VILNIAUS GEDIMINO TECHNIKOS UNIVERSITETAS

Reinforcing cooperation with Eastern Partnership countries on bridging the gap between energy research and energy innovation

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Vilnius Gediminas Technical University, Lithuania

Energy efficient building pre-design aspects

June 2, 2015, Tbilisis, Gruzija, Sakartvelo

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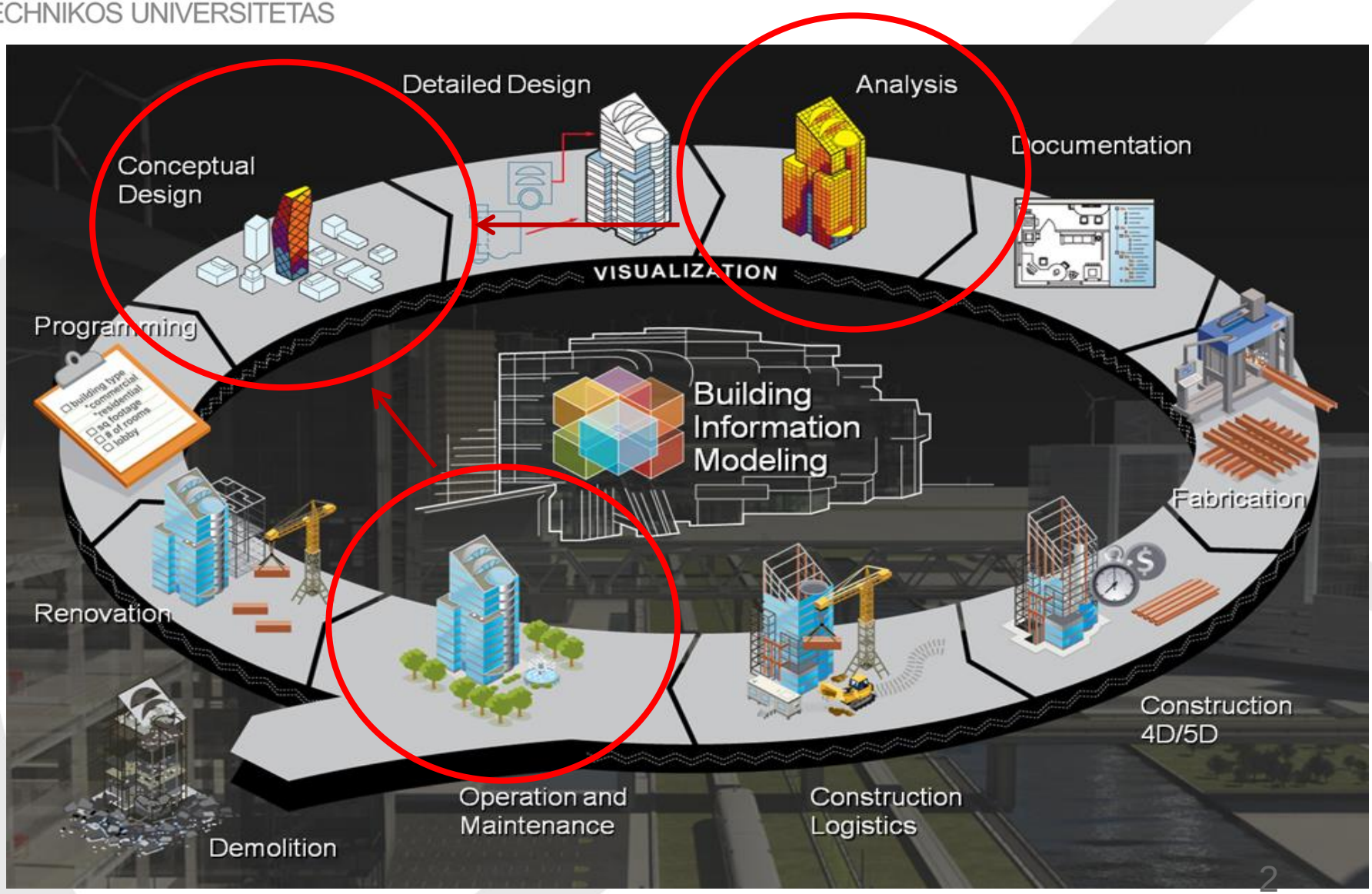
BIM CYCLE



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Benchmarks

		German Energy Savings Ordinance (EnEV 2009)		Benchmarkpool Universities and University Hospitals Building Management, State of Baden-Württemberg						
Building Code (BWZK)	Building Use	Electricity	Heat incl. Hotwater	Electricity			Heat incl. Hotwater			Area Factor
				low	mean	high	low	mean	high	Net Floor Area (NFA) Usable Floor Area (UFA)
		kWh/m²$_{NFA}$a	kWh/m²$_{NFA}$a	kWh/m²$_{NFA}$a	kWh/m²$_{NFA}$a	kWh/m²$_{NFA}$a	kWh/m²$_{NFA}$a	kWh/m²$_{NFA}$a	kWh/m²$_{NFA}$a	m²$_{NFA}$/m²$_{UFA}$
	Public Buildings									
1320	Office building with higher level of M&E installations	40	85	11	30	53	75	124	173	1,33
1350	Data Centre	155	90	159	364	584	42	91	140	1,54
2100	Auditorium	40	90	30	64	88	61	116	171	1,64
2200	Buildings for Education and Research (not incl. Nr. 2210 to 2250)	65	105	0	0	0	0	0	0	1,54
2210	Departments of Humanities, Arts, Languages, Mathematics etc.	35	85	10	27	53	57	103	163	1,50
2220	Departments of Constructional Engineering, Geology or Computer Sciences	55	110	17	74	148	67	131	238	1,49

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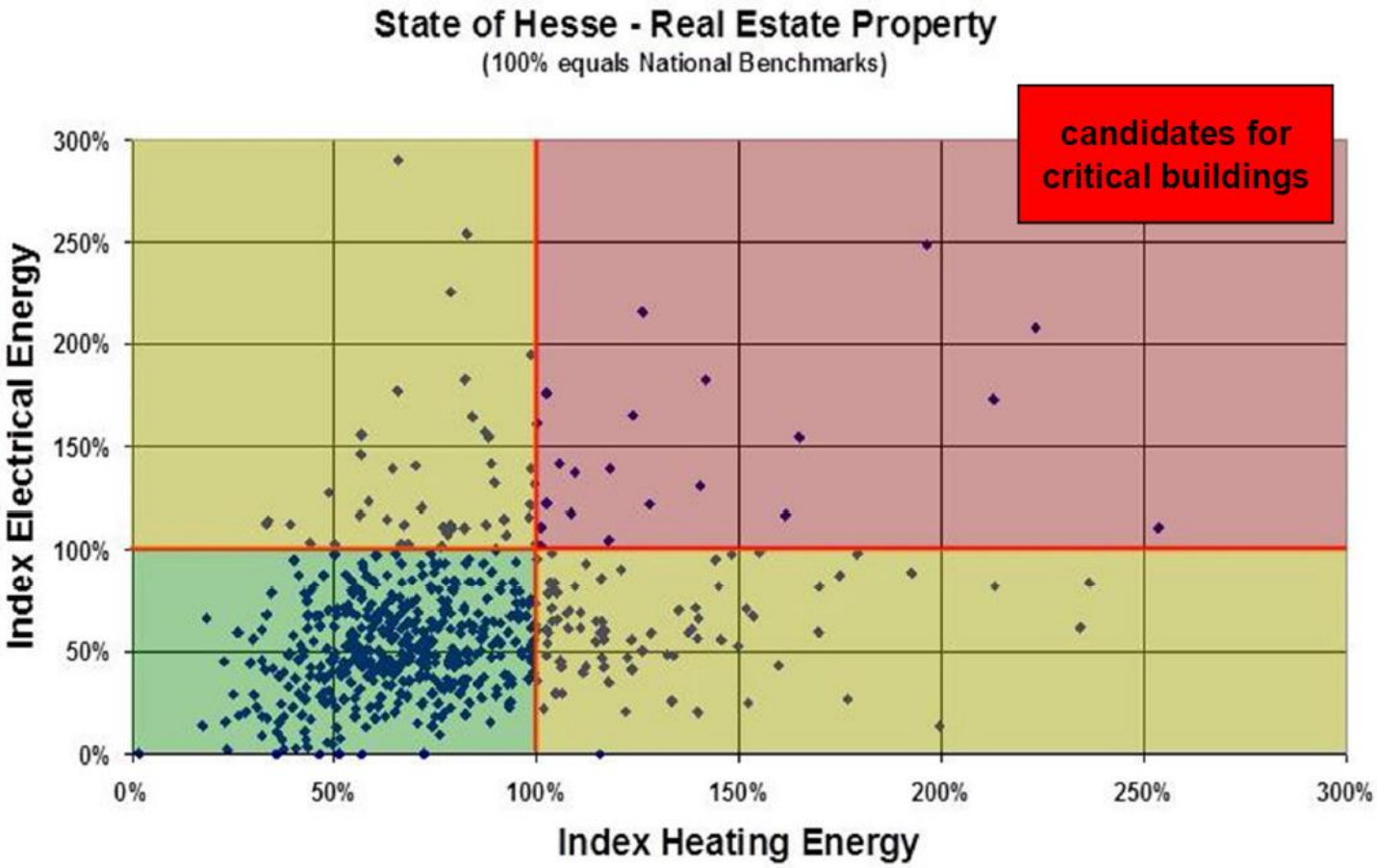
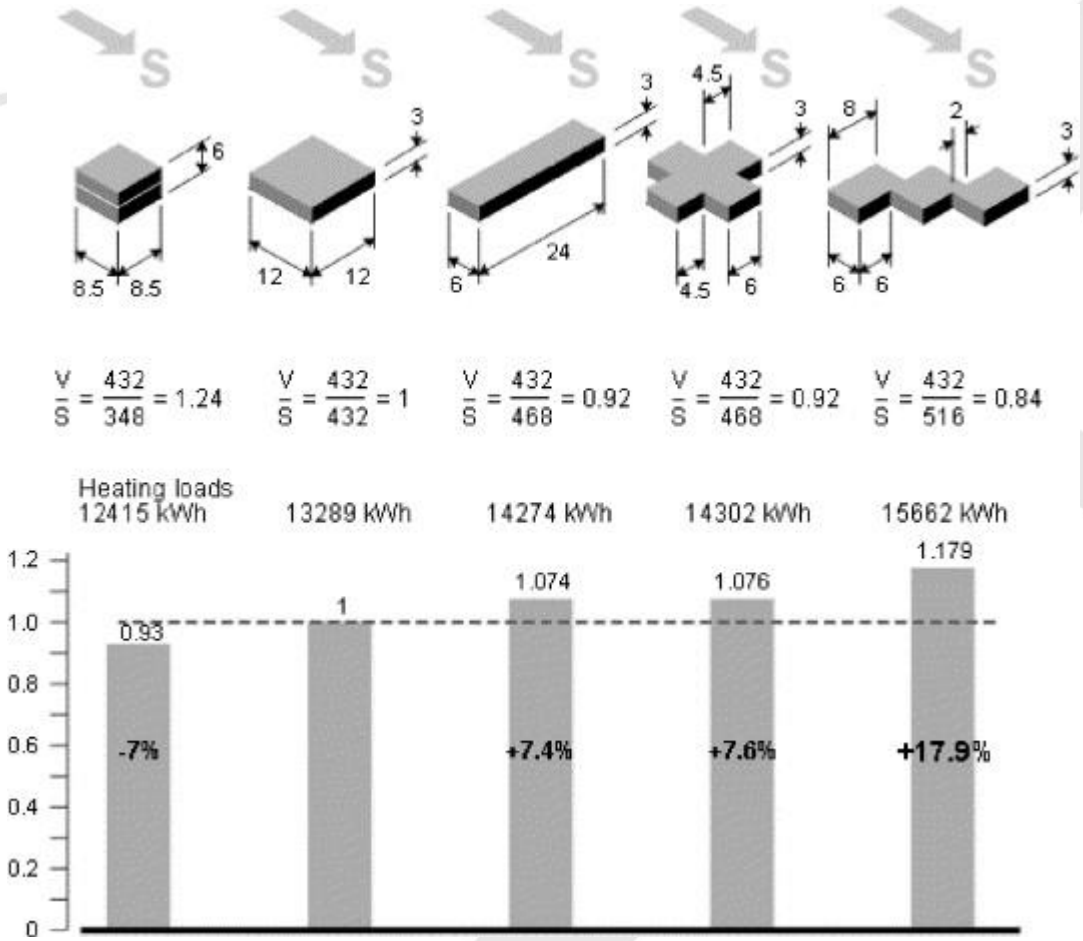
Benchmarks



Shape



(Elisabeth Gratia, 2003)

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Opaque envelopes

By European (and National) Directives:

Now for C-B energy class building U_{wall}=0,2 W/m^{2}K (residential buildings)

From 2016 – A class U_{wall}=0,12 W/m^{2}K

and from 2021 – A++ class U_{wall}=0,1 W/m^{2}K

But…

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Opaque envelopes

Ex.: Buildings' renovation in Vilnius

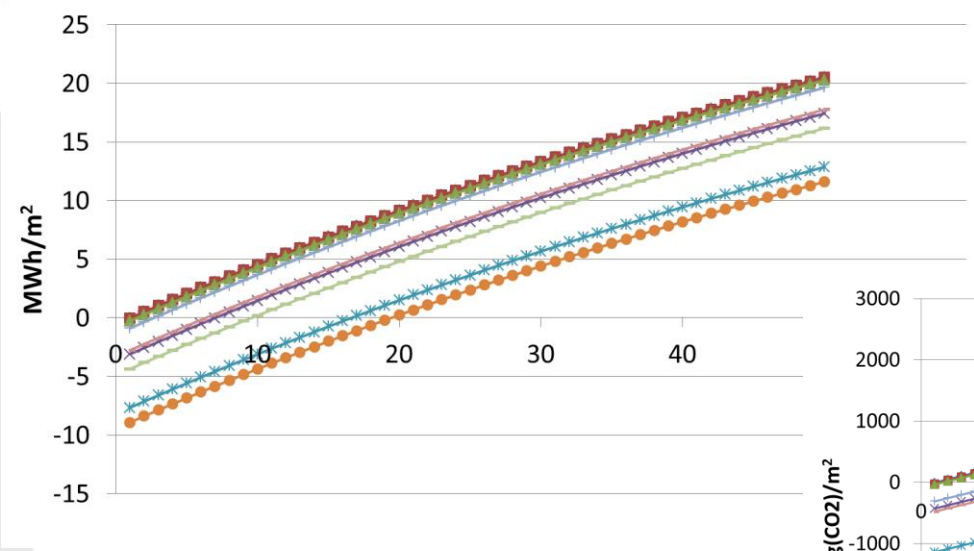
The highest investment of the total building renovation consists of the walls' insulation.

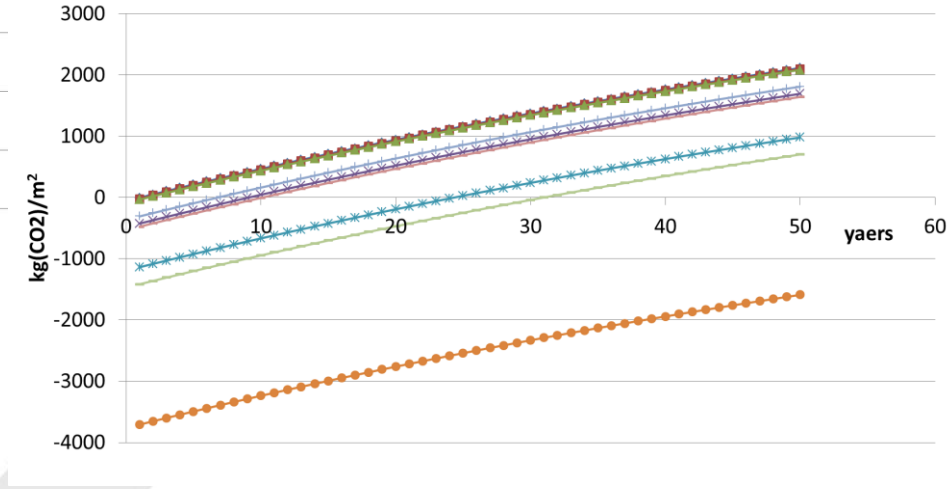
Cost of 1m^2 of the wall renovation (insulation) from "soviet" F-E energy class to B energy class is **~100 €** and with heat price **0,07 €** the simple payback is … **near 20 years**. + interest rate…so …

No payback!

Opaque envelopes

Payback of primary energy MWh/m^2 and CO_2 emission of insulation materials from B to A++ energy class

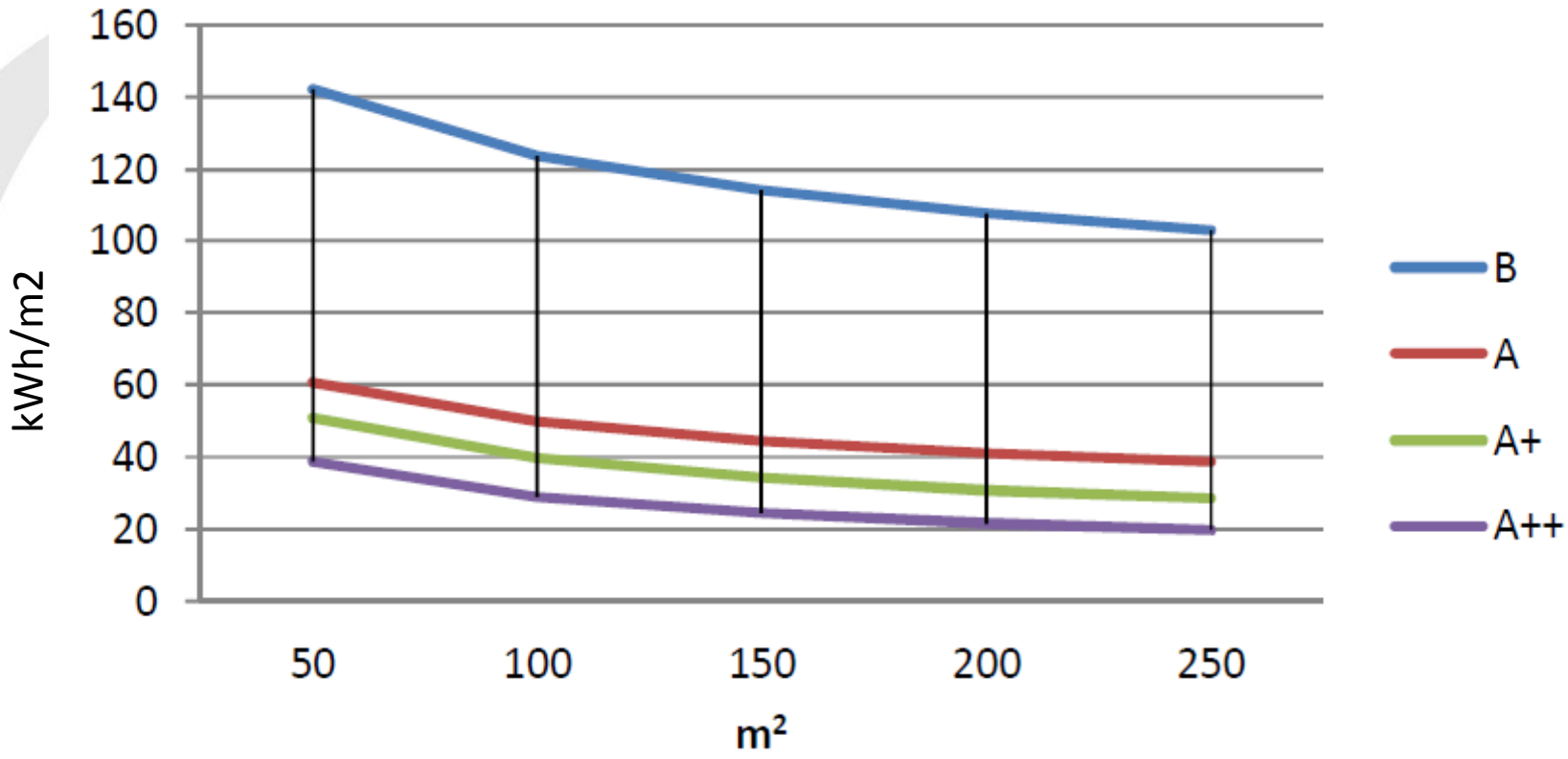




And 2 times lower U-value doesn't mean 2 times lower heat demand…

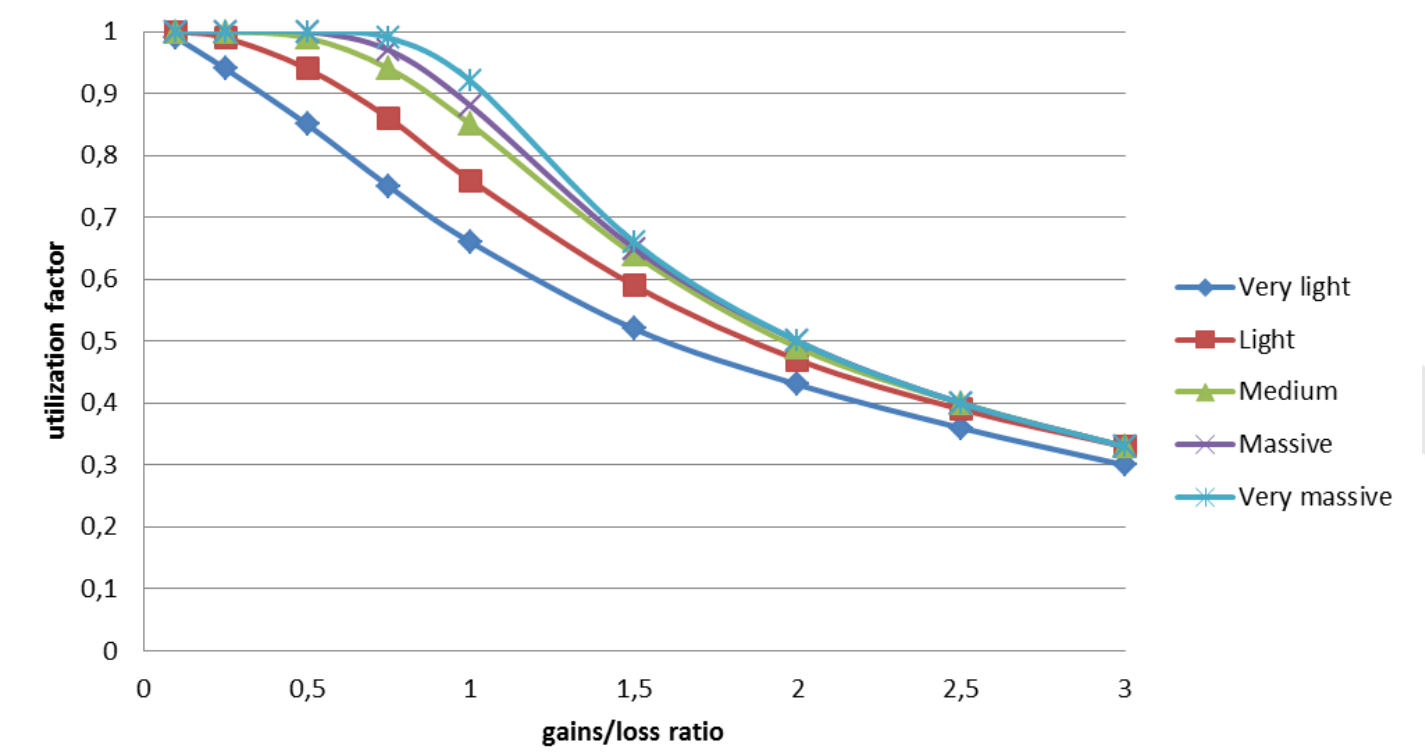
Benchmarks (LT)

Ex. Multi-flat residential - heating



Building thermal mass

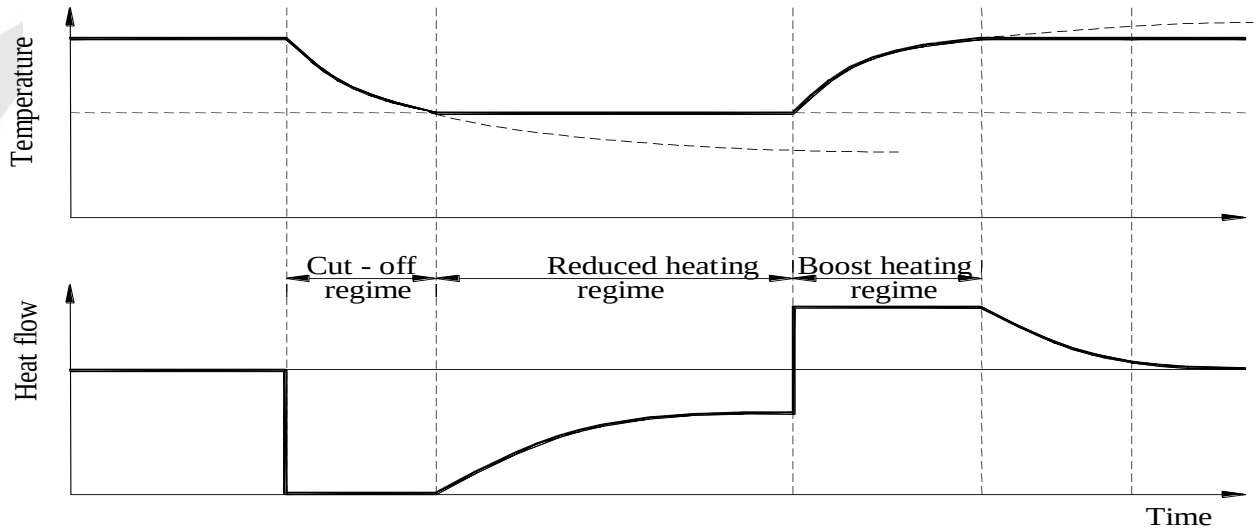
Heat gain utilization for different building mass



System control is important here too…

Building thermal mass

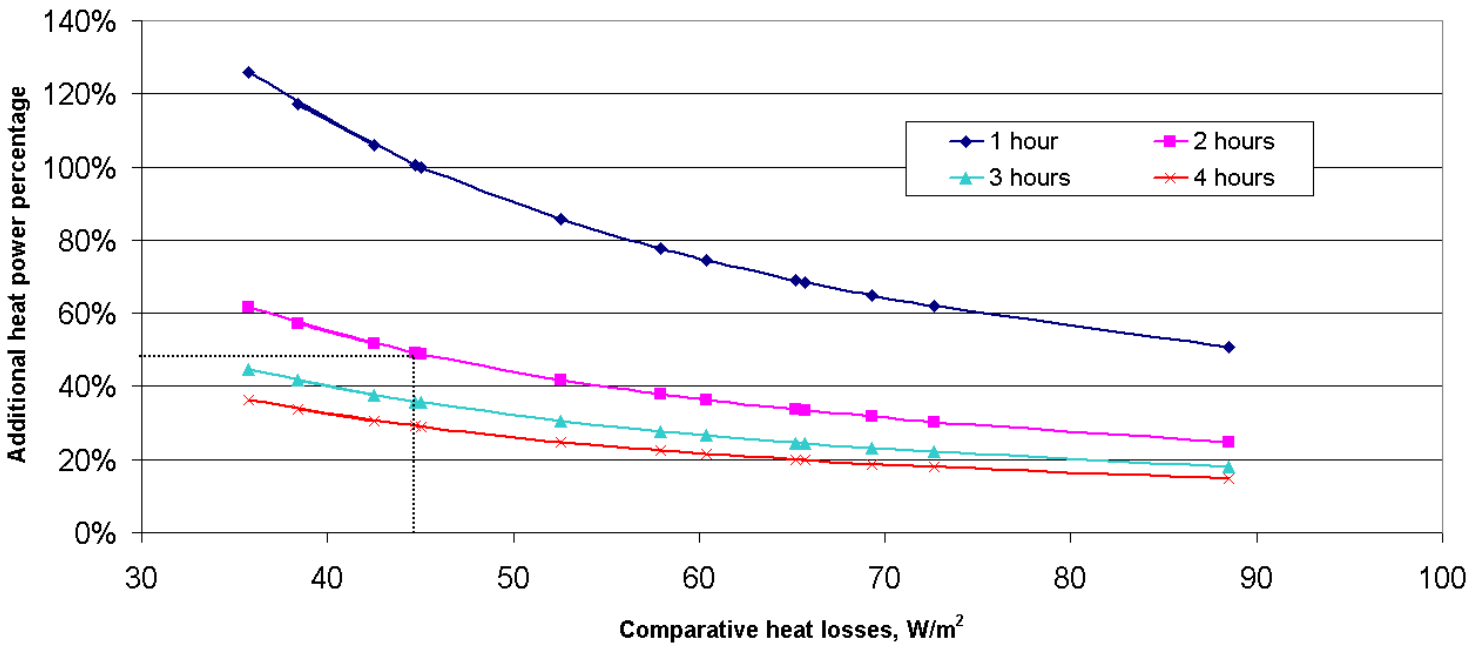
Intermittent heating



The boost heating period is always required for intermittent (unsteady) heating use to achieve the design indoor temperature during the fixed period of time without influence of internal heat gains

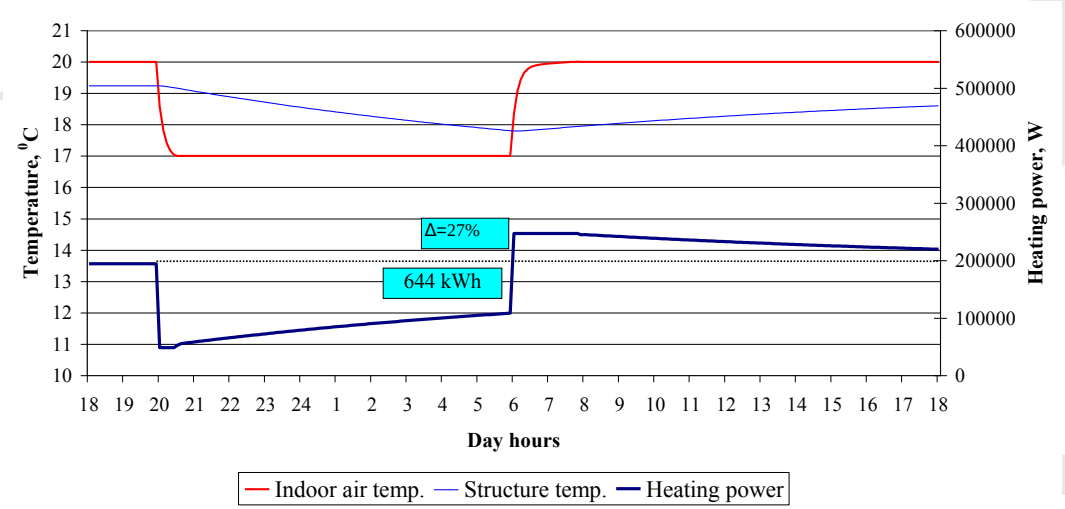
Building thermal mass

The heating power increase on behalf of intermittent heating effect is ranging from 18 % to 125 % according to temperature drop and re-heating time period for particular buildings

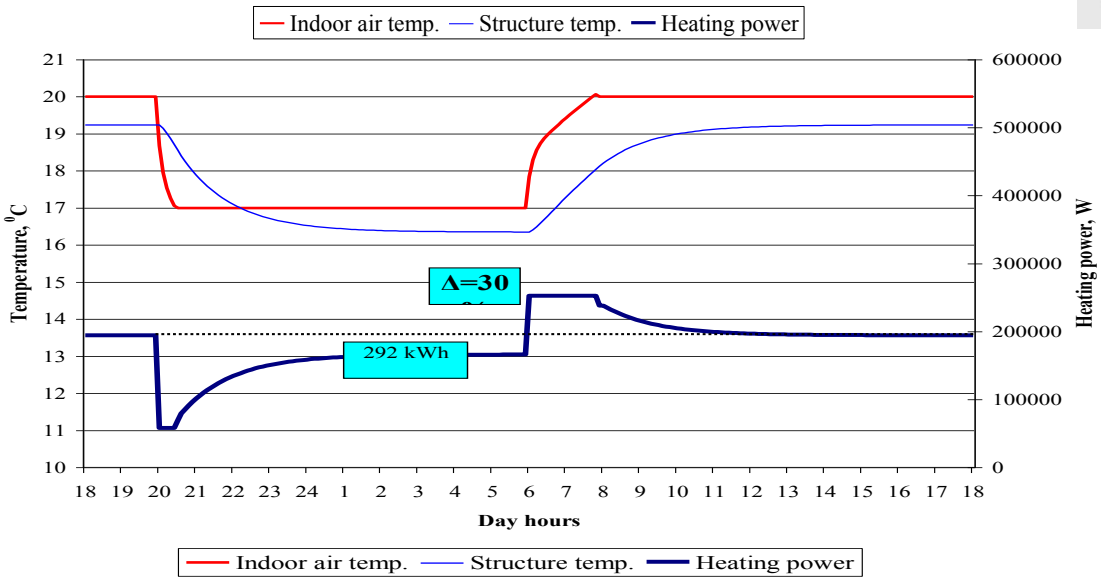


Building thermal mass

"heavyweight building"



"lightweight building"



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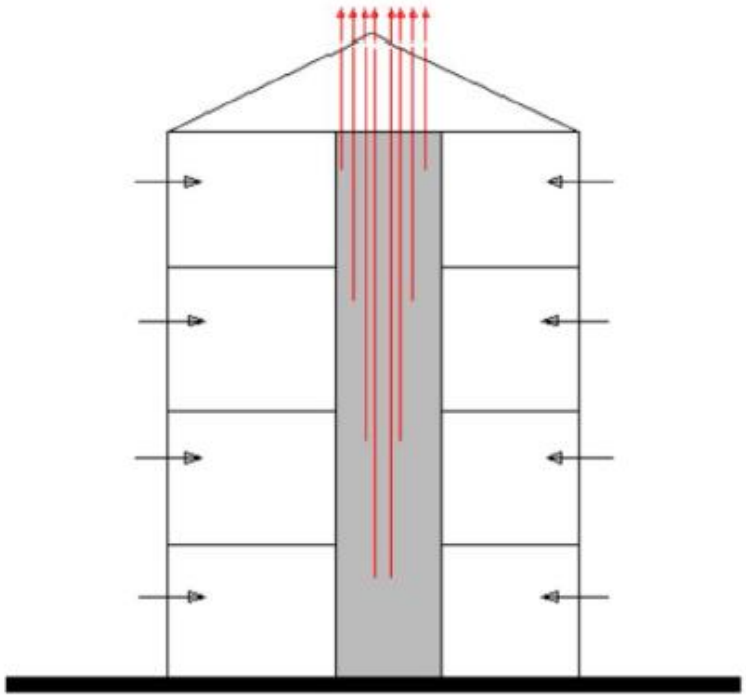
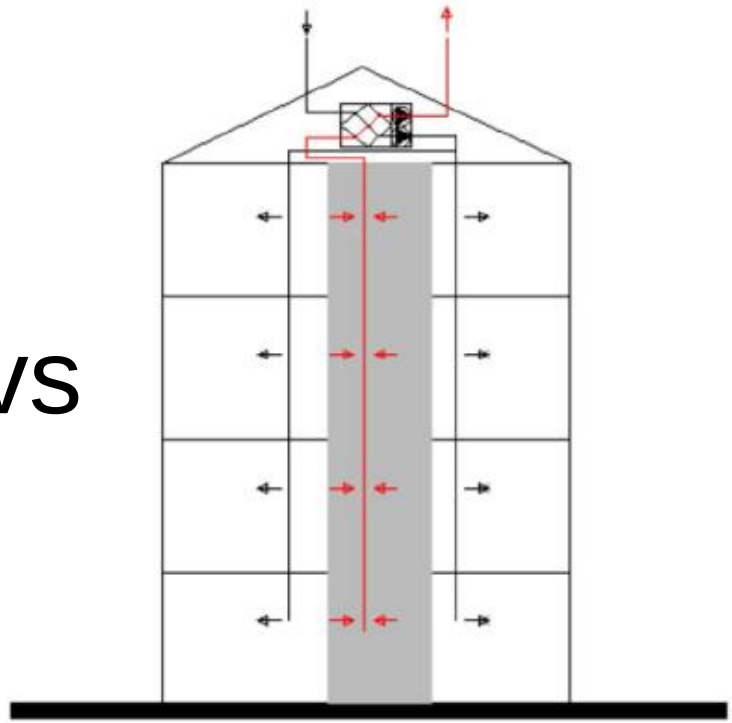
Ventilation



NATURAL VENTILATION

VS

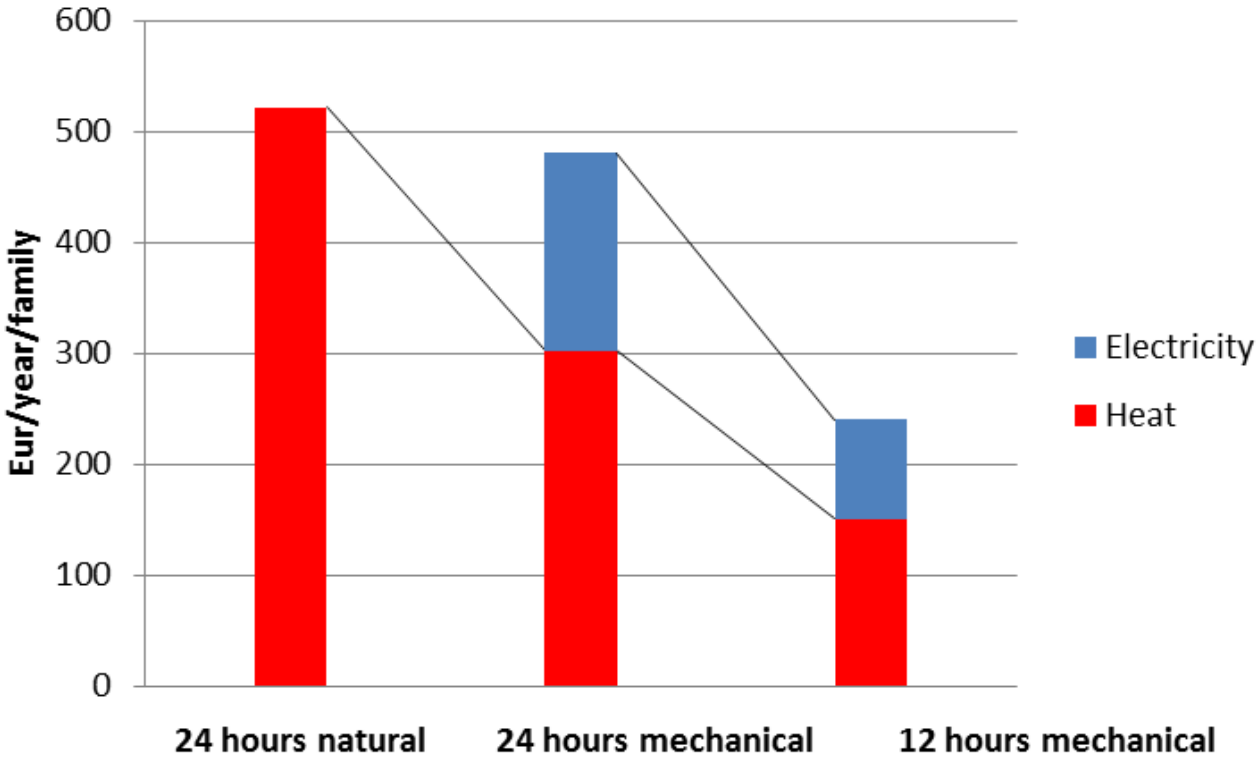


MECHANICAL VENTILATION

Compulsory for A…A++ buildings

Ventilation

Ex.: Cost for ventilation (162 m^3/h) for family flat per year



With heat price 0,07€ and electricity – 0,15 €

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Ventilation

The human factor…:

"To open the window costs nothing… but to switch on the electric equipment – costs…"

And/or
"We can not live without Heating, but we can without Ventilation…"

The CO_2 meters need…?

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Glazing

Factors influencing the energy demand:

WWR – Window Wall Ratio, %.

Orientation: N, S, E, W.

Glazing characteristics:

U – heat transfer coef;

τ – light transmittance;

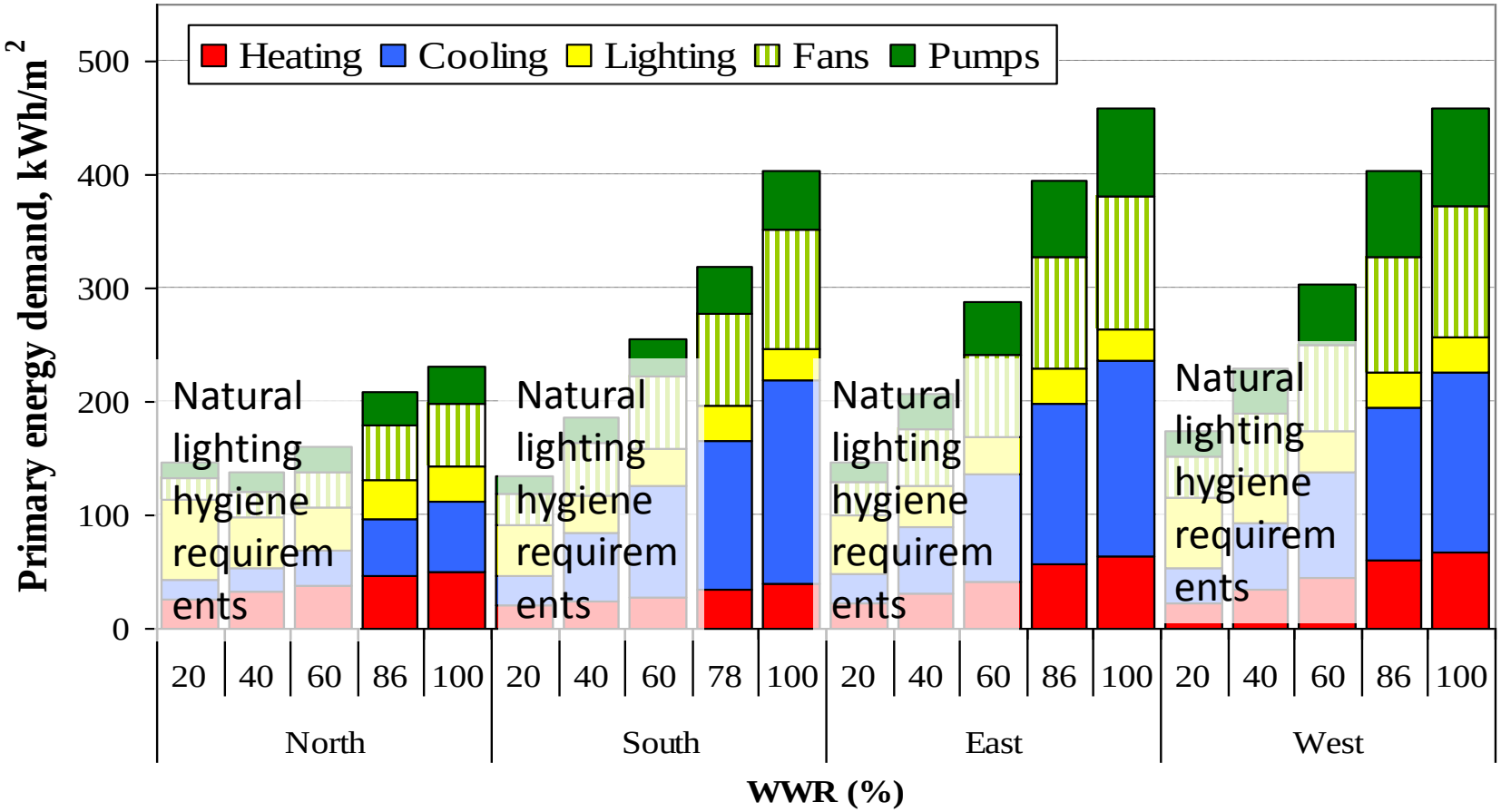
***g* – heat transmittance**;

a – shading.

Usually what's good for summer – bad for winter….

Glazing

Ex. Office building energy demand of different systems according glazing area, orientation and characteristics



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Glazing

And the buildings we build now…

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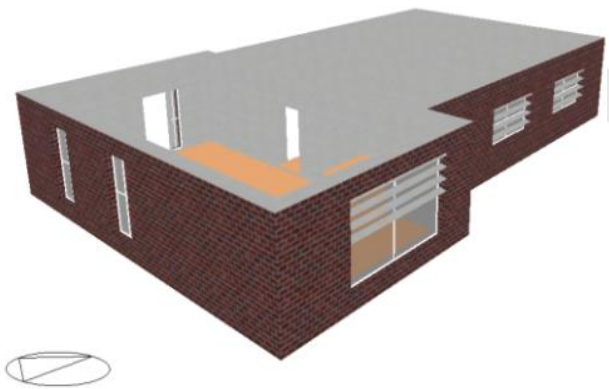
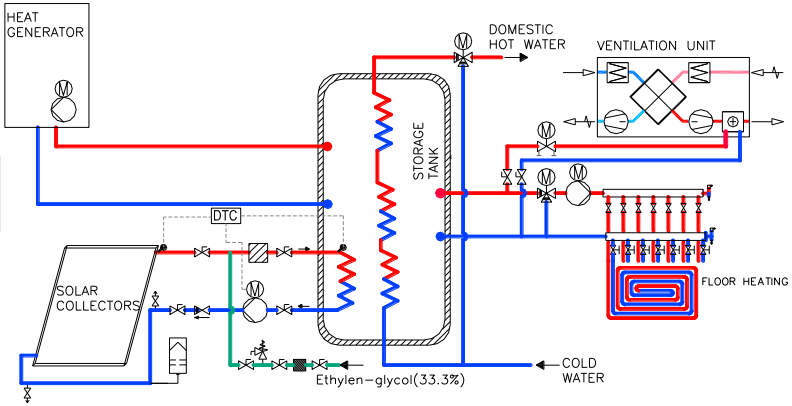
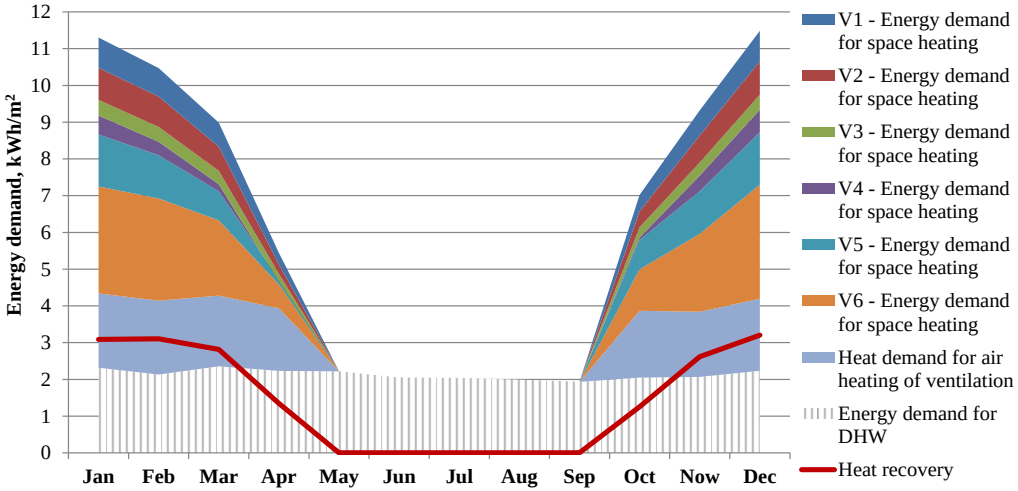
Analysis







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Conclusion

Make together (architects, constructors, energy engineers etc.)

building efficient (comfort, energy, ecological, economical… = sustainable)

before it is built…

Thank you!
Didi Madloba!

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The most results presented here are obtained by Vilnius Gediminas Technical University researchers of the Department of Buildings Energetics by using manual and simulation tools:
SimaPro, Design Builder(EnergyPlus), Trnsys.