIS
KONINKLIJKE BESCHERMING
HET NEDERLANDSE INSTITUUT
VOOR ONDERZOEK EN INNOVATIE



© VMSW – Bressers Architecten

Nearly Zero Energy Renovation of houses Life cycle costs & Environmental impact



bbri.be
Researches • Develops • Informs

Jeroen Vrijders & Lisa Wastiels
Belgian Building Research Institute

NZE Renovation of Houses : LCC & Environmental Impact

NZE Renovation of Houses : LCC & Environmental Impact

NZE Renovation of Houses : LCC & Environmental Impact



ONE STOP SHOP

**From demonstration projects towards volume market
Innovations for sustainable renovation**

www.one-stop-shop.org

Demand side & Supply side - > Business models

Motivating clients:

- Comfort, quality, need
- Budget & cost efficiency
- Environmental consciousness

NZE Renovation of Houses : LCC & Environmental Impact

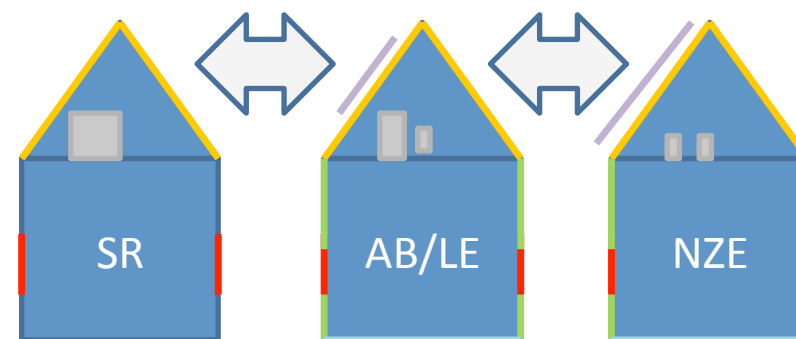
NZE Renovation of Houses : LCC & Environmental Impact

■ Insights in costs & benefits of 'deep' renovation

- Actual costs
- Environmental impact

■ Ambition levels

- LE – Low Energy = As Built
- SR – Standard Renovation
- NZE – Nearly Zero Energy



→ New construction anno 2012

→ Feasibility? Definition ?

As Built + extra measures

'getting as near to zero energy consumption as possible within the project's site boundary'

(1) a very low primary energy consumption in kWh/m²a on a yearly basis including heating, cooling, ventilation, lighting and aid energy, using nationally defined conversion factors, and (2) renewable energy production on-site, nearby and off-site, where 50-90% of the energy demand is covered by renewable energy. [BPIE]

NZE Renovation of Houses : LCC & Environmental Impact

NZE Renovation of Houses : LCC & Environmental Impact



- © BENERGIE.BE
- Early 1970's
- Architectural Façade
- E40 – K21 – PE: 45-55 kWh/m²a

Floor: 15 cm EPS insulation
New roof : +32 cm mineral wool
Façade: Partial demolition +
External Insulation system (24cm)
Triple glazed aluminium windows;
VIP in doors
Solar boiler, heat pump, PV-
installation

NZE Renovation of Houses : LCC & Environmental Impact

	SR-CB	LE-CB	LE-HP	NZE-HP
Insulation: Prim.En.:	K48 E83	K21 E44	K21 E36	K21 E20
Prim.En. Consump.	105 kWh/m ² a	55 kWh/m ² a	45 kWh/m ² a	25 kWh/m ² a

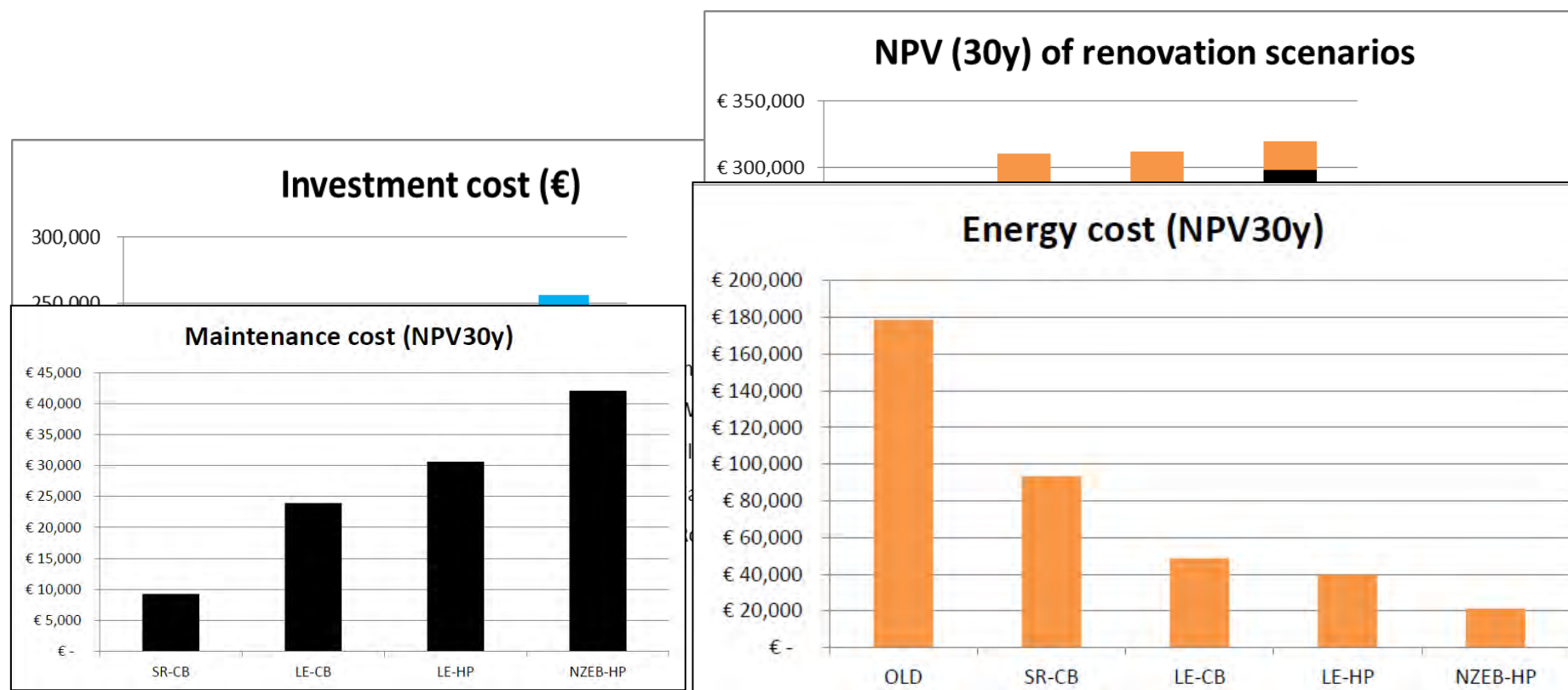
NZE Renovation of Houses : LCC & Environmental Impact

	SR-CB	LE-CB	LE-HP	NZE-HP
Roof	20 cm MW between existing structure	2x16 cm mineral wool on top of existing roof structure (16 cm MW)		
Walls	12 cm cellular glass & ceramic tiles	Demolition of external cavity wall, 2x12 cm cellular glass & glued ceramic tiles		
Floor	6 cm sprayed PU	15 cm EPS		
Doors & gates	Alu with PU-core	Alu with VIP-core		
Windows	Alu with 1.1 glass	Alu with triple glazing		
Thermal bridges	Not remediated	All solved		
Heating & hot water production	Condensing boiler on natural gas + radiators & floor heating	Heat pump (water/air) + radiators (LT) & underfloor		
Solar boiler	/	5 m ²	5 m ²	25 m ²
PV panels	0.9 kWp	0.9 kWp	0.9 kWp	3.4 kWp
Ventilation	Natural ventilation	Mechanical ventilation + heat recovery (system D)		
Air tightn. (v50)	7	2		

NZE Renovation of Houses : LCC & Environmental Impact

NZE Renovation of Houses : LCC & Environmental Impact

- NPV over 30 years – 1.96% Real Discount Rate
- Actual occurred energy-related costs (Subsidies)
- Electricity: 0.2 €/kWh ; Gas : 0.08 €/kWh ; +2.25%/a

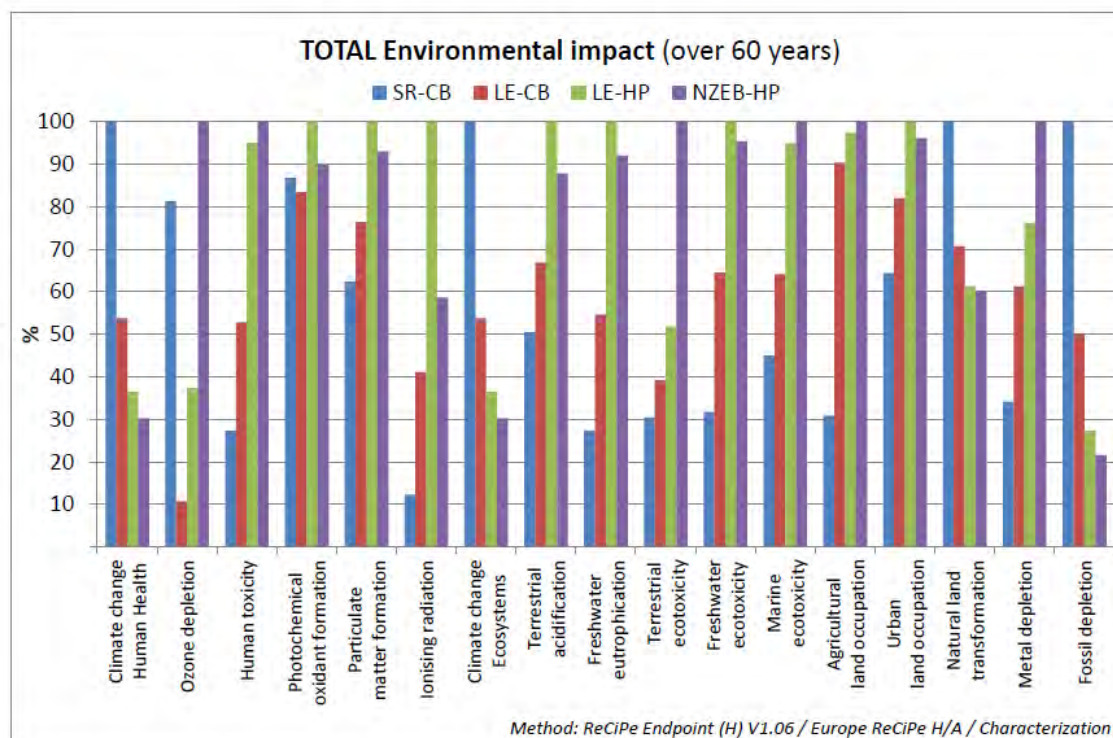


SR = Standard Renovation ; LE = Low Energy ; NZE = Nearly Zero Energy ;
 CB = Condensing boiler ; HP = Heat Pump

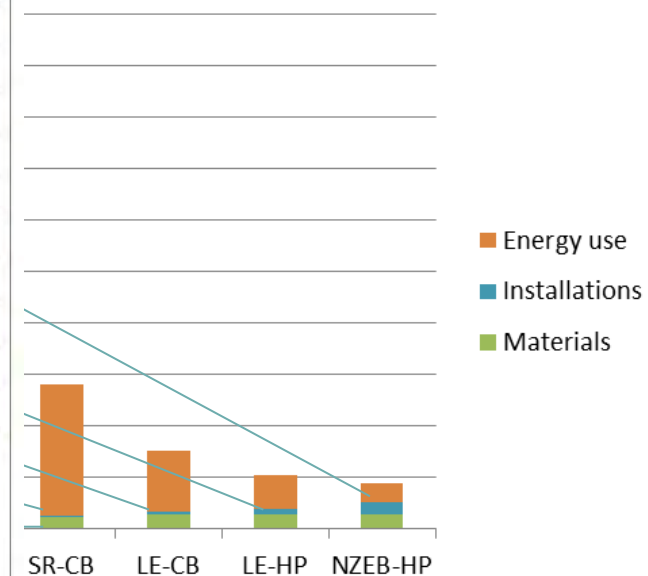
NZE Renovation of Houses : LCC & Environmental Impact

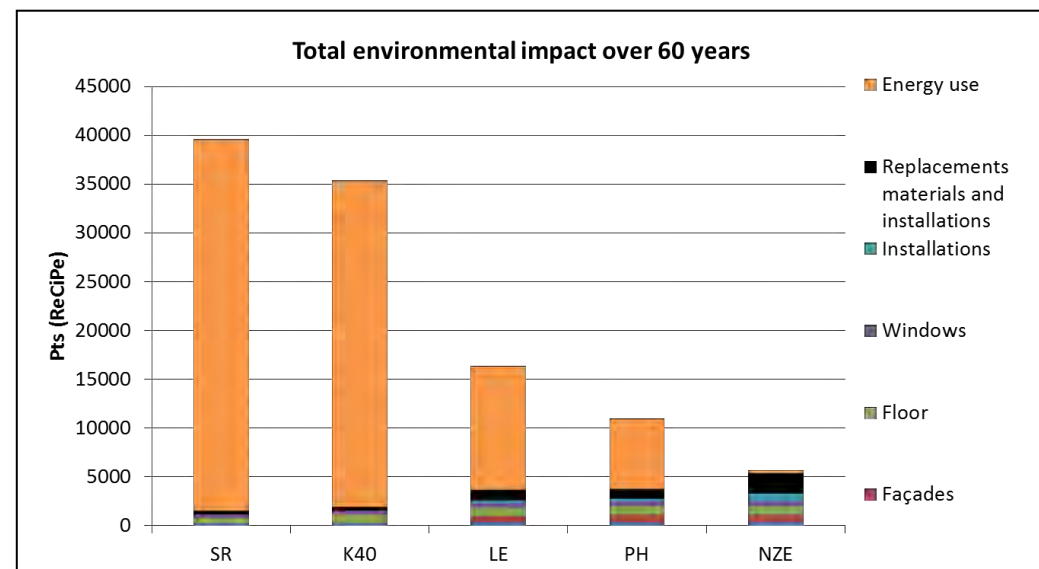
NZE Renovation of Houses : LCC & Environmental Impact

- LCA – 60 years – incl. replacements
- EN 15978 & EN 15804
- EcolInvent Life Cycle Inventory Database (2.0), ReCiPe Endpoint (H) V1.06 / Europe ReCiPe H/A / Single score



Environmental impact over 60 years (incl. replacements)





NZE Renovation of Houses : LCC & Environmental Impact

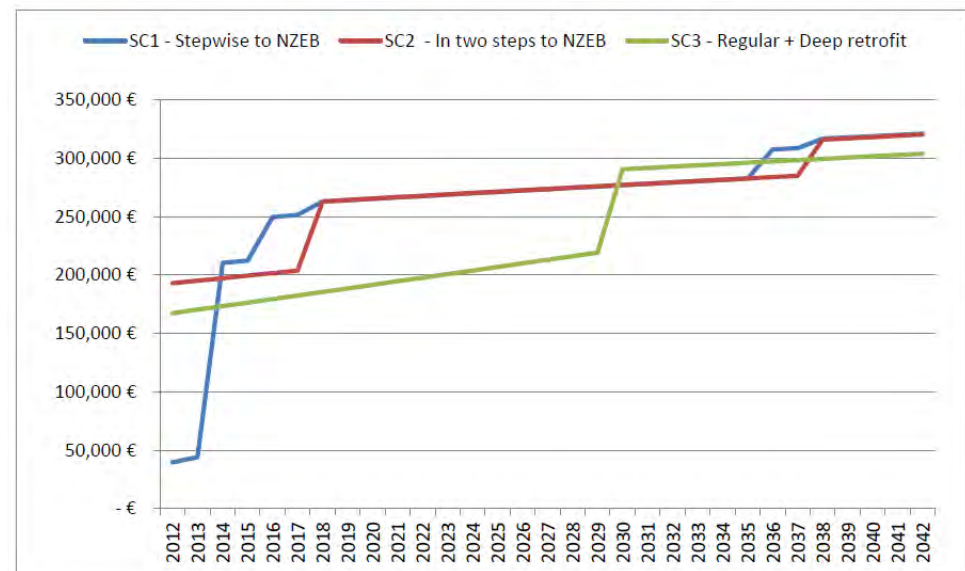
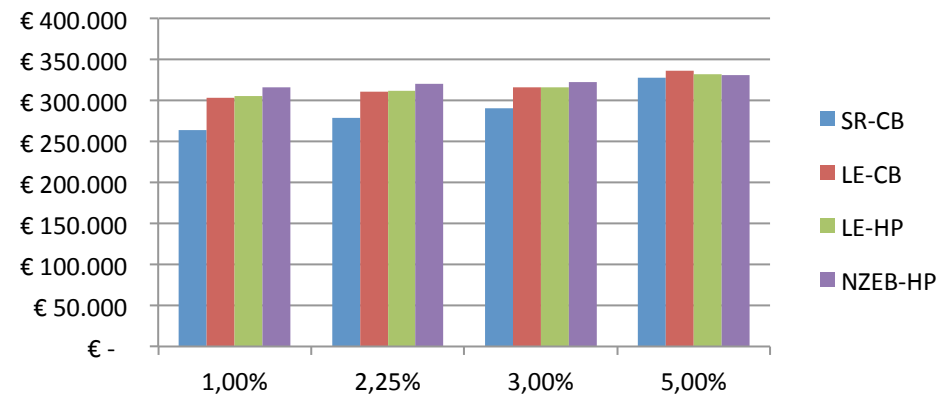
■ Other work

- Robustness
 - Sensitivity analysis
- End-of-life costs
 - Residual Value
 - Upgrade costs to NZE

- Renovating in stages

⇒ one-stop-shop.org!

NPV (30y - excl. subs.) for different energy price escalation scenarios



NZE Renovation of Houses : LCC & Environmental Impact

■ Conclusions

Real cases - Limited number

Costs

High investment <-> Residual Value
Sophisticated systems -> Maintenance
Case per case – New Build Level

Trade-Off

Environmental
Impact

Energy consumption is dominant
At NZE -> importance of materials

NZE

Reduce demand first – then on-site renewables

■ Acknowledgement

This presentation has been made possible thanks to the Brussels Institute for Research and Innovation by funding the Technological Support for Sustainable Construction and Development in the Brussels Capital Region.



VMSW
Luc Dedeyne

INNOVIRIS
ENFORCING RESEARCH
HET BRUSSELS INSTITUUT
VOOR ONDERZOEK EN INNOVATIE



*A sustainable world:
the contractor builds
and renovates
it !*

jeroen.vrijders@bbri.be