USING EXERGY ANALYSIS IN THE CONCEPTUAL BUILDING DESIGN PHASE

IEEES2 Second International Exergy, Energy and Environment Symposium, 3-7 July 2005, Kos, Greece

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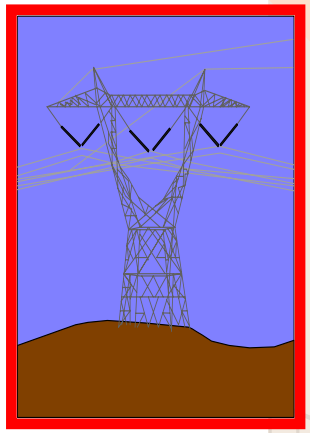
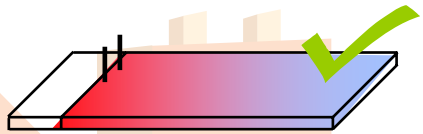
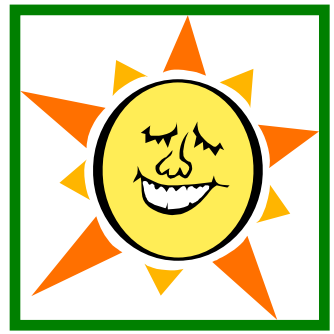
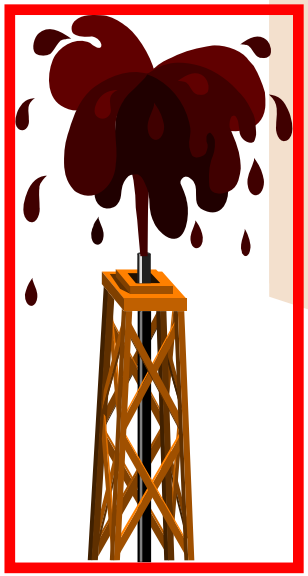
High valued energy sources

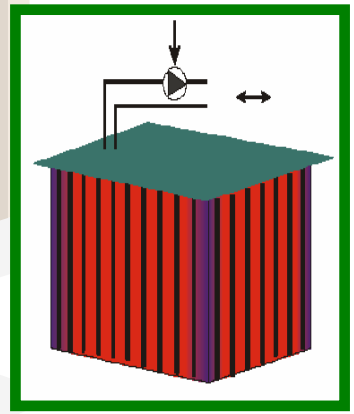
Low valued energy sources





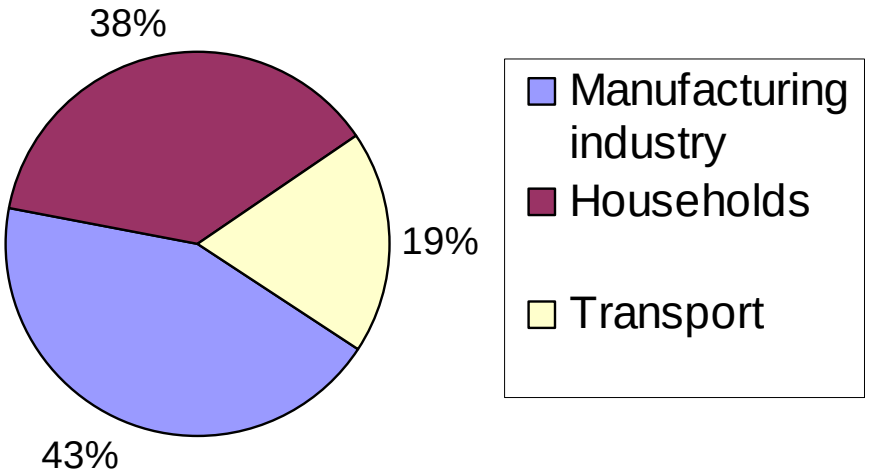




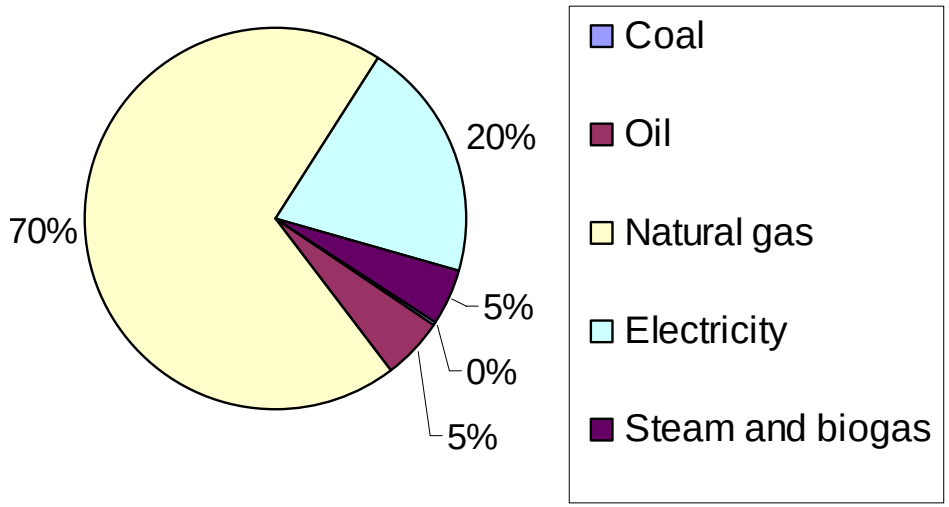


Potential for reducing energy use

Energy consumption in The Netherlands (2004)



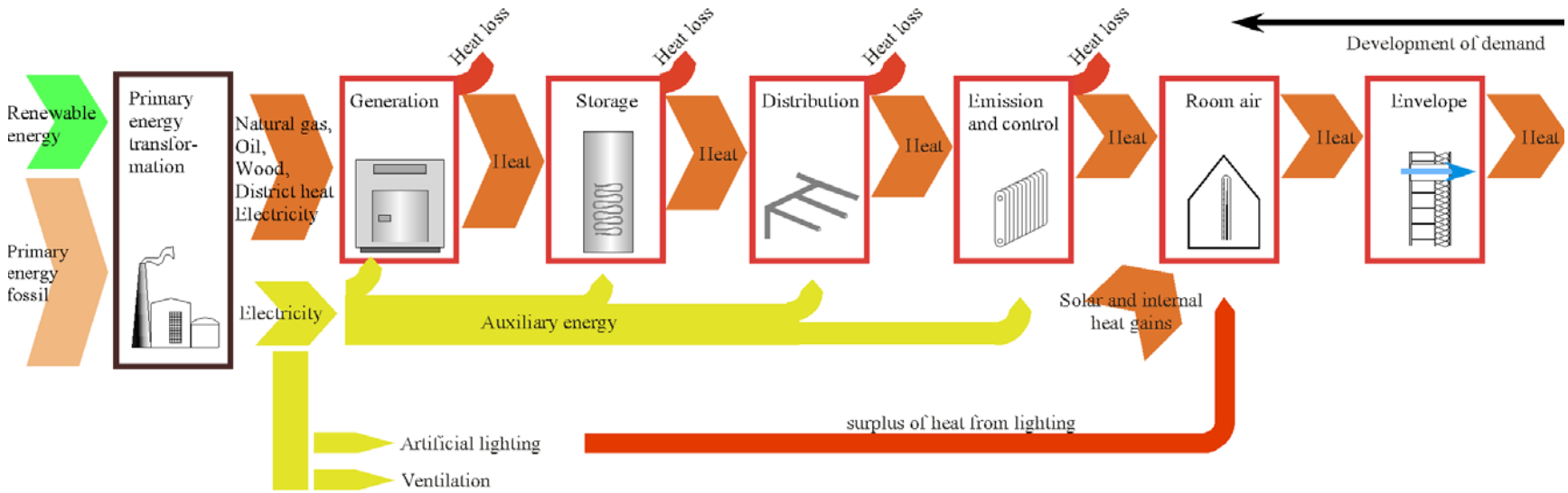
Energy consumption in households



Heat delivered to buildings -> ca. 80 ^{o}C
Indoor temperature -> ca. 20 ^{o}C

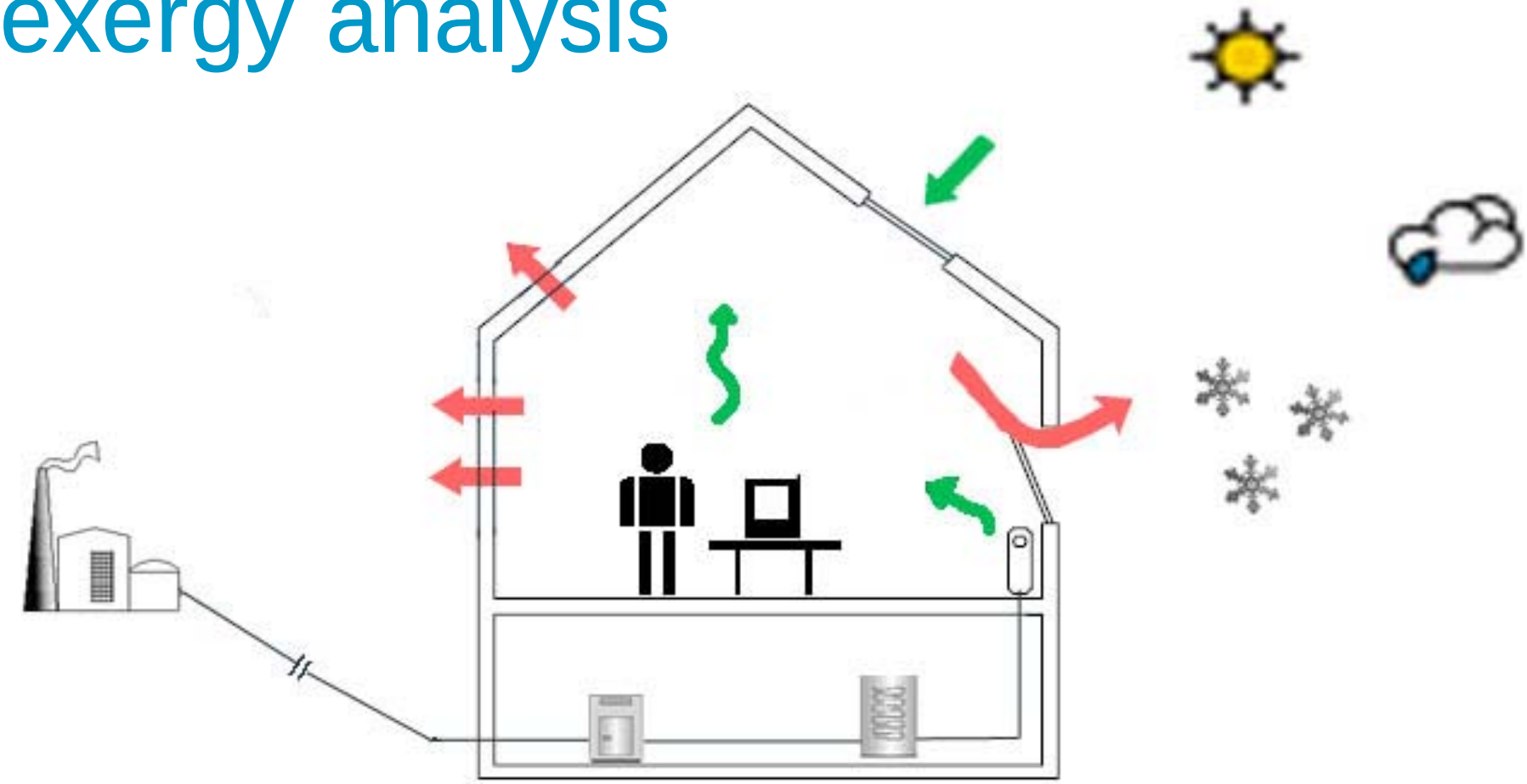
$$\frac{\text{Thermal exergy factor at 80 } ^{o}\text{C}}{\text{Thermal exergy factor at 25 } ^{o}\text{C}} = \frac{0.170}{0.016} = 10.625$$

Exergy analysis tool

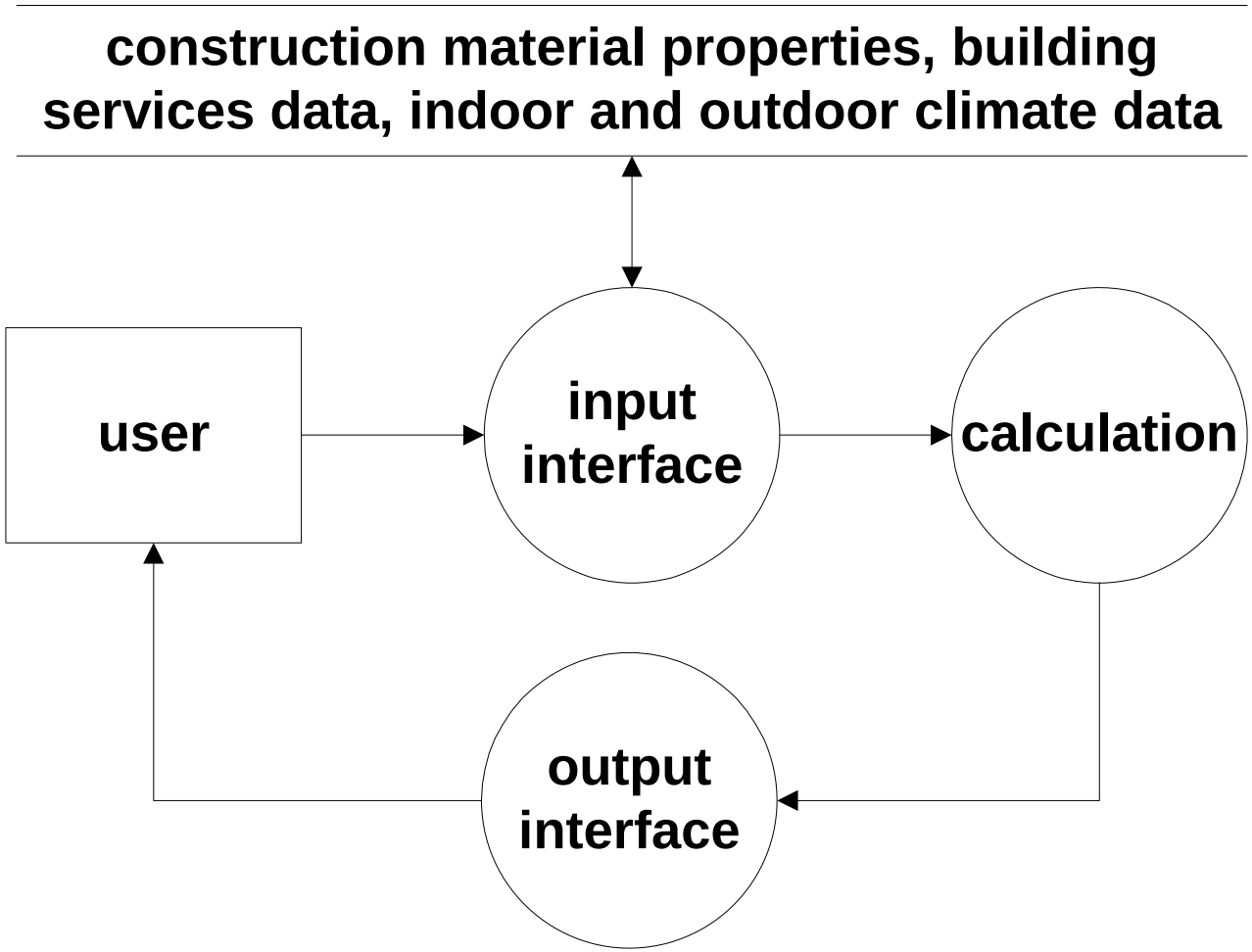


Energy & Exergy flows

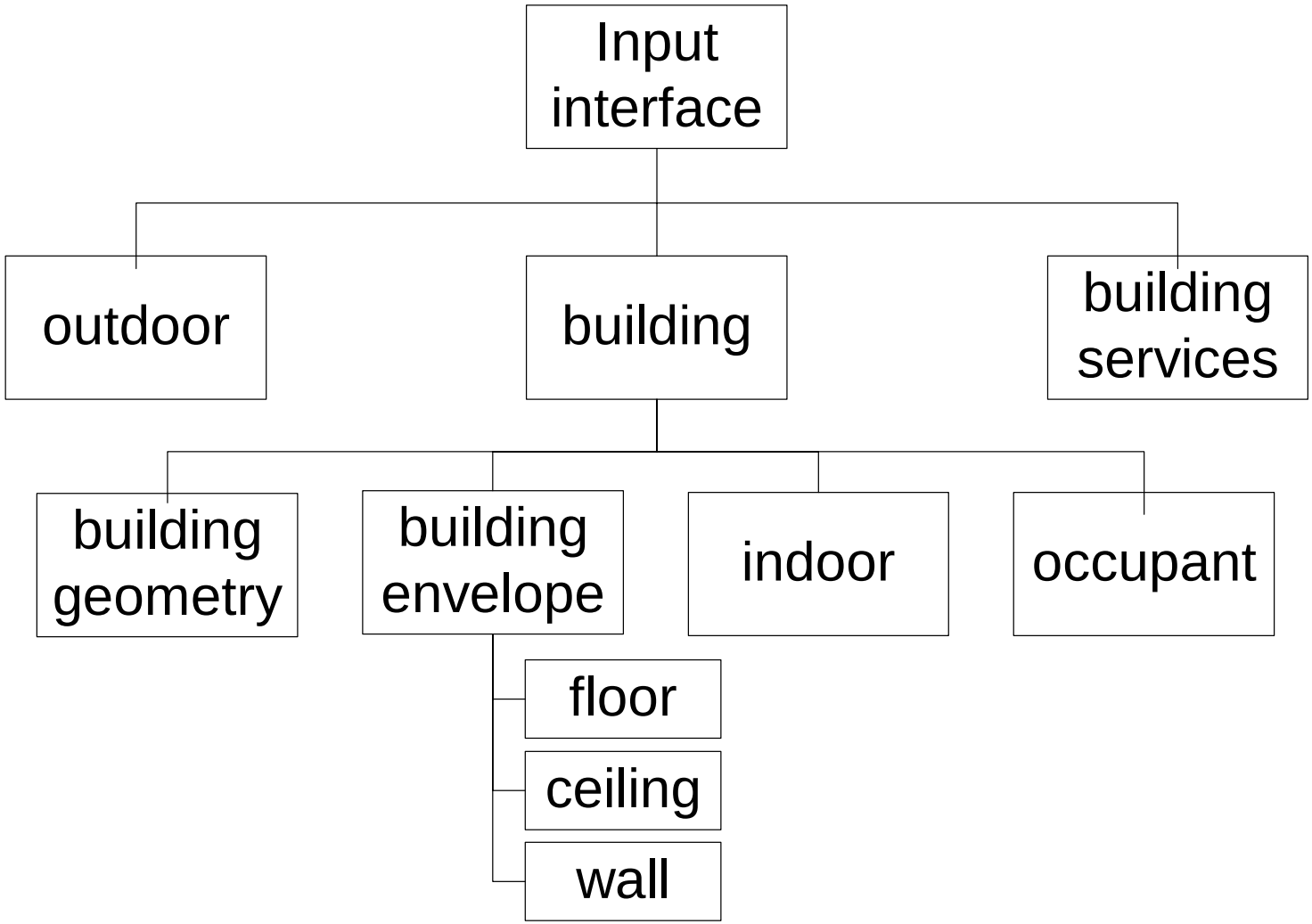
Building-centred approach to exergy analysis



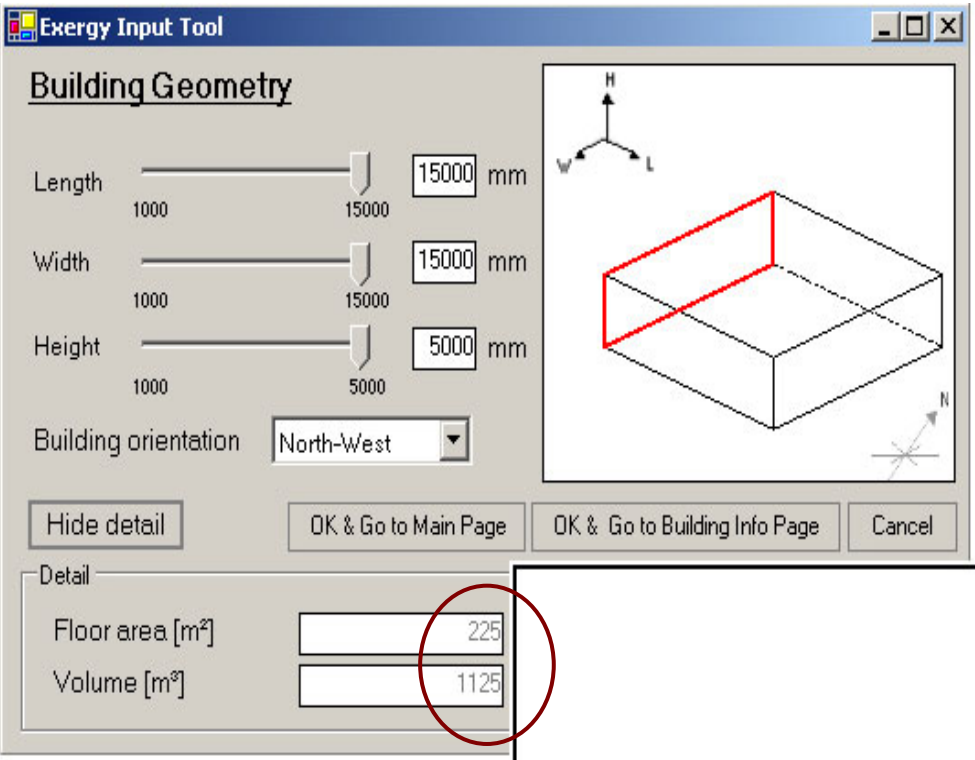
Graphic user interface (GUI)



Input of building specifications



Exergy Analysis instruments



Pre-design sheet for an exergy optimised building design

IEA ECBCS Annex 37

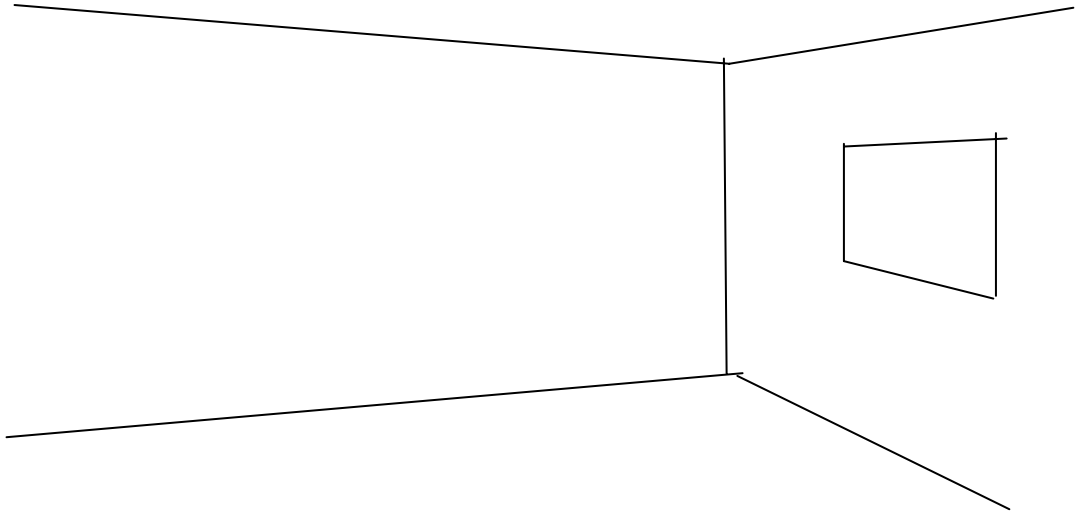
Steady state calculations for heating case

Version 2.3

LowEx

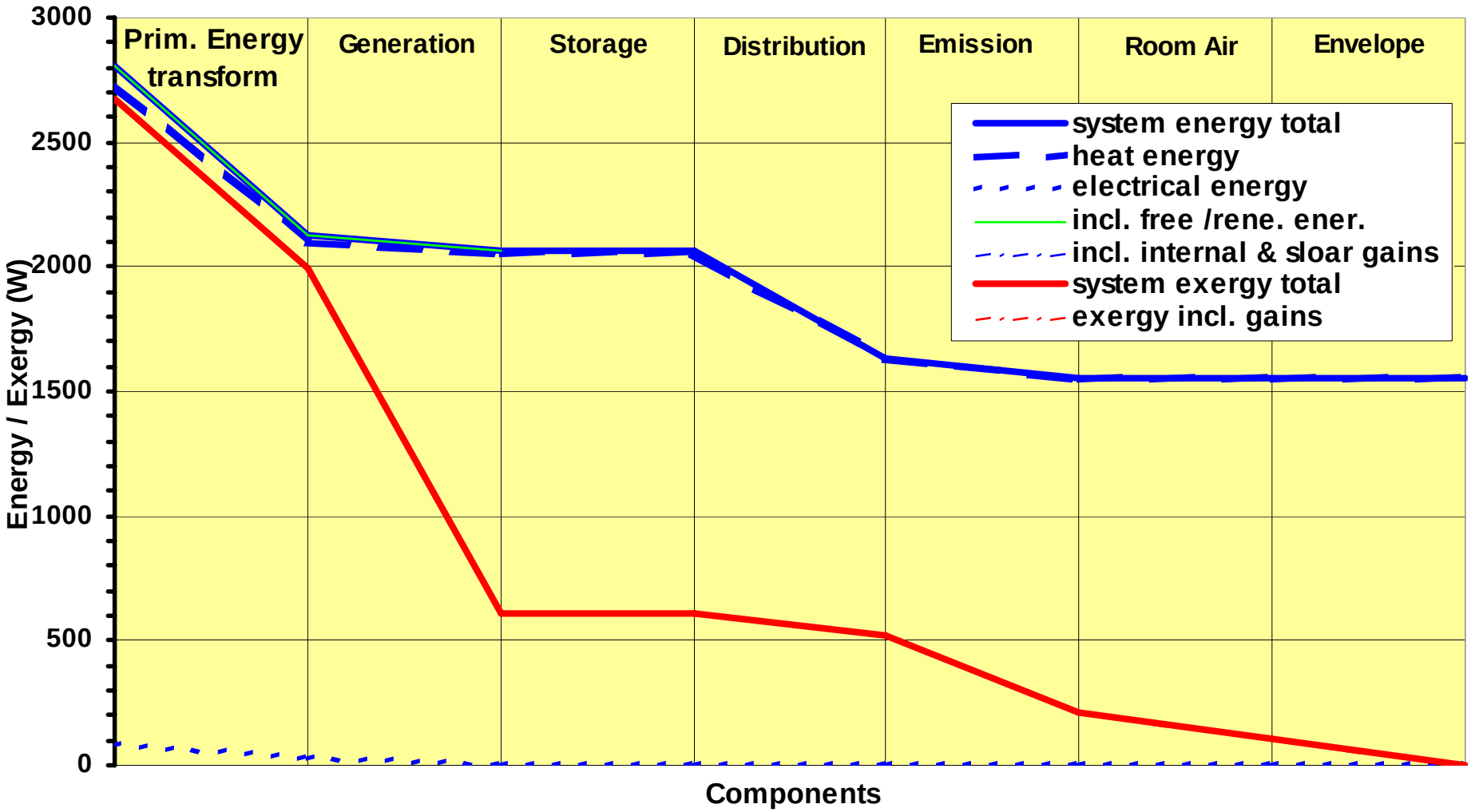
Object:	*Annex 37 basic case 1 residential; Shukuya*			Graphical input
1	**1. Project data, boundary conditions**			
2	Volume (inside) [m³]	V =	*1125*	
3	Net floor area [m²]	A_N =	*225*	
4	Indoor air temperature [°C]	θ_i =	*20*	
5	Exterior air temperature [°C]	θ_e =	*0*	= θ_{ref} Reference temperature

Example of energy & exergy calculation results



Room dimension	6 X 6 X 3 m^3
Boiler	Standard boiler (efficiency = 0.98 and supply temperature at 90 °C)
Emission	High temperature radiators, with supply at 70°C and return at 60°C
Ventilation	Natural ventilation, with an air exchange rate of n = 1.5 h^{-1}
Exterior wall	U_W = 0.4 $W/m^2.K$, A_W = 18 m^2
Window	U_{win} = 2.2 $W/m^2.K$, A_{win} = 9 m^2

Result : Exergy and energy flows



Conclusions

- The exergy analysis tool was developed to analyze energy and exergy chains in buildings.
- The GUI for the tool was designed with consideration to a building designer's perspective, with two concepts:
  - Basic design parameters are descriptively inputted into a GUI
  - Some detailed values of building service components are incorporated as default values and referred to by the respective component name.

Questions ?

THANK YOU

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