

HP4<sub>n</sub>ZEB



15.6.2015

## Life Cycle Costing

Capital cost

Renewing and  
maintenance cost

Energy  
cost

## Basis

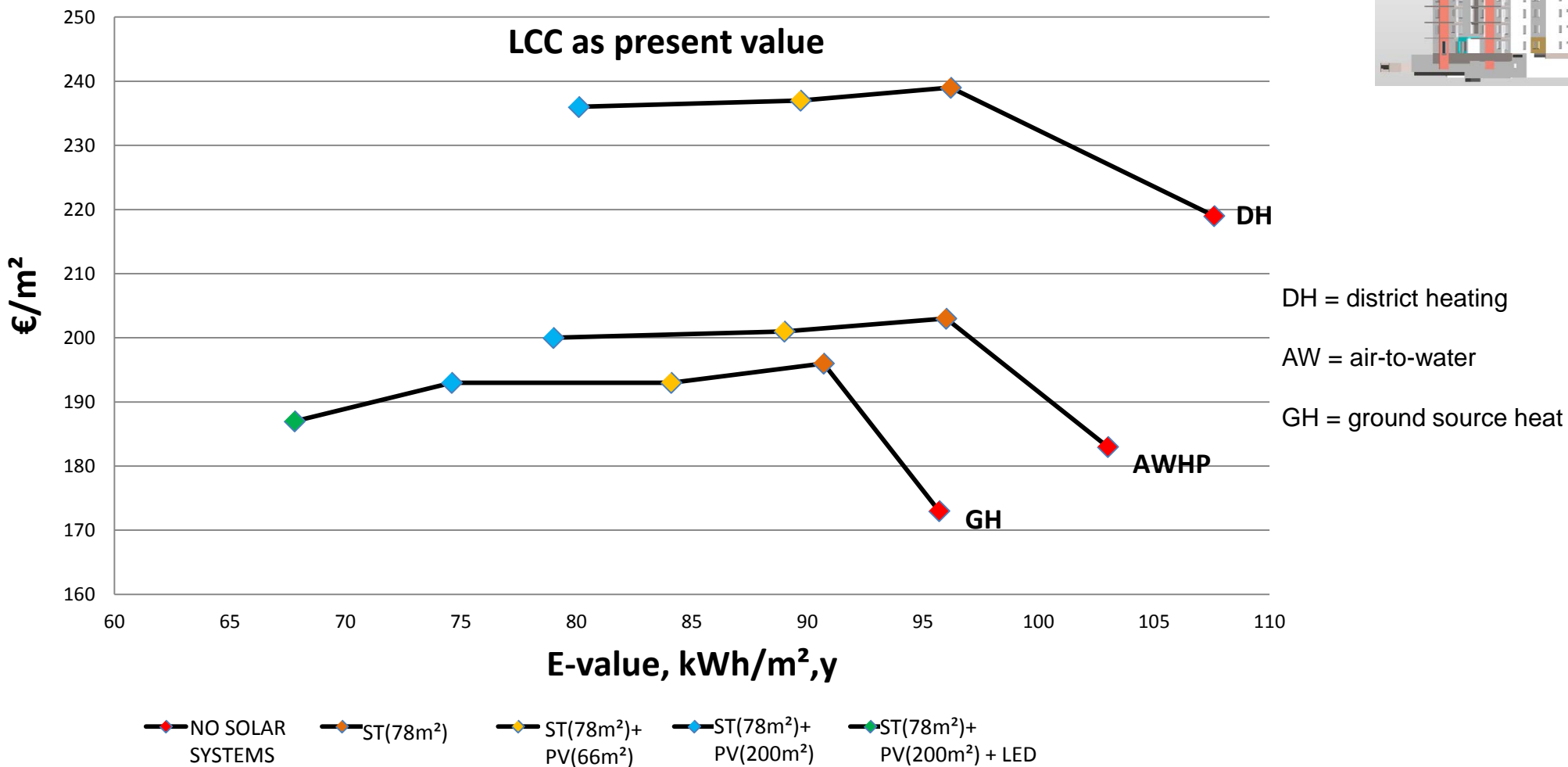
This study is based on three different types of buildings:

- a new apartment building with passive structures
- a new detached house with passive structures
- an existing apartment building, built in the 1960s.

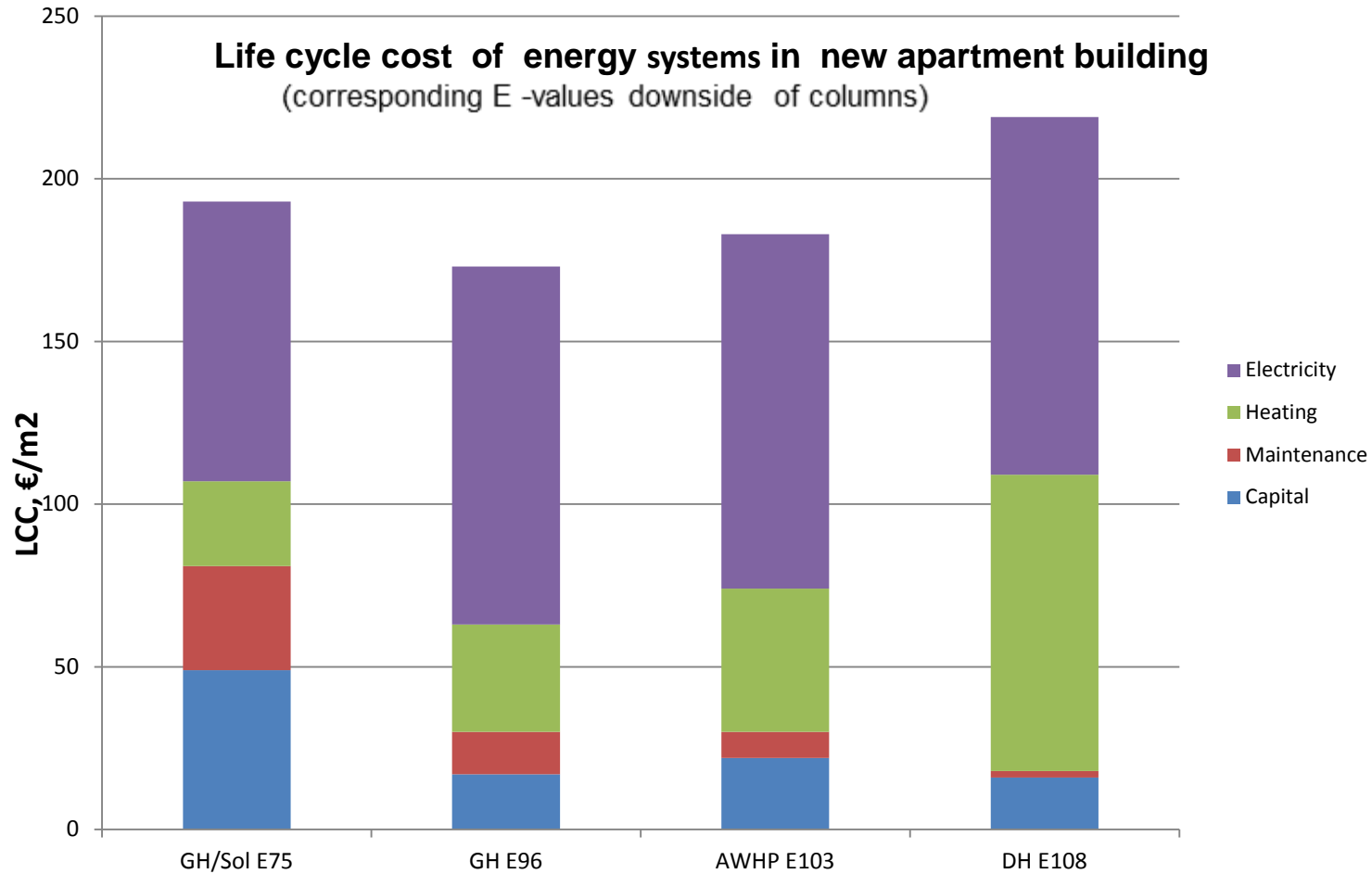
The life cycle costing is carried out during 25 year period by using net present value. The following issues have been taken into account in the calculations:

- ✓ The investment cost covering the design and construction costs collected from suppliers and literature
- ✓ Capital cost (= investment cost + renewing cost – residual value)
- ✓ Service and maintenance cost
- ✓ Heating energy cost based on the average month tariffs and the average basic fees (Vantaan Energia Ltd. 3/2015)
- ✓ Electrical energy cost (based on the prices of Vantaan Energia Ltd. 6/2014)

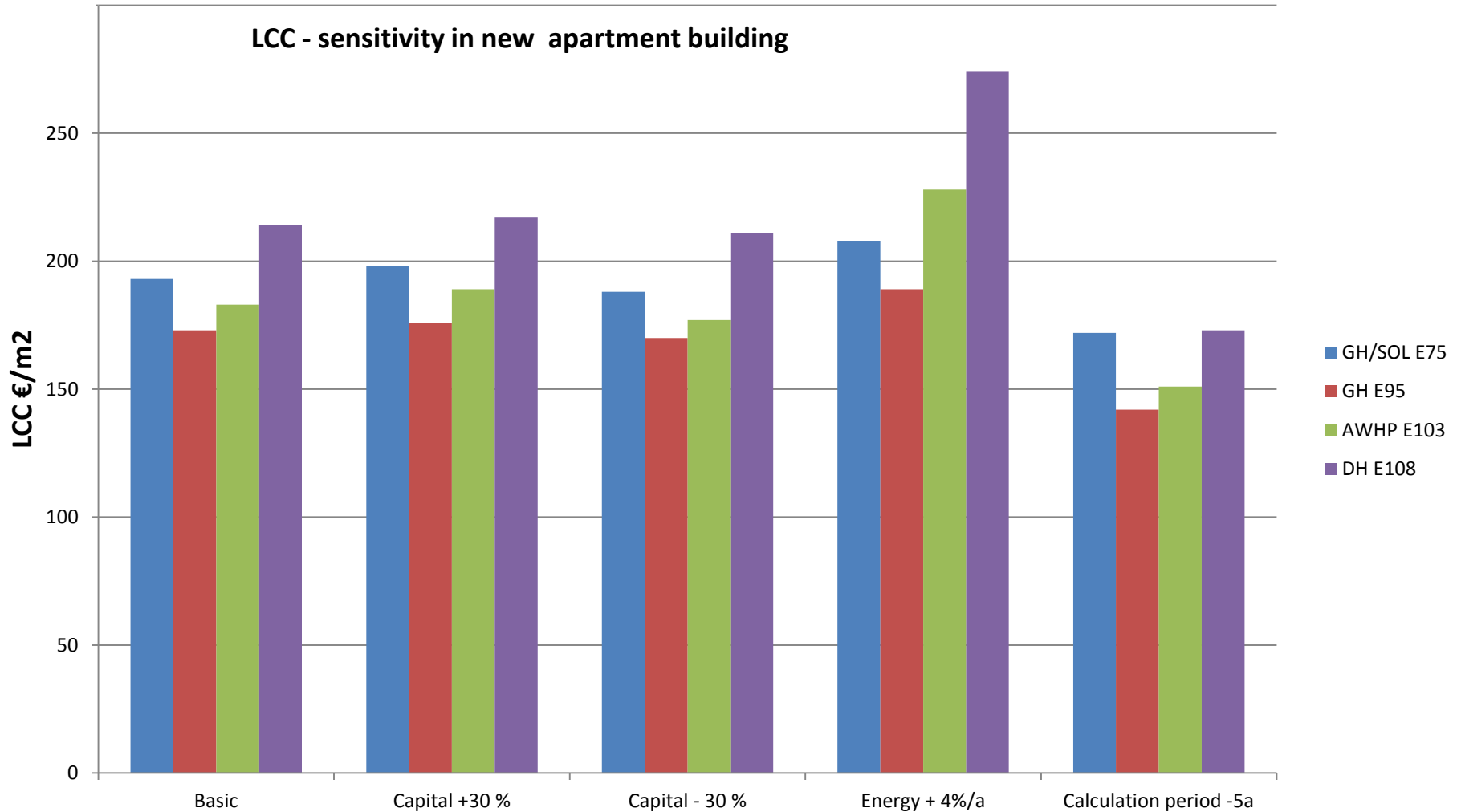
Results have been presented from owner's and users point of view (micro economic calculation).



*Results show that only maximal utilization of solar energy is worth LCC comparison in connection to heat pump systems. And for example LED lightning system is in all cases a way to economical lowering of E value.*



GH = ground source heat, AW = air-to-water, DH = district heating, Sol = solar energy



HP = heat pump, GH = ground source heat, AW = air-to-water, DH = district heating, Sol = solar energy

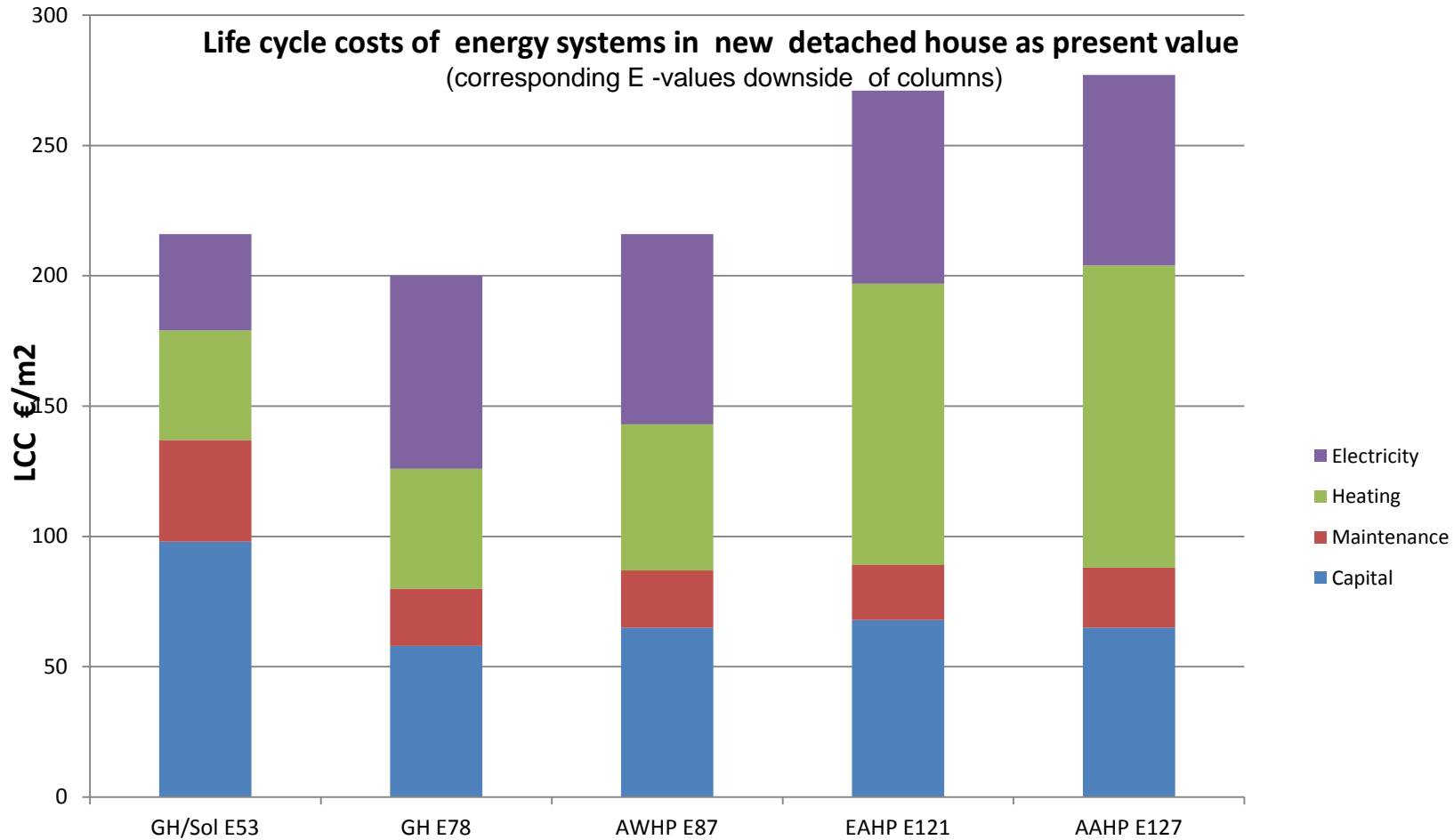
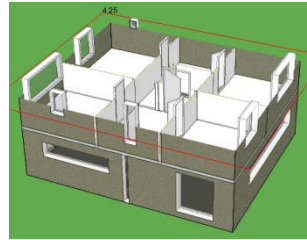
*The order of alternatives does not change in any sensitivity factors. The importance of changes in energy costs clearly bigger than capital costs.*

GH = ground heat,, DH = district heating, Sol = solar energy

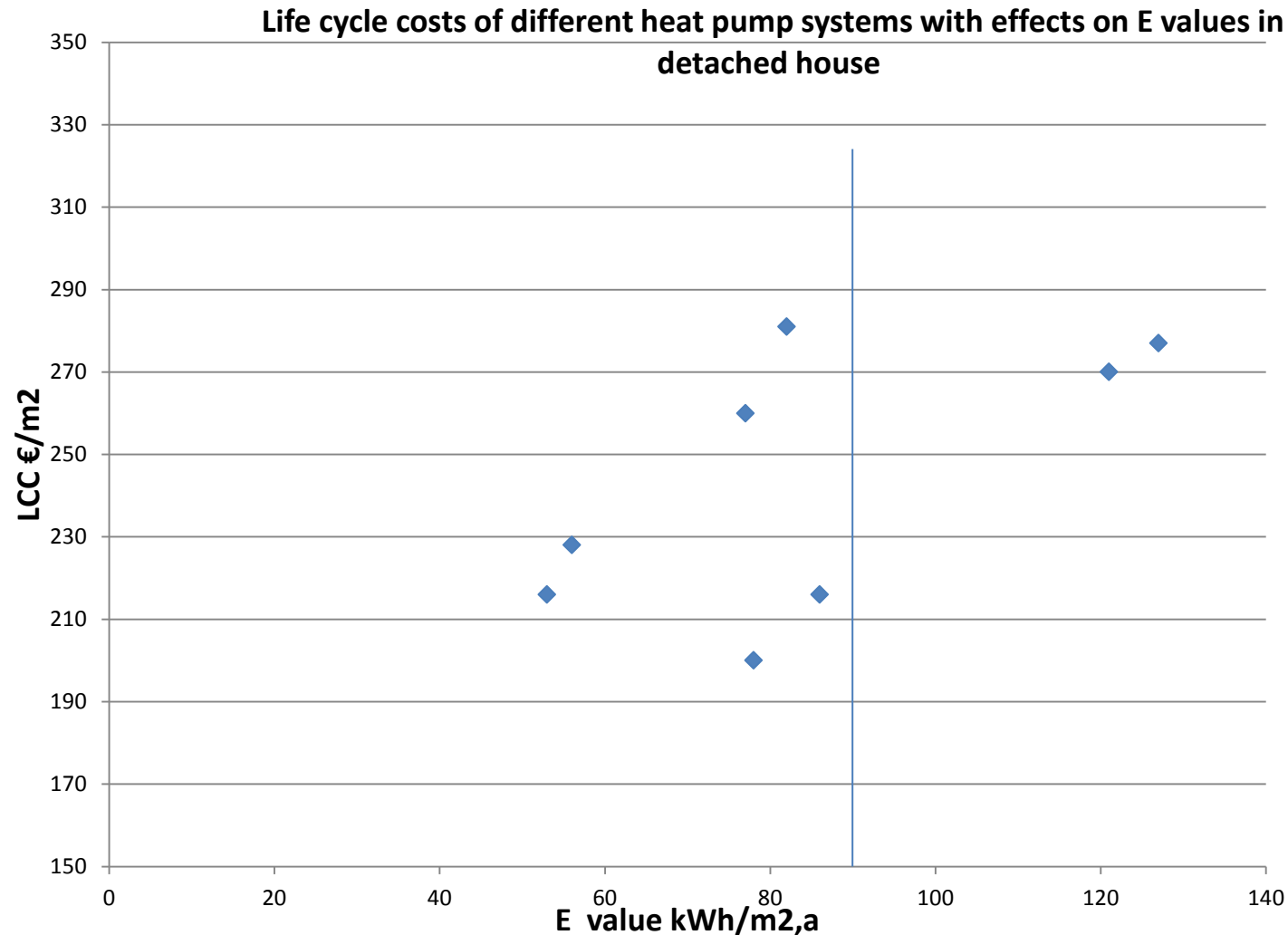
		HP4nZEB			Checking points		
<b>New Apartment building</b>							
	Unit	DH	GH	GH/SOL	Planning	Construction	Use
<b>Life Cycle Economy</b>							
Investment cost	€/m <sup>2</sup>	27	25	60			
Annual life cycle cost	€/m <sup>2</sup> /v	8,8	7,5	7,6			
ROI	%/v		100	4,8			
Pay Back Time	years		0	9			
<b>Inner circumstances</b>							
Inner climate class	Class	S2	S2	S2			
<b>Energy efficiency</b>							
Energy class	Class	C	B	A			
E	kWh/m <sup>2</sup> ,a	108	96	75			
Share of renewable energy	%	0	29	43			
Heating energy	kWh/m <sup>2</sup> ,a	91	33	26			
Electrical energy	kWh/m <sup>2</sup> ,a	110	110	86			

*When utilizing results of this study in choice of heating system it is worth to check out quality of planning and installation to confirm all targets of great importance.*

# Results –new detached house



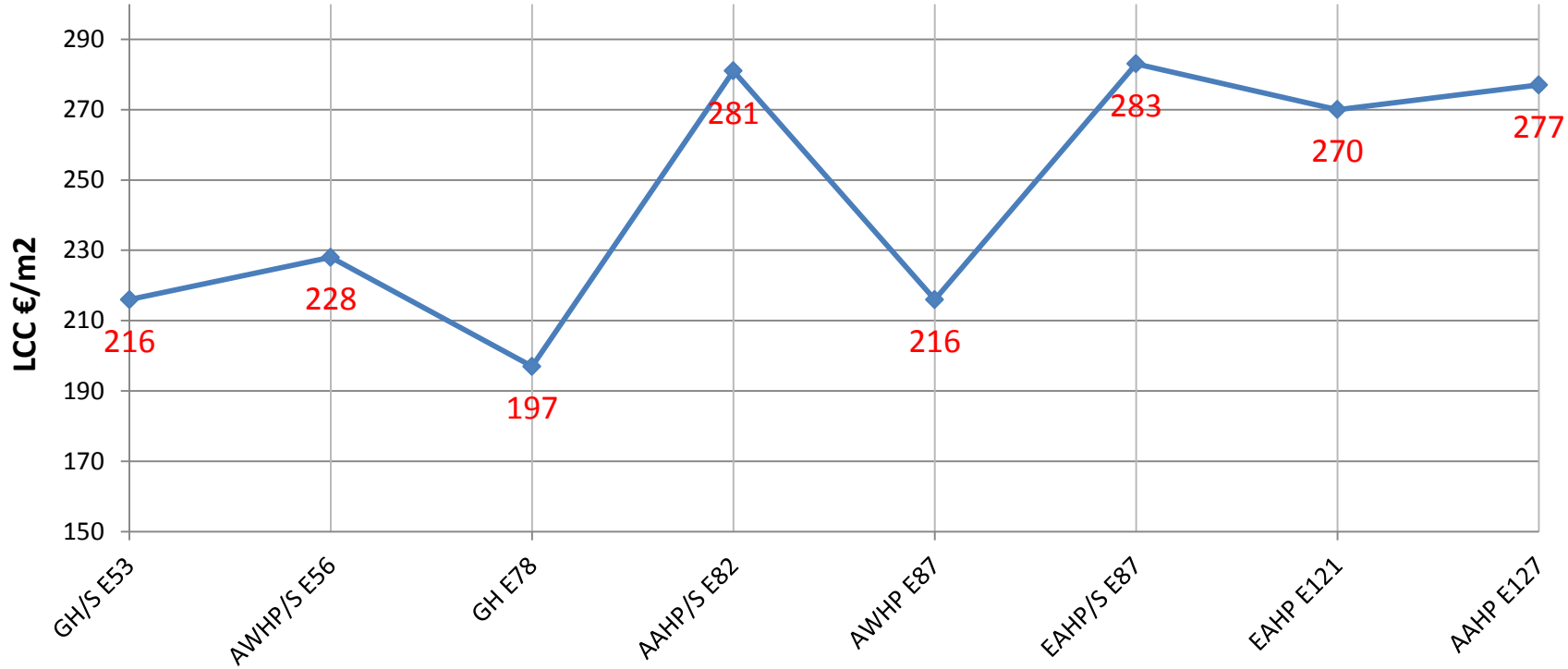
GH = ground source heat, AW = air-to-water, DH = district heating, EA = exhaust air, Sol = solar energy



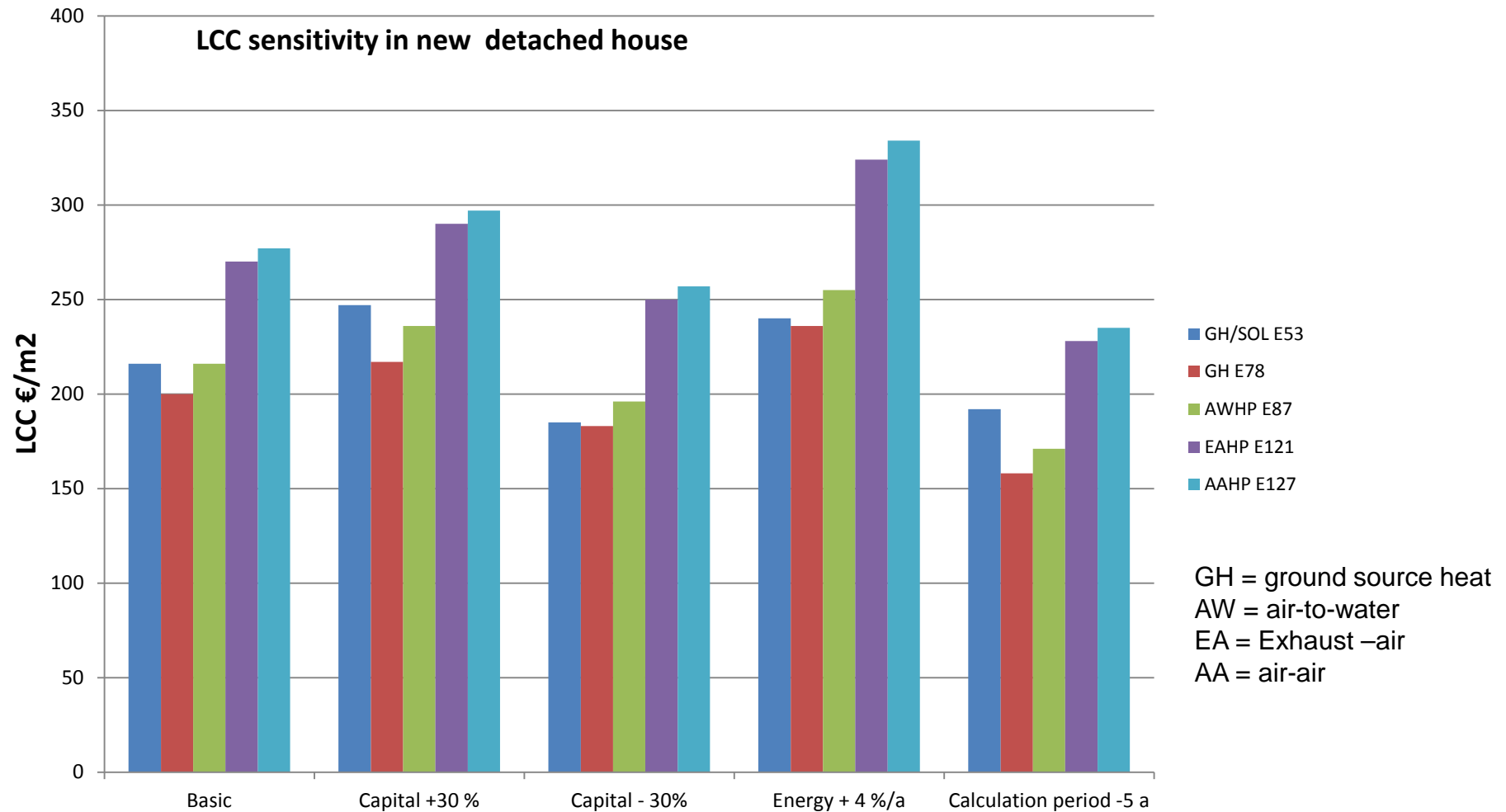
*Both ground and air water heat pump solutions make it possible to achieve lower total energy consumption (E value) than 90 kWh/m²,a, which means energy class A. Then ground heating and air water heat pump are most life cycle economical choices.*



**New detached house – all alternatives LCC**  
 (corresponding E-values downside of columns)



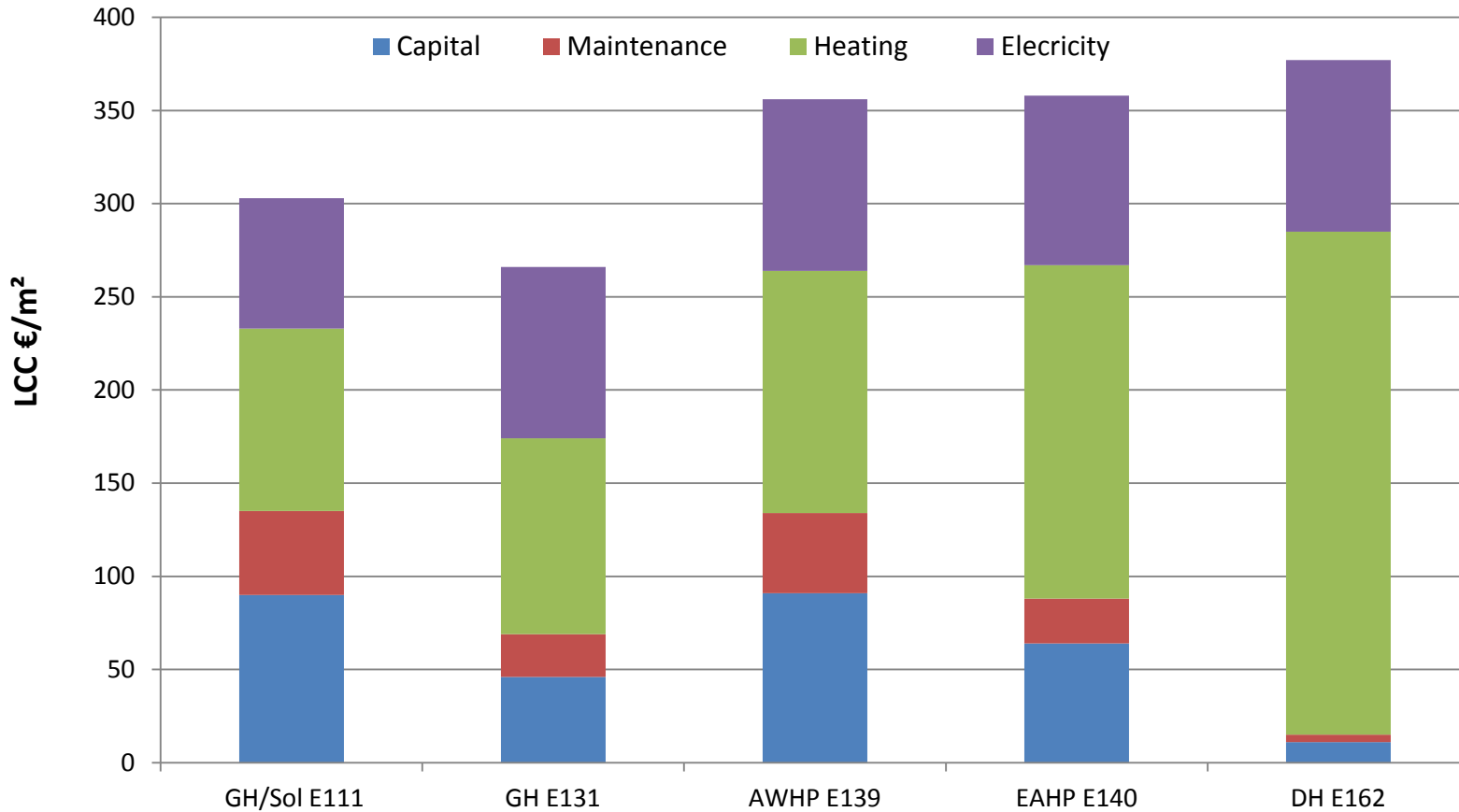
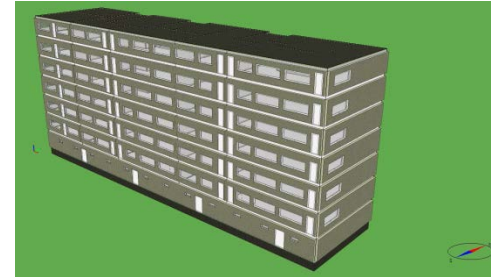
*The savings of Ground source heat (GH) and Ai water heating (AWHP) in house with 150 m<sup>2</sup> are over 10 000 € compared to air-air water pumps or exhaust-air heat pumps.*



*The order of alternatives does not change in any sensitivity factors. The importance of changes in energy costs clearly bigger than capital costs.*

# Results 1960's Apartment Building

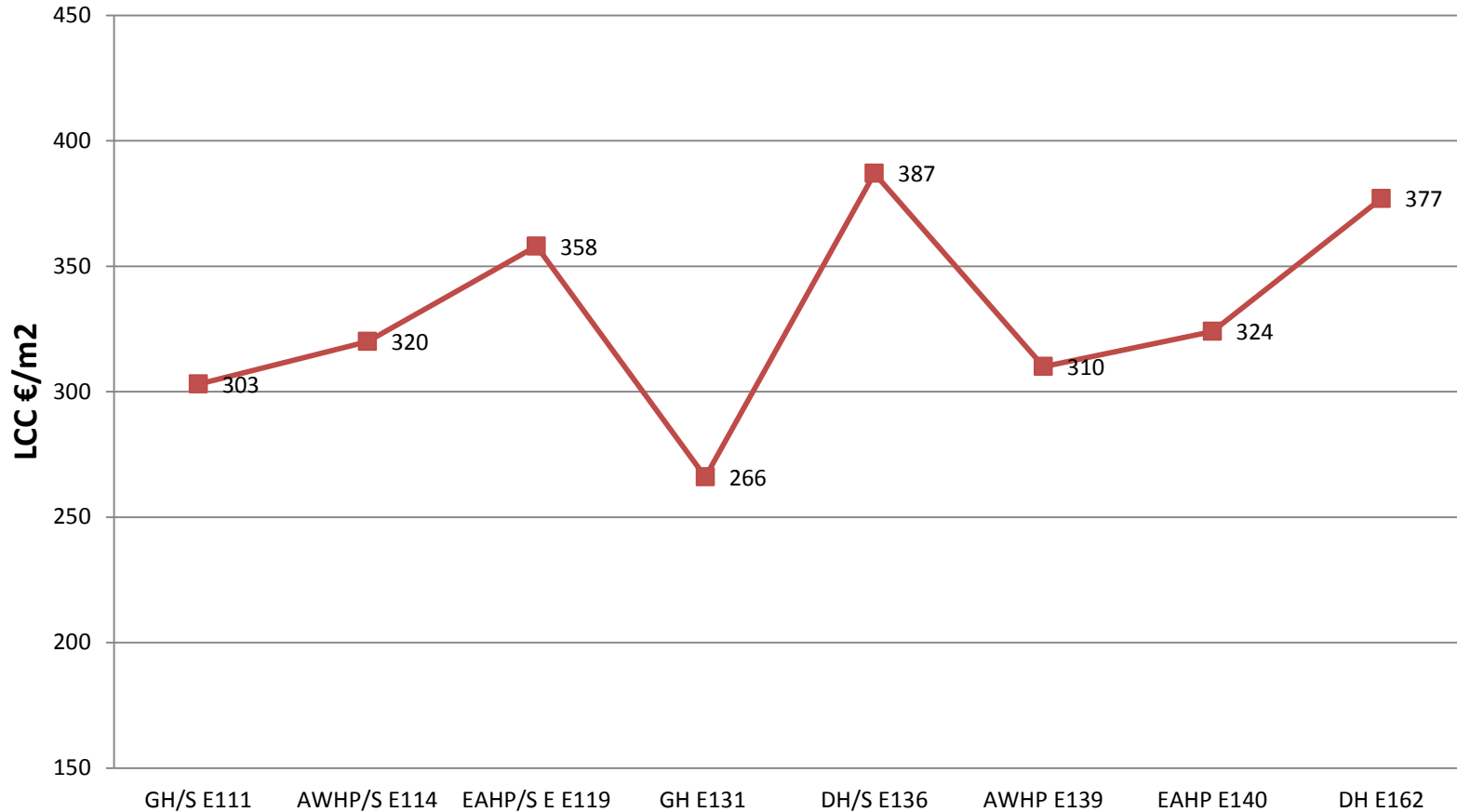
Life cycle costs of energy systems in 1960's apartment building as present value  
(corresponding E-values downside of columns)



GH = ground source heat  
 AW = air-to-water  
 EA = Exhaust-air  
 DH = district heating

## 1960's apartment building– all alternatives LCC

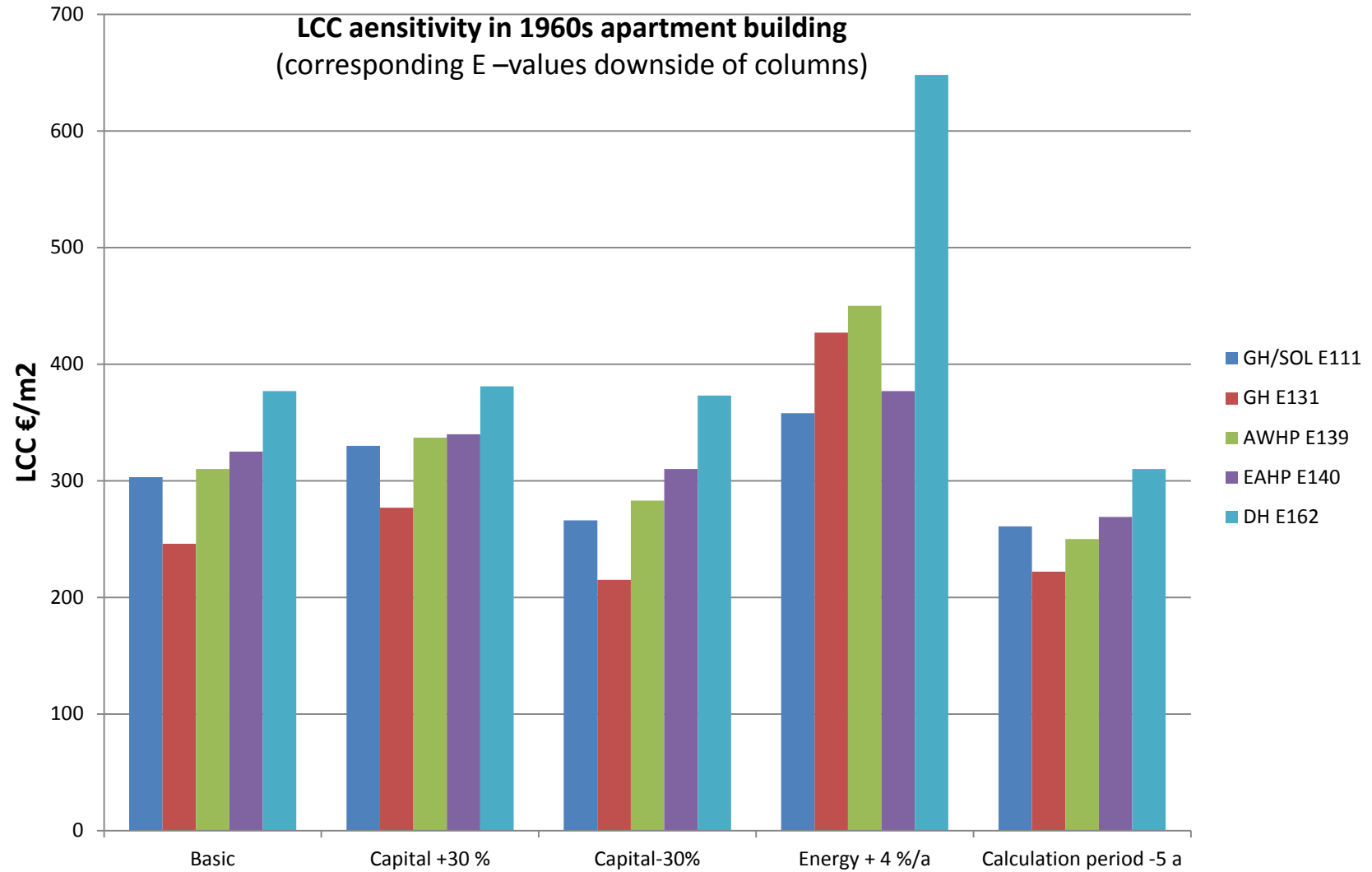
(corresponding E -values downside of columns)



GH = ground source heat  
AW = air-to-water  
EA = Exhaust-air  
DH = district heating

*The savings of ground source heat (GH) are about 100 €/m<sup>2</sup> compared to district heating (DH) and 50 €/m<sup>2</sup> compared to air-air or Exhaust-air heat pumps.*

*Only ground heating with solar panels make it possible to achieve energy class c in Finland. So usually nZEB target means also need for LED lightning system , improvement of insulation and change of windows and/or installation of mechanical ventilation in old buildings.*



GH = ground source heat  
 AW = air-to-water  
 EA = Exhaust-air  
 DH = district heating

## Conclusions

The ground heat pump is the best choice in all three different types of buildings: a new detached house, a new apartment building and an existing apartment building, built in the 1960s.

Even after sensitivity analyses the ground heat pump is the most profitable solution, when taking all life cycle costs into account. The economic efficiency of the ground heat pump is even better in two cases: when energy costs rise and/or the ground heat pump's investment costs decrease at the same time when the investment costs of district heating stay the same.

Innovative and integrated concept development is still welcome for welfare of people and to prevent climate change.



**TECHNOLOGY «FOR BUSINESS»**

