COMPARISON OF ENERGY PERFORMANCE CALCULATION AND ENERGY INDICATORS OF REFERENCE BUILDING FOR BOSNIA AND HERZEGOVINA AND FRANCE

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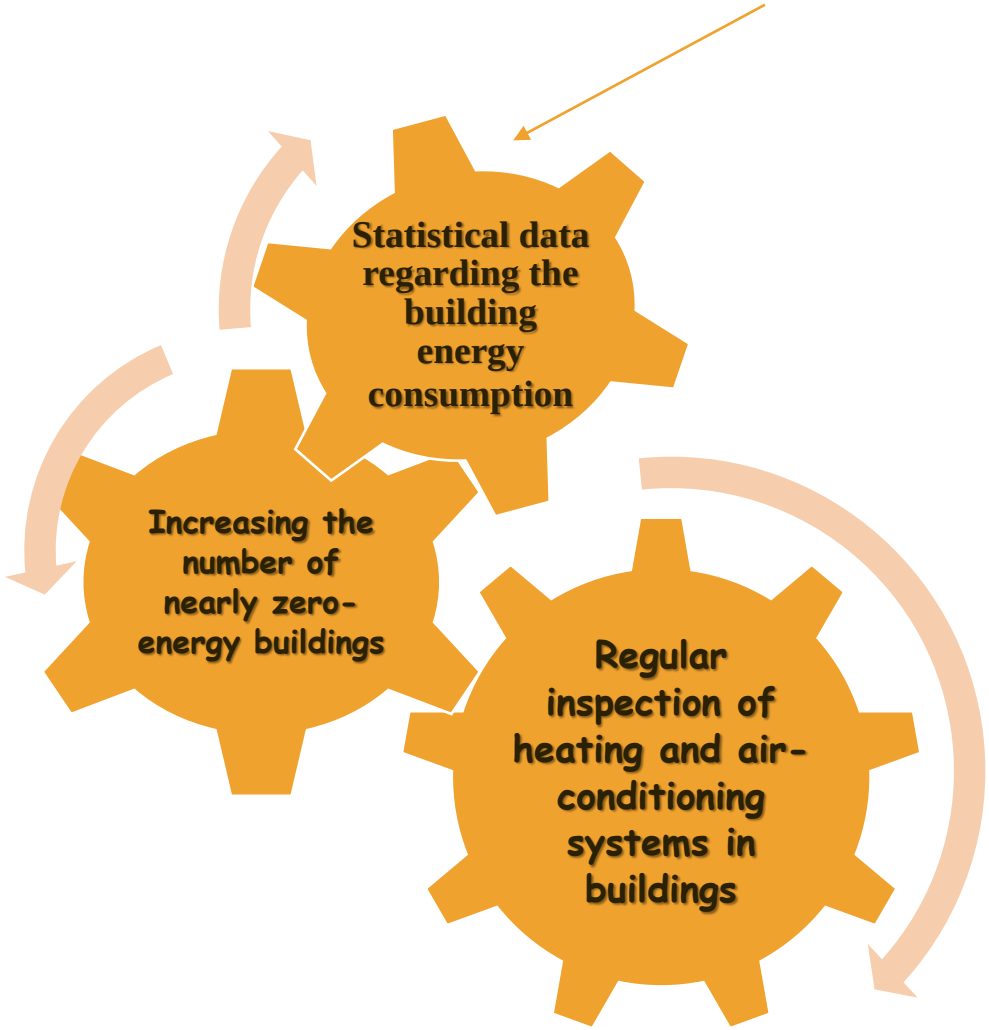
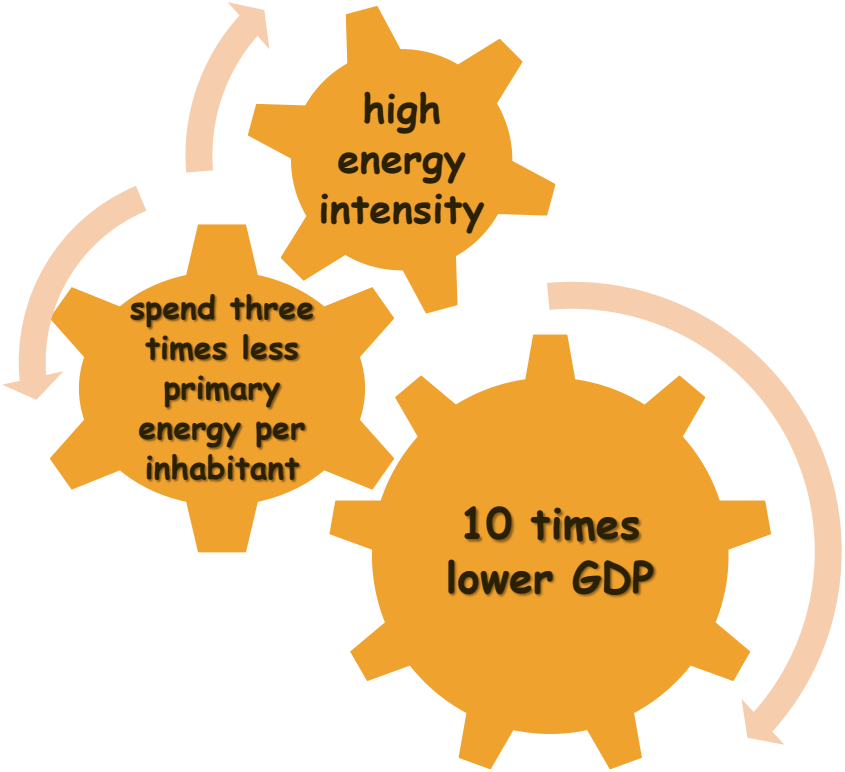
EU vs BiH

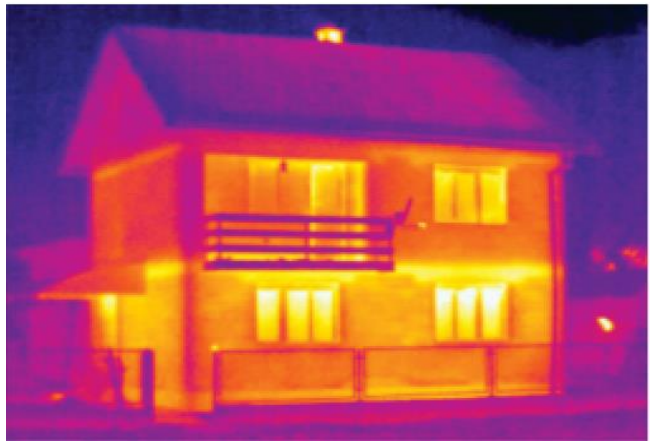

Statistical data regarding the building energy consumption
Increasing the number of nearly zero-energy buildings
Regular inspection of heating and air-conditioning systems in buildings


high energy intensity
spend three times less primary energy per inhabitant
10 times lower GDP

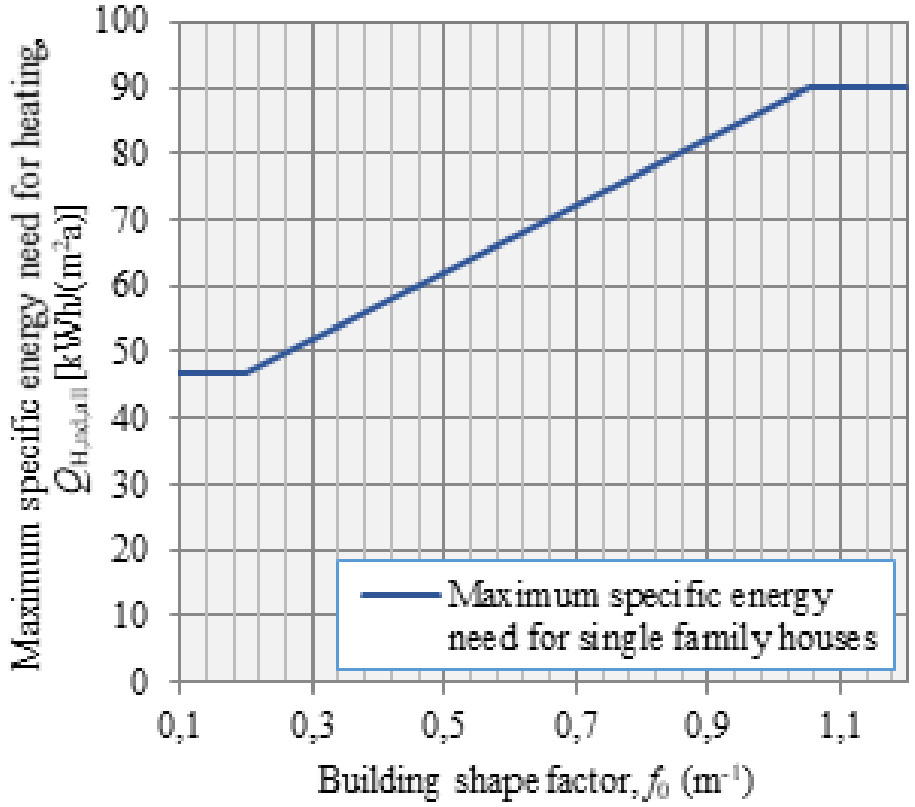
Typical building

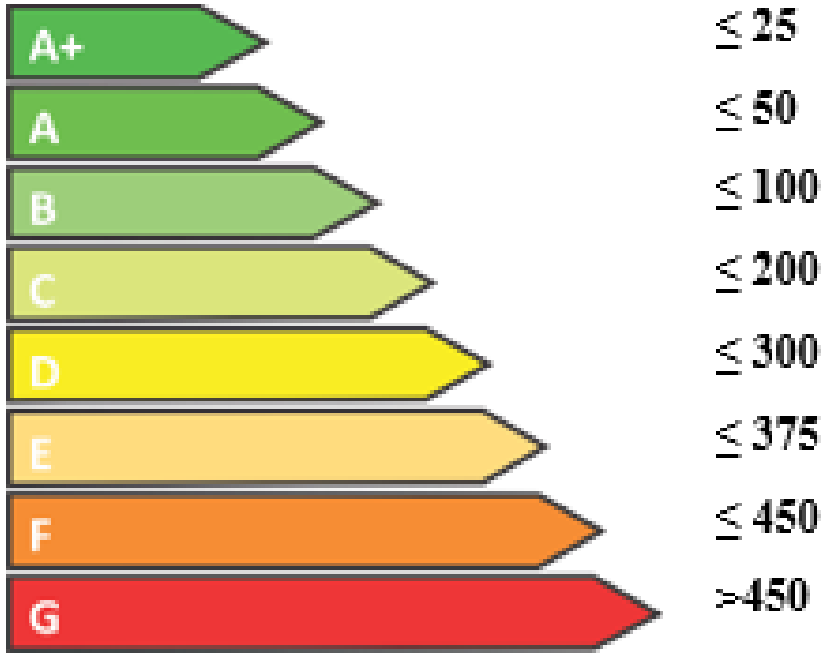
Parameter	Residential building
Climate region	Region North
Number of floors	2
Net surface of the heated space	67,83 m^2
Heated space volume	149,23 m^3
Time of use	08:00-22:00, 7 days a week

Building envelope	Surface area	U	U_{max} (FBiH)	U_{max} (France)
	[m^2]	[W/(m^2K)]	[W/(m^2K)]	[W/(m^2K)]
W1, external wall	111,3	1,86	0,35	0,24
W2, external wall at attic	14,5	1,98	0,35	0,24
W3, external wall	10,72	1,45	0,35	0,24
F1, ground floor	29,42	3,31	0,40	0,30
F2, ground floor	14,2	1,28	0,40	0,30
CE1, ceiling	42,32	1,68	0,40	0,24
Windows and doors	13	2,8 – 6,4	1,40 windows, 2 -doors	1,50 windows, 2 doors



Energy performance indicators for BiH





$$Q_{H,nd,rel} = \frac{Q_{H,nd,ref}}{Q_{H,nd,all}}, \ [\%]$$

Energy performance indicators for BiH

Parameter	Total value, [kWh/a] or [kg_{CO2}/a]			Specific value, [kWh/(m^2a)] or kg_{CO2}/(m^2a)]		
	Energy for heating	Energy for DHW	Auxill. energy	Energy for heating	Energy for DHW	Auxill. energy
Energy need, [kWh/a]	20557,6	847,9	179,0	303,1	12,5	2,6
Delivered energy, [kWh/a]	20557,6	847,9	179,0	303,1	12,5	2,6
Total delivered energy, [kWh/a]	21584,5			318,2		
Primary energy, [kWh/a]	61672,8	2543,6	537,0	909,2	37,5	7,9
Total primary energy, [kWh/a]	64753,4			954,6		
CO_2 emission, [kg_{CO2}/a]	45921,6	1894,0	133,3	677,0	27,9	2,0
Total CO_2 emission, [kg_{CO2}/a]	47948,8			706,9		

$$Q_{H,nd,rel} = \frac{Q_{H,nd,ref}}{Q_{H,nd,all}} == \frac{303,1}{89,75} = 337,7\ \%,\ \text{energy class}\ E$$

Energy performance indicators for France

Using the values of annual energy need for heating, cooling, DHW system, lighting and auxiliary energy for termotechnical system and using the values of B_{bio} and C_{ep} are calculated

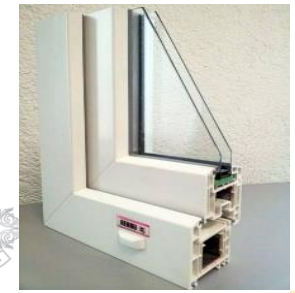
Specific energy is ratio of annual energy (energy need, delivered or primary energy) and *brutto* heated area of building.

Parameter	Calculated	Maximum allowed
B_{bio} [-]	458	96
C_{ep}, [kWh/m²a]	562,5	90
Energy class	G	A or B

Energy performance indicators for France

Parameter	Heating	DHW	Auxilliary	Cooling	Lighting	Specific values
Energy need, [kWh/a]	16305,6	847,9	255,2	206,9	1395,2	-
Delivered energy, [kWh/a]	16305,6	847,9	255,2	206,9	1395,2	-
Total delivered energy, [kWh/a]			19010,7			218,0
Primary energy, [kWh/a]	42068,3	2187,5	658,4	533,8	3599,6	-
Total primary energy, [kWh/a]			52810,9			562,5
CO_2 emission, [kg_{CO2}/a]	40385,6	2100,0	245,0	512,4	3455,6	-
Total CO_2 emission, [kg_{CO2}/a]			42732,5			490,1

Architectural measures for energy performance improvement



Building envelope	[W/(m²K)]	[W/(m²K)]	[W/(m²K)]
W1, external wall, 15 cm od TI	0,22	0,35	0,24
W2, external wall at attic, 15 cm od TI	0,23	0,35	0,24
W3, external wall, 15 cm od TI	0,22	0,35	0,24
F1, ground floor	3,31	0,40	0,30
F2, ground floor	1,28	0,40	0,30
CE1, ceiling, 15 cm od TI	0,20	0,40	0,24
Windows and doors	1,4 – 2,0	1,40 windows, 2 - doors	1,50 windows, 2 doors

Comparison of energy performance parameters for FBiH and France (baseline and architectural measures)

Parameter	Baseline			Implementation of architectural measures		
	Energy for heating	Energy for DHW	Auxill. energy	Energy for heating	Energy for DHW	Auxill. energy
Energy need, [kWh/(m²a)]	303,1	12,5	2,6	83,3	12,5	1,8
Total delivered energy, [kWh/(m²a)]	318,2			97,6		
Total primary energy, [kWh/(m²a)]	954,6			292,9		
Total CO_2 emission, [kg_{CO2}/(m²a)]	706,9			215,4		
Energy class	E			B		

Parameter	Baseline	Calculated	Maximum allowed
B_{bio} [-]	458	222	96
C_{ep}, [kWh/m²a]	562,5	257,6	90
Energy class	G	E	A or B

Introduction of renewable energy source for energy performance improvement

Parameter	Baseline			Implementation of architectural measures		
	Energy for heating	Energy for DHW	Auxill. energy	Energy for heating	Energy for DHW	Auxill. energy
Energy need, [kWh/(m²a)]	303,1	12,5	2,6	83,3	12,5	0,0
Total delivered energy, [kWh/(m²a)]	318,2			35,3		
Total primary energy, [kWh/(m²a)]	954,6			105,8		
Total CO_2 emission, [kg_{CO2}/(m²a)]	588,2			74,1		
Energy class	E			B		

Parameter	Baseline	Calculated	Maximum allowed
B_{bio} [-]	458	222	96
C_{ep}, [kWh/m²a]	562,5	110,9	90
Energy class	G	C	A or B

Energy cost saving analysis of improvement measures

Parameter	Energy cost	Energy savings	Investment cost	Simple payback period
	[Euro/a]	[Euro/a]	[Euro/a]	[year]
Current state	1743	-	-	-
Architectural measures	535	1208	7320	6,1
Technical measures (inculdes architectural measures)	194	1549	16037 (with 7320 Euro included)	10,3

Conclusion

Energy performance calculation methodology for residential buildings in FBiH accounts energy need for heating, domestic hot water (DHW) and auxiliary energy of element of heating and DHW system. Therefore, when architectural improvement measure for improvement of thermal performance of building envelope, are applied, energy class of building will improve. Technical measures, which result in a more efficient energy conversion or decrease of the energy consumption of auxiliary systems does not contribute in energy performance indicator.

Calculation methodology in France account to the total primary energy for following systems: heating, cooling, DHW and lighting as well as auxiliary energy of all systems.

When delivered or even better, primary energy is used as an energy indicator, they encounter efficiency of thermo-technical system but also primary energy conversion factor and its environmental impact. This results in use of more efficient thermo-technical systems and fuels (or energy carrier) with smaller primary energy conversion factor, and also use of renewable energy sources such as solar panels to decrease the building energy indicator.

Thank you for attention...

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