NEW RESULTS OF CLEANER BUILDING MATERIAL WORKGROUP

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Cleaner Building Material Workgroup (TEAM) was established in 1999 in Budapest. Original members were the Hungarian Assisiation of Building-biology, the St. Stephen University - Faculty of Ybl Miklós College - Labor 5, and the Independent Ecological Center (IEC).

The long-run aim of TEAM to introduce regular qualification of building materials from the point of view of building-ecology and building-biology in Hungary. To achieve this aim TEAM would like to work out a qualification method, which has a strong scientific background and is easy to adopt.

To find the adaptable method TEAM does research on international calculation and qualification methods and try work together with research institutes, ministries and trade-corporations.

In 2001-2002 TEAM, in the administration frame of IEC, done research on "**Hole life cycle energy and cost analysis of usual and environment-conscious, new constructed dwelling houses, and their market potential**" to determine, in dwelling house size, the potential advantages of clean and energy conscious building materials and construction.

We followed the next steps in our research work:

1. Determine the average dwelling house size and the total national building capacity.
2. Define the usual and environmental conscious dwelling house.
3. Hole life cycle energy calculation and analysis.
4. Hole life cycle cost calculation and analysis.
5. Survey of motivation of builders who built environmental conscious houses.
6. Define of target groups (who probably will build environmental conscious houses).
7. Summary

1) Determine the average dwelling house size and the total national building capacity.

Analysing the dates of Hungarian Central Statistical Office we determined the size and the facilities of typical Hungarian dwelling houses and group of flats. After building visions of Hungarian future of constructions we sketched the potential house size and market size of dwelling houses. Table 1.

	2000	**2005-estimation**
Usual size (m^2)	120	cca. 135
National building volume (piece)	cca. 14000	11-18500
National building volume (t. m^2)	cca. 1370	1500-2500

Table 1.
House size and market size of dwelling houses in Hungary in 2000 and in 2005.

2) Define the usual and environmental conscious dwelling house.

To measure the differences and the potential advantages of environment conscious houses we analysed an existing dwelling house, representing the usual type, and we planned an environment conscious one on the same building spot, representing the environmental-conscious type.

Our planning goal was, to build a clean, low environment load, cost efficient house, therefor we used simple and law cost constructions and building techniques. Table 2.

	Usual dwelling house	Environment-conscious house
External walls	30 cm aerated concrete	12 cm rockwool in timber construction, and 12 cm adobe wall
Slab	light construction and 10 cm glaswool	light construction and 10+12 cm rockwool
Roof	polymere bitumen sheet	clay tiles
Floor	wood fibre hard parquet and 5 cm polystyrene	natural parquet and 10 cm rockwool
Openings	thermal glas	thermal glas, filled with argon and LOW-E layer
Heating, Hot-Water Supply	gas boiler	fire-wood boiler and sun-collector

Table 2.
Different constructions of Usual And Environment-conscious house.

We summarised the differences in the Figure1-4 and in Table 3-4.

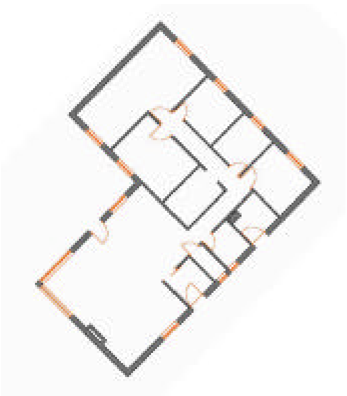


Figure 1.
Plan of Usual dwelling house.

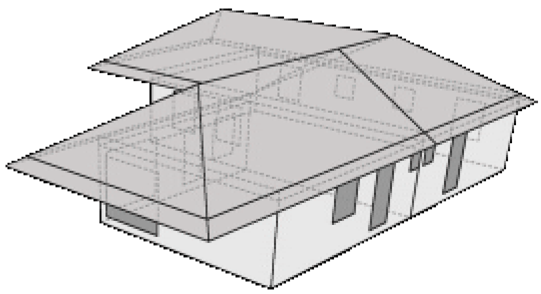


Figure 2.
Overview of Usual dwelling house.

Area: 128 m^2	**wall**	**openings**	**slab**	**floor**
k or U value (W/m^2K)	0,47	2,69	0,36	0,64

Table 3.
Summary of technical and physical parameters of Usual house.

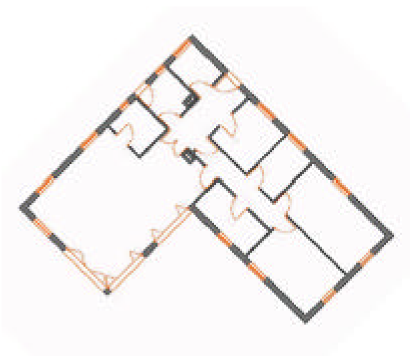


Figure 3.
Plan of Environment-conscious dwelling house.

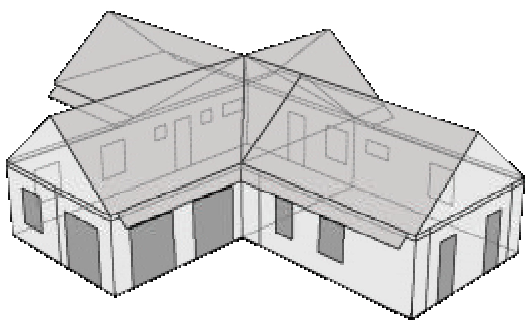


Figure 4.
Overview of Environment-conscious dwelling

Area: 119 m^2	wall	openings	slab	floor
k or U value (W/m^{2}K)	0,23	1,21	0,17	0,34

Table 4.

Summary of technical and physical parameters of Environment-conscious house.

3) Hole life cycle energy calculation and analysis.

In the research work we calculated the inbodied and the operational energy demand of each building.

The inbodied energy calculation was based on the dates of Bau-Bio-Data-Bank of GIBB - Genossenschaft Information Baubiologie. The summary of analyses are shown in the Table 5.

The operational energy demand was based on different calculation software, which were compared with the measured energy demand of existing Usual house. The summary of analyses are shown in the Table 6.

	Usual dwelling house					Environment conscious dwelling house				
	PET-nmu (kWh)	PET-mu (kWh)	PET-össz (kWh)	CO2eq (kg)	SO2eq (kg)	PET-nmu (kWh)	PET-mu (kWh)	PET-össz (kWh)	CO2eq (kg)	SO2eq (kg)
foundation	18 371	0	18 371	10 908	38	16 039	0	16 039	9 523	33
wall	50 324	1 632	51 956	20 857	69	71 665	150 892	222 558	20 028	102
partition	35 289	1 032	36 321	14 396	49	23 079	3 032	26 111	9 393	33
openings (out)	16 986	582	17 569	3 665	20	638	3 327	3 966	193	1
shalters	16 711	6 117	22 828	3 509	19	1 105	5 760	6 865	333	2
openings (in)	2 158	6 037	8 194	547	2	535	2 788	3 323	161	1
slab	16 322	11 565	27 888	4 118	22	22 491	11 173	33 664	5 628	28
roof	97 809	67 397	165 206	10 284	61	23 930	35 565	59 495	7 043	31
floor	50 894	35 134	86 028	16 383	67	46 416	30 101	76 517	14 739	64
	0	0	0	0	0	0	0	0	0	0
	304 865	129 497	434 362	84 668	349	205 899	242 639	448 538	67 042	295

Table 5.

Inbodied energy and environment load of Usual and Environment conscious dwelling house.

	Usual dwelling house	Environment conscious dwelling house
Natural gas/wood consumption [kWh/a]	32598	18499
Electricity consumption [kWh/a]	2221	2221
Energy consumption [kWh/a]	**34819**	**20720**
Area [m2]	128	119
Unit energy consumption [kWh/(m2a)]	**272.0**	**194.3**
Heating energy consumption [kWh/a]	28598	16899
Unit heating energy consumption [kWh/m2a]	**223.4**	**142.0**

Table 5.

Operational energy demand of Usual and Environment conscious dwelling house.

4) Hole life cycle cost calculation and analysis.

The cost analysis researched the construction as well as the maintain cost. The construction costs were calculated by an independent cost calculator by both situation. The operational cost were calculated for the hole life cycle, using the following scenarios for future cost of energy sources:

a) Using the present Hungarian energy-prices during the hole life cycle,
b) starting from the present Hungarian energy-prices, calculating 1,5% real increase in value,
c) starting from the present Hungarian wood-price and Austrian natural gas price, calculating 1,5% real increase in value,
d) starting from the present Austrian energy-prices, calculating 1,5% real increase in value.

We could calculate the expected savings in private and in national level. Table 6-7.

Hole life cycle cost demand	**Usual dwelling house**	**Environment-conscious house**	**Savings on the 100 year lc.**	**Saving per years on present price**	**Rate of return (year)**
aa) Construction costs (t HUF)	17 400	20 767			
a) using the present Hungarian energy-prices during the hole life cycle,	31 297	24 971	-6 325	97	35
b) starting from the present Hungarian energy-prices, calculating 1,5% real increase in value,	50 130	30 669	-19 461	97	28
c) starting from the present Hungarian wood-price and Austrian natural gas price, calculating 1,5% real increase in value,	104 951	30 669	-74 281	369	8,5
d) starting from the present Austrian energy-prices, calculating 1,5% real increase in value.	104 951	66 864	-38 086	176	17

Table 6.

Private savings by building an environment-conscious dwelling house using different scenarios for future cost of energy sources.

Extra costs on national level (for all houses in the next 3 years)	1 040 million EURO
Calculated energy saving	656 GWh
Savings on the 100 year life cycle	
1) using the present Hungarian energy-prices during the hole life cycle,	- 892 million EURO
2) starting from the present Hungarian energy-prices, calculating 1,5% real increase in value,	-3 612 million EURO
3) starting from the present Hungarian wood-price and Austrian natural gas price, calculating 1,5% real increase in value,	- 15 176 million EURO
4) starting from the present Austrian energy-prices, calculating 1,5% real increase in value.	- 6 964 million EURO

Table 7.

National savings by building **only** environment-conscious dwelling houses in the **next 3 years** using different scenarios for future cost of energy sources. (1 EURO = 250 HUF)

5) Survey of motivation of builders who built environmental conscious houses.

The research through inquires shown that the main motivations of the so called "eco-house builders" are the following:

1. Health
2. Naturality
3. Low energy cost

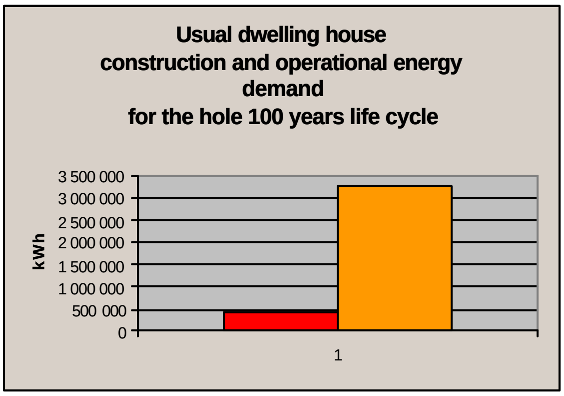
6) Define of target groups (who probably will build environmental conscious houses).

The research determined two potential target groups, whom could involve a possible environment-conscious house program.

1. Young, at least middle educated, well paid married couple (age 25-35).
2. Elderly married couple before pension (age 50-60).

7) Summary

As interpretation the cost and energy analysis we have to underline that there is a big disproportion between the hole life cycle energy and cost demand. The market, throw the prices, press the investors to build cheap and non environment-conscious houses. Figure 5-8.



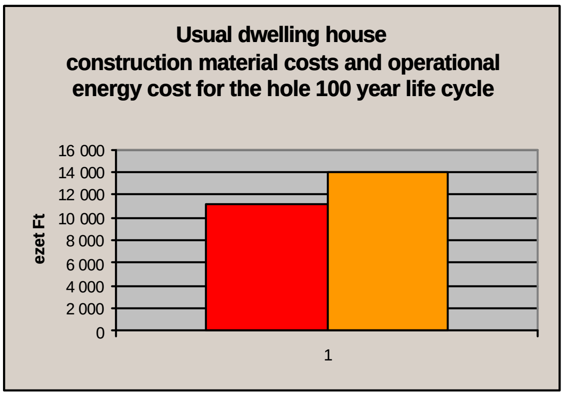
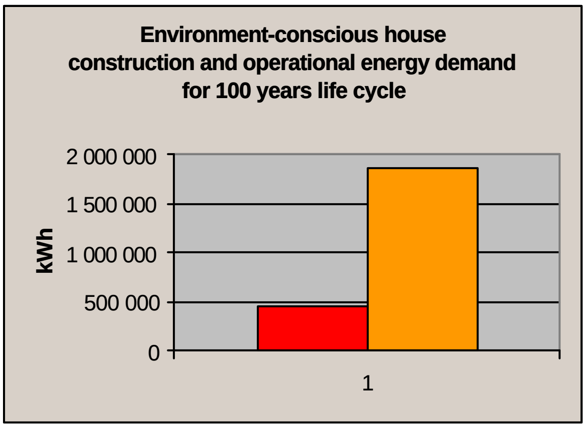


Figure 5 and Figure 6.

The market, throw the prices, shows 9,46 more important by the Usual house the construction period as would be well-proportioned regarding the energy demand.



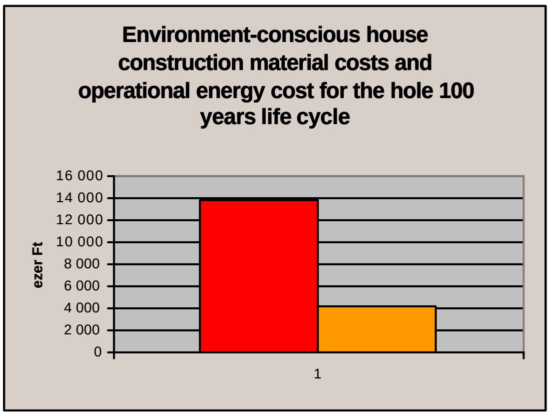


Figure 7 and Figure 8.

The market, throw the prices, shows 20,37 more important by the Environment-consciuos house the construction period as would be well-proportioned regarding the energy demand.