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Factors influencing households' energy consumption in Hungary

Case-study conducted in the city of Debrecen

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Tartalom

1. Theoretical background and research questions

This case study analysis focuses on social dimensions of household energy consumption and energy saving projects. The main goal is to analyse new relations and co-operations of actors which may lead to a more sustainable energy use and efficient energy policy.

According to authors of "Report on assessment of energy-efficient policies and interventions" the household's energy efficiency depends on technical and financial availability of technology, the barriers to energy efficiency and policy intervention.

In this case study about factors influencing households' energy consumption we focus less on availability of technology. The concept of "private energy-efficiency gap" or with other name "energy paradox" clearly explains that some energy-saving technologies are not equipped even though companies promised to pay for the users (Gerarden et al. 2017)

For our study the concept of barriers provides theoretical framework (Schleich et al. 2016) which describes external and internal barriers of energy efficiency. External barriers can be changed flexibly while internal barriers related to values, preferences, practices and behaviours are hard to change.

External barriers are considered as factors that limit the adoption of energy efficient technologies although they can be easily influenced. The factors depend on institutional setting and external to stakeholders who can change them without difficulties which may

lead to "market failure explanations" (Gerarden et al. 2017). An example of "capital market failure" is as some user cannot obtain capital to invest in energy saving equipment and technologies (Gillingham et al. 2009). Another important barrier of energy efficiency is discount rate reflecting to balance between capital cost and operational cost (Hausman 1979)

Analyses include information as external constraints, especially information lack (Palmer et al. 2013). The energy users invest less in energy saving if they lack information or they are misinformed on energy efficiency technic availability, price, potential energy and financial saving or advantages/disadvantages of investment in energy saving projects. According to literature lack of information is a dominant barrier which underlines the importance of political intervention because the lack of information triggers the underinvestment of energy efficiency (Allcott – Greenstone 2017). The financial and technological risks, the technical risk and time risk are listed in the literature as external barriers (Schleich et al. 2016).

Time-preference and risk are elements of the energy efficiency internal barriers. Time preference points to values and expectations in time discounting and allocates the level of willingness to patience, impatience, present or future orientation. Individual customers more present than future oriented care less future than present therefore they are less willing to invest in long term energy-saving projects. Present oriented home owners prefer fast-returning benefits and they are less willing to spend money on energy efficient technology.

Individuals having sympathy or awareness for risks can change their attitude and literature explains that risk-averse owners are more cautiously apply energy efficient appliances (Weber – Chapman 2005; Fischbacher et al. 2015). Steg et al documented that hedonic and ego-oriented values constrain pro-environment behaviour while altruistic environment-oriented values correlate with pro-environment

behaviour (Steg et al. 2014). Ramos, Labandeira and Löschel (2016) add to this that eco-friendly behaviours supported by environmental policy, movements and actions positively correlate with energy efficient investment, but environmental attitudes do not effect positively energy saving projects.

Authors of "Report on assessment of energy-efficient policies and interventions" listed regulatory instruments, economic and financial instruments, provision of information, audits, labeling and hard information interventions, nudges as tools of policy intervention. The case study gives a detailed description of the locally relevant policy instruments.

Energy efficiency is not only influenced by the availability of cheap technologies to reduce energy use, but also by the openness of the actors to apply the new technologies. The openness of the actors is influenced by the actors' environmental consciousness, the perception of climate change, financial background but also by different policies, or the availability of information. As our case study aims at analysing individual energy use in a Central-European, Hungarian town, we focus on two types of homes: flat in a block-of-houses and detached houses.

A recent study (Bhattacharjee – Reichard 2011) analysed the socio-economic factors influencing household energy use by conducting a meta-analysis of 51 research articles. The authors argue that the following factors reduce energy use: (1) number of individuals sharing the same household, (2) by the increasing of educational level energy use decreases, and (3) the openness to changes also decreases energy use (Bhattacharjee – Reichard 2011). Unfortunately, the authors do not present how these factors influence energy use.

By the time spent at home, the degree of urbanization, size and type of the home the energy use is growing. There are some macro-level factors which are linked to increased household energy use:

general economic development in a country, decreasing the energy-prices, and the availability of the energy-using appliances. These latter three factors show that in general the prices and the economic situation is an important factor influencing energy use.

The analysis finally mentions that the climatic situation also influences energy use.

Another study (Gram – Hanssen 2011) using Danish statistical data, argues that the characteristics of the building determine 42% of energy use, individual behaviour determines 50%, while socio-demographic characteristics determine 4,2%. The decrease in energy use is counter-balanced by the increase in the number of electric appliances. As the paper argues, not the energy-efficiency of the household appliances, but their number influences the overall energy use of the household. This study also found that more individual lives in a household, the less the per capita energy use is.

The role of the age of the head of the household and the educational level of the individuals are disputed.

While electricity use is mainly determined by household and individual characteristics, heating energy depends on the characteristics of the building.

The main goal of the case study is to identify most important actors of energy efficiency, their motives and interest in joining energy efficiency projects: building insulation, modernization of the heating system and applying solar cells technology. We use the concept of governance which proved to be a suitable theoretical frame to study households' energy demand, energy use and governance in the context of climate change management (Gotts – Kovách 2010).

Applying theoretical considerations about the technical term of governance (Rhodes 1996; Stoker 1998, Kooiman – Van Vliet 1993), one of our aims of defining governance was to include growing number of actors which may have an impact on energy efficiency

oriented behaviour. The multi-level and multi-actor governance is a complex of structures, institutions and actors (and their networks, values, motivations and interests). We aim to understand sociological and institutional aspects of household energy consumption, the role of stakeholders and mediator actors of efficient energy policy and projects at national and local level, the impact of policy intervention, new relations and co-operations among actors which may lead to new scope for future actions.

1.1. Main research questions

1. The focus of this study is to explore the factors that help to understand interference between social status, norms which impact consumer groups' behaviour related to energy efficiency and in specific cases (renovation of buildings, applying solar cells technology) the role of governance.
2. Exploration and comparison of varied social components, social status (income level, age, education, gender) and social norms which influence the individual and communal choice of consumers.
3. To find the social and institutional conditions necessary to foster social response to energy efficiency policies, the social determinants of novel operational knowledge and the role of knowledge.

First, in chapter 3, the case study presents research methods. The chapter 3.1 describes the main social and energy use characteristics of study area. The chapter 3.3 has been written about policy background. The fifth is the main chapter which presents initiatives to reduce household energy consumption as using solar cells and

insulation of block buildings. The sixth chapter is stakeholder analysis while chapter 7 provides an outlook about future tendency. The last chapter is a summary on factors influencing households' energy consumption.

2. Methods

To answer research questions, we used tape interview-based case study, which aims to explore impact of energy policy, actors of local energy governance, their interests and reflexions to policy, which may successfully lead to progress of sustainable energy consumption.

We analysed Penny survey conducted in Italy, The Netherlands, Germany and Switzerland in 2017–2018.

In Debrecen city we made:

1. 40 interviews with blockhouse flat owners who participated in energy saving building renovation, insulation and heating system modernisation programmes in blocks of flats estates in the neighbourhood of villa district (see chapter 4.2) The interviewees have been randomly selected. For the sampling we used list of flat owners we received from building maintenance managers of those block houses which participated in energy saving building insulation programs.
2. 17 interviews with stakeholder experts (engineers, planners and designers, leader of non-profit agency). We could make only one, not recorded interview, with representative of local government but as it turned out from the stakeholder interviews the local government has little role in energy saved projects (see chapter 5).

3. 3 interviews with building maintenance managers of insulated block buildings where interviews have been made with flat owners.
4. 10 interviews with owners of houses where solar cells are applied for energy saving. The interviewees have been randomly selected.

2.1. Energy use in the PENNY countries

In this part we present the results of a survey conducted among Italian, Swiss, German and Dutch households to explore their energy-related behaviour. Our goal is to provide an international outlook for the interpretation of the results of the Debrecen case study. First, we present socio-demographic characteristics, then a typology of energy use clusters. Finally, we compare the socio-demographic characteristics and energy-related behaviour of the different energy use groups.

2.2. Socio-demographic characteristics of the respondents

The average age of the respondents from the three countries 51 years, the Dutch population is slightly younger 48.9 years, while the Swiss and Italian population is slightly older: 51 and 53 years old.

1. table: The gender distribution of the respondents

		CH	NL	IT	D	Total
Female	Count	399	721	472	26	1618
	% within Respondent's country	36.7%	37.7%	31.3%	34.2%	35.3%
	Std. Residual	.8	1.8	-2.6	-.2	
Male	Count	687	1182	1035	49	2953
	% within Respondent's country	63.3%	61.9%	68.6%	64.5%	64.5%
	Std. Residual	-.5	-1.4	2.0	.0	
Other	Count	0	7	1	1	9
	% within Respondent's country	0.0%	0.4%	0.1%	1.3%	0.2%
	Std. Residual	-1.5	1.7	-1.1	2.2	
Count	1086	1910	1508	76		4580
	% within Respondent's country	100.0%	100.0%	100.0%	100.0%	100.0%

Sig: p<0,000 (Source: PENNY survey 2017)

According to the table, 4580 respondents answered this question from Netherlands, Italy, Germany and Switzerland. The number of females is 35.3% from the countries. This rate is 37.7% in Netherlands, 31.3% in Italy, 36.4% in Switzerland and 34.2% in Germany. The male respondents' ratio is higher in a national and an international level too. In an international level, the ratio of males is 64.5%. In Netherlands 61.9%, in Italy, 68.6%, and in Switzerland 63.3% and in Germany 64.5% the proportion of men. The questionnaire took into consideration the diversity. Because of this, we can find a third category „other". Only 0.2% of the respondents chose this category. 0.4% from the Netherlands, 0.1% from Italy and none of the respondents chose this category from Switzerland, while 1.7% in Germany. Based on the Chi-Square Test the differences between the three countries are significant.

In general, the respondent's average age is 51 and basically, the size of their home is 138 m^2. In the Netherlands, the average age is 48.8. And in general, the size of their house is 152 m^2. The Italian respondents are 53.2 years old in general and their flat size is 111 m^2. In Switzerland, the respondents' average age is 52 years old and their flat size is 148 m^2. The average age of German respondents is 48 years and their flat floor area is 111 m^2.

2. Table: What is your principal career status?

		CH	NL	IT	D	Total
Employed (full time)	Count	411	832	701	35	1979
	% within Respondent's country	37.8%	43.4%	46.5%	46.1%	43.2%
	Std. Residual	-2.7	.2	2.0	.4	
Employed (part time)	Count	232	346	65	10	653
	% within Respondent's country	21.4%	18.1%	4.3%	13.2%	14.2%
	Std. Residual	6.2	4.4	-10.2	-.3	
House-wife / House-husband	Count	32	40	51	2	125
	% within Respondent's country	2.9%	2.1%	3.4%	2.6%	2.7%
	Std. Residual	.4	-1.7	1.5	-.1	
Other	Count	23	82	118	7	230
	% within Respondent's country	2.1%	4.3%	7.8%	9.2%	5.0%
	Std. Residual	-4.3	-1.4	4.9	1.6	

Retired	Count	249	323	370	16	958
	% within Respondent's country	22.9%	16.9%	24.5%	21.1%	20.9%
	Std. Residual	1.5	-3.9	3.1	.0	
Seeking work	Count	12	61	42	1	116
	% within Respondent's country	1.1%	3.2%	2.8%	1.3%	2.5%
	Std. Residual	-3.0	1.8	.6	-.7	
Self-employed / Freelancer	Count	104	190	152	2	448
	% within Respondent's country	9.6%	9.9%	10.1%	2.6%	9.8%
	Std. Residual	-.2	.2	.4	-2.0	
Student / Trainee	Count	23	41	9	3	76
	% within Respondent's country	2.1%	2.1%	0.6%	3.9%	1.7%
	Std. Residual	1.2	1.6	-3.2	1.6	
	Count	1086	1915	1508	76	4585
	% within Respondent's country	100.0%	100.0%	100.0%	100.0%	100.0%

Sig: p<0,000 (Source: PENNY survey 2017)

This table consists of 4585 respondents' answer about their labour market status. All together 43.2% of respondents have a full-time job. On a national level, this ratio is 43.4% in the Netherlands, 46.5% in Italy, 37.8% in Switzerland and 46.1% in Germany. On international level, 14.2% of the respondents have a part-time job. This percent is the highest in Switzerland (21.4%). According to the table 2, only 2.7% of the respondents are housewife/househusband. This number is the highest in Italy (3.4%). 958 pensioners fulfilled the questionnaire, which 20.9% of the respondents in an international level. This number is the lowest in the Netherlands (17%). 2,5% of the respondents are job seekers. This rate is the lowest in Switzerland (1.1%). 9.8% of the respondents are freelancer/self-employed. 1.6% of the subjects are students/trainees. The number of the students/interns is the lowest in Italy (0.6%). 5% of the respondents chose the „other" category in the questionnaire. Based on the Chi-Square Test the differences between the three countries are significant.

3. Table: Which of the following best describes your household type?

		CH	NL	IT	D	Total
Couple, with 1 or more children	Count	453	601	838	29	1921
	% within Respondent's country	41.7%	31.4%	55.6%	38.2%	41.9%
	Std. Residual	-.1	-7.1	8.2	-.5	
Couple, without children	Count	322	723	313	19	1377
	% within Respondent's country	29.7%	37.8%	20.8%	25.0%	30.0%
	Std. Residual	-.2	6.2	-6.6	-.8	
Non-family household	Count	49	41	32	16	138
	% within Respondent's country	4.5%	2.1%	2.1%	21.1%	3.0%
	Std. Residual	2.9	-2.2	-2.0	9.1	
Single parent with 1 or more children	Count	52	140	127	12	331
	% within Respondent's country	4.8%	7.3%	8.4%	15.8%	7.2%
	Std. Residual	-3.0	.1	1.7	2.8	

Single person	Count	210	410	198	0	818
	% within Respondent's country	19.3%	21.4%	13.1%	0.0%	17.8%
	Std. Residual	1.2	3.7	-4.3	-3.7	
	Count	1086	1915	1508	76	4585
	% within Respondent's country	100.0%	100.0%	100.0%	100.0%	100.0%

Sig: p<0,000 (Source: PENNY survey 2017)

41.9% of respondents have their own family with one or more children. This ratio is the highest in Italy (55.6%). The percentage of couples without children at cross-country level is 30.4%. This percentage is the highest in the Netherlands (37.8%). 3.0% of the respondents live in a non-family household. In this category we find the highest percentage in Switzerland (4.5%). 7.2% of respondent bring up their child/children alone. This number is the highest in Italy (8.1%), and the lowest in Switzerland (4,8%). 17.8% of the respondents are single. This rate is 21.4% in the Netherlands, 19.3% in Switzerland, 13.1% in Italy and no one in Germany. Based on the Chi-Square Test the differences between the three countries are significant.

4. Table: What is the highest educational degree you have completed?

		CH	NL	IT	D	Total
3-year university degree/ higher education diploma	Count	196	770	107	8	1081
	% within Respondent's country	18,0%	40,2%	7,1%	10,5%	23,6%
	Std. Residual	-3.8	15.0	-13.2	-2.3	
5-year university degree	Count	354	463	358	21	1196
	% within Respondent's country	32.6%	24.2%	23.7%	27.6%	26.1%
	Std. Residual	4.2	-1.6	-1.8	.3	
Lower secondary school certificate	Count	16	80	155	7	258
	% within Respondent's country	1.5%	4.2%	10.3%	9.2%	5.6%
	Std. Residual	-5.8	-2.7	7.6	1.3	

None	Count	2	3	5	0	10
	% within Respondent's country	0.2%	0.2%	0.3%	0.0%	0.2%
	Std. Residual	-.2	-.6	.9	-.4	
Postgraduate qualification	Count	74	107	56	4	241
	% within Respondent's country	6.8%	5.6%	3.7%	5.3%	5.3%
	Std. Residual	2.2	.6	-2.6	.0	
Primary school certificate	Count	5	30	9	2	46
	% within Respondent's country	0.5%	1.6%	0.6%	2.6%	1.0%
	Std. Residual	-1.8	2.5	-1.6	1.4	
Upper secondary school diploma	Count	110	145	702	16	973
	% within Respondent's country	10.1%	7.6%	46.6%	21.1%	21.2%
	Std. Residual	-7.9	-13.0	21.3	.0	

Vocational secondary school diploma (3 years of study)	Count	329	316	116	18	779
	% within Respondent's country	30.3%	16.5%	7.7%	23.7%	17.0%
	Std. Residual	10.6	-.5	-8.8	1.4	
	Count	1086	1914	1508	76	4584
	% within Respondent's country	100.0%	100.0%	100.0%	100.0%	100.0%

Sig: p<0,000 (Source: PENNY survey 2017)

In this part, we analysed the respondent's educational level. 23.6% has a 3 year university degree. The highest ratio is among the Dutch respondents with 40.2%. The lowest number is among the Italian respondents with 7.1%. 26.1% of the respondents have a 5 year university degree. This ratio is the highest, 32.8% among the Swiss respondents. In an international level 5.6% of the respondents have a lower secondary school certificate. This number is the highest among the Italian respondents (10.3%) and the lowest among the Swiss respondents (1.5%). 0.2% of the respondents had no education. 5.4% of the respondents have a postgraduate qualification. 1% has a primary school certificate. 21.2% has an upper secondary school diploma. This rate is the highest among the Italian respondents (46.6%). 16.6% has a vocational secondary school diploma. This

number is the highest in Switzerland (29.8%). Based on the Chi-Square Test the differences between the three countries are significant.

Almost one-fourth of the respondents didn't answer about their income. This number is very high among Italian respondents (33.7%). 24.1% of the Italians earn between 1501–3000 Euro. They have the lowest income if we take into consideration the other nationalities.

From Netherlands 15%, from Switzerland, 15.5% of the respondents didn't answer this question. 16.4% of the respondents in the Netherlands earn between 4'501–6'000 Euro, 15.3% of them earn 3'501–4'500 Euro. 13.2% earn between 6'001–9'000 Euro, and 13% has an income between 2'501–3'500 Euro. 23.9% of the Swiss respondents earn between 6'001–9'000 Euro. The second most common category is the above 12.000 earnings among these respondents (22.2%). Based on the Chi-Square Test the differences between the three countries are significant in both categories.

2.3. The characteristics of the homes

The average size of the homes are 123 m^2. In the Netherlands, the size of the homes are bit larger: 128 m^2. The homes of the Italian respondents are around 110.8 m^2, while in Switzerland the average size of the home is 123.8 m^2.

5. Table: How do you heat your flat/house?

		CH	NL	IT	D	Total
Gas	Count	217	1491	1110	36	2854
	% within Respondent's country	18.7%	69.5%	73.6%	42.4%	58.2%
	Std. Residual	-17.7	6.8	7.8	-1.9	
Electricity	Count	74	125	38	1	238
	% within Respondent's country	6.4%	5.8%	2.5%	1.2%	4.9%
	Std. Residual	2.3	2.0	-4.1	-1.5	
District Heating	Count	11	134	4	12	161
	% within Respondent's country	0.9%	6.2%	0.3%	14.1%	3.3%
	Std. Residual	-4.4	7.6	-6.5	5.5	
Heat Pump	Count	122	89	8	0	219
	% within Respondent's country	10.5%	4.1%	0.5%	0.0%	4.5%
	Std. Residual	9.7	-.7	-7.2	-1.9	

Solar	Count	1	29	2	0	32
	% within Respondent's country	0.1%	1.4%	0.1%	0.0%	0.7%
	Std. Residual	-2.4	4.0	-2.5	-.7	
Wood/pellet	Count	21	45	92	1	159
	% within Respondent's country	1.8%	2.1%	6.1%	1.2%	3.2%
	Std. Residual	-2.7	-3.0	6.2	-1.1	
Oil	Count	187	1	6	8	202
	% within Respondent's country	16.1%	0.0%	0.4%	9.4%	4.1%
	Std. Residual	20.1	-9.3	-7.1	2.4	
Other	Count	27	57	23	3	110
	% within Respondent's country	2.3%	2.7%	1.5%	3.5%	2.2%
	Std. Residual	.2	1.3	-1.9	.8	
Don't know	Count	20	29	16	3	68
	% within Respondent's country	1.7%	1.4%	1.1%	3.5%	1.4%
	Std. Residual	1.0	-.1	-1.1	1.7	

No answer	Count	481	146	209	21	857
	% within Respondent's country	41.4%	6.8%	13.9%	24.7%	17.5%
	Std. Residual	19.5	-11.8	-3.4	1.6	
	Count	1161	2146	1508	85	4900
	% within Respondent's country	100.0%	100.0%	100.0%	100.0%	100.0%

Sig: p<0,000 (Source: PENNY survey 2017)

The most popular heating mode among the respondents is the gas heating. This ratio is almost 60% (58.2%). This was especially popular among the Italian (73.6%) and the Dutch (69.5%) respondents. This kind of heating system is unpopular among the Swiss respondents, only 18.7% of them use gas.

2.4. Energy use clusters

We developed a typology of energy use according to the size of the home, number of electronic appliances, number of pc's and televisions in the household, number of cooked meals, average winter temperature of the home and washing-machine use. We found three types. The first type, the high energy use households has bigger homes, more appliances, but less pc's and televisions than the average, their homes are warmer and they cook more often at home.

Socio-demographic characteristics of energy use

In the Netherlands 30.8% of the respondents are high energy user, 48.2% are low energy users and 21% of them are medium energy users. Among the Italians 37.8% of them are high energy user, 45.5% are low energy users and 16.7% of them are medium energy users. In Switzerland 64.1% of the subjects are high energy users, 22.9% are low energy users and 13% of them live in a medium energy use household. 41.2% of the respondents' households consume low energy, 41.3% high energy users, while 17.5% are medium energy users.

The following table shows the gender differences in energy use.

6. Table: Gender and energy use

		Low energy use HH	High energy use HH	Medium energy use HH	Total
Female	Count	608	464	227	1299
	% within Cluster Number of Case	39.3%	29.7%	34.1%	34.4%
	Std. Residual	3.3	-3.2	-.1	
Male	Count	936	1094	438	2468
	% within Cluster Number of Case	6.5%	70.0%	65.9%	65.4%
	Std. Residual	-2.4	2.3	.1	

Other	Count	3	4	0	7
	% within Cluster Number of Case	0.2%	0.3%	0.0%	0.2%
	Std. Residual	.1	.6	-1.1	
	Count	1547	1562	665	3774
	% within Cluster Number of Case	100.0%	100.0%	100.0%	100.0%

Sig: p<0,000 (Source: PENNY survey 2017)

According to the Chi-Square Test, there is a significant difference between the genders and energy consumption. According to the table the males are overrepresented among the high energy users. Their ratio is 70.0%, while the proportion of females are 29.7%. We identify the same among the medium energy users. The males are overrepresented in this category too. Among the low energy users, the females ratio is 34.1%, the male's ratio is 65.9%.

7. Table: Household type – Energy use clusters

		Low energy use HH	High energy use HH	Medium energy use HH	Total
Couple, with 1 or more children	Count	519	1021	124	1664
	% within Cluster Number of Case	33.5%	65.3%	18.6%	44.0%
	Std. Residual	-6.2	12.7	-9.9	
Couple, without children	Count	550	371	227	1148
	% within Cluster Number of Case	35.5%	23.7%	34.1%	30.4%
	Std. Residual	3.7	-4.8	1.8	
Non-family household	Count	56	33	13	102
	% within Cluster Number of Case	3.6%	2.1%	2.0%	2.7%
	Std. Residual	2.2	-1.4	-1.2	

Single parent with 1 or more children	Count	143	81	42	266
	% within Cluster Number of Case	9.2%	5.2%	6.3%	7.0%
	Std. Residual	3.2	-2.8	-.7	
Single person	Count	281	58	259	598
	% within Cluster Number of Case	18.1%	3.7%	38.9%	15.8%
	Std. Residual	2.3	-12.0	15.0	
	Count	1549	1564	665	3778
	% within Cluster Number of Case	100.0%	100.0%	100.0%	100.0%

Sig: p<0,000 (Source: PENNY survey 2017)

According to the Chi-Square test there is a significant difference between the clusters. 63.2% of high energy users are couple with 1 or more children. 33.5% of low energy use household members are couples without children, 35.5% couple with 1 or more children. 34.5% of medium energy users are couple without children and 38.9% of them are single.

According to the Chi-Square Test, the differences between the clusters are significant. The educational level and the career status influence the energy consumption. An interesting result too that our partner's educational level and career status are also related to the energy consumption patterns of the household. According to the Chi-Square Test, the differences between the clusters are significant. The income has an important role in our energy consumption.

As we realized before the respondents mostly use gas for heating. If we take into consideration the results 55.4% of high energy use households have gas heating. The other important result that 64.7% of low energy households have gas heating too. 13.8% of high energy users have central heating. The second important category has a connection with central heating. 13.8% of high energy households and 17.8% of low energy use households use central heating. 61.8% of medium energy use households have a gas heating and 17.1% of them have central heating.

According to the Chi-Square Test, there is a significance between the level of the households' energy using and in the form of heating.

The most common form of water heating both in high energy use households and low energy use households is heating by gas. In high energy use households, this ratio is 60.1%. In those houses, which has a low-level energy consumption this ratio is 67.5%. Among those high energy use households, which heating the water by central heating this ratio is 12.7%. This ratio among low energy use households is 14.2%. If we take into consideration the data of medium energy use households whose heating their water by gas is 64%. That ratio who is using central heating to warm the water is 14.6%. According to the Chi-Square Test, there is a significance in the level of the households' energy using and between the form of water heating.

50.6% of the high energy use households use gas for cooking. 49.1% of them use electricity when they are cooking. 72% of low energy households cook by gas and 27.6% of them use electricity for this activity. 62% of medium energy use households use gas as a cooking energy, 38% of them use electricity. According to the Chi-Square Test, there is a significance between the level of the households' energy using and in the form of cooking.

8. Table: Characteristic of the energy consumers/ energy use households

Cluster Number of Case	Low energy use household		High energy use household		Medium energy use household		Total	
	Mean	N	Mean	N	Mean	N	Mean	N
Age	49.32	1545	52.35	1562	51.89	665	51.03	3772
Completely switching off electronic devices?	3.4174	1550	3.1292	1563	3.2147	666	3.2625	3779
Turning of the lights when leaving the room?	4.2781	1550	4.2091	1564	4.2057	666	4.2368	3780
How regularly do you run the dishwasher or washing machine full loads?	4.3454	1543	4.411	1562	4.2451	665	4.3549	3770

Sig: p<0,000 (Source: PENNY survey 2017)

According to the Chi-Square Test, the differences between the tree energy use type and the analysed activities are significant. Based on the data the high energy use households 40.9% very often running only full loads when using the dishwasher or the washing machine. This ratio among the low energy use households is 33.4%. 51.8% of the high energy use households chose the „always category", while the ratio is 55.1% among low energy use households. Among the medium energy use households, 41.4% chose the very often category.

In the high energy use households, 15.3% of the residents never switch off the ICT devices completely. 21.7% of them rarely. Among the low energy use households, 26.7% of the respondents very often and 26.6% of them always switch off these devices.

10.5% of the high energy use households „sometimes" turn off the light when they leave the room. 45.9% of them very often do this. 38.8% always follow the turn of the light rule. This level among the low energy user households is similar. But we can find the main difference when they chose the „always" category. The ratio among them is 47.4%.

3. The qualitative case study in Debrecen about factors influencing households' energy consumption

3.1. The research area: Debrecen

The following chapter introduces the characteristics of the case-study area: first, socio-demographic characteristics of the population and social geography. Then we analyse environmentally relevant characteristics, and finally energy use relevant specialities of housing.

Debrecen, the research area is in the eastern part of the Great Hungarian Plain. Its geographical position is favourable as it is situated along a main railway line, a highway and several main roads. It has an international airport. The capital city, Budapest is in a 220 km distance. The Hungarian–Romanian border is 30 km east of the town and the Hungarian–Ukrainian border is 120 kilometres, thus the city has dense international relationships. The town is economic, educational, scientific and cultural centre of the Northern Great Plain. Regarding population. Debrecen is the second biggest Hungarian town with around 211.320 inhabitants, according to the 2011 census data.

3.1.1. Main demographic characteristics: age structure, education level and employment characteristics

Age structure

The age structure of the population is favourable (the ratio of the aging index in 2011 and 2001 was less than one). This is mainly typical of the urban areas where housing projects took place between 2001 and 2011 and caused a significant increase in population growth. Most of the newcomers were younger families with children, resulting in a low aging index, and revitalization.

9. Table: Population breakdowns by age groups in the 2001 and 2011 censuses in Debrecen

Age group	2001	2011
0–4	4.43	4.48
5–14	11.41	8.83
15–29	26.87	22.85
30–39	12.85	16.18
40–49	14.84	12.64
50–59	12.23	13.80
60–64	4.54	6.12
65–	12.83	15.10

Source: Census volumes for the years concerned – Debrecen Settlement Development Concept and Integrated Settlement Development Strategy 2014–2020 – preliminary examination

The favourable situation is basically explained by the fact that there was a significant migration surplus, which could counter-balance the negative tendencies of natural population losses. The positive migration balance is the result of a continuous immigration into the town from rural areas and that the target-settlements of outmigration are belonging to the town, at least administratively. Although suburbanization is important the population of the town did not decrease. The population gain of the surrounding small settlements is huge.

Education level

The general educational level of the population has increased significantly in the last decade. It can be explained by the fact that Debrecen is an educational centre of the region: the town consciously enforced public education, and the massification of the higher education.

10. Table: Population breakdowns by education level in the 2001 and 2011 censuses in Debrecen

Year	No elementary school (over 10)	Elementary school (over 15)	Secondary school (high school degree) (over 18)	B.A. or M.A. (over 25)
2001	0.7	92.8	51.1	19.1
2011	0.5	97.1	62.5	27.6

Source: Census volumes for the years concerned – Debrecen Settlement Development Concept and Integrated Settlement Development Strategy 2014–2020, preliminary examination

Employment

The economic situation and employment indicators of Debrecen are favourable, but as it is the centre of the Northern Great Plain region with economic and social difficulties, Debrecen faces certain problems. Full-time employees are broken down by sector over the past decades (Figure 11), which shows the change in the situation of individual sectors: because, at the end of 2000s and the beginning of the 2010s both construction and tourism, and activities related to finance went into recession, which explains that the number of working people decreased. By contrast, the Shared Service Centre sector plays an increasingly important role in the economy of the town, which appears in the significant increase of the number of employees in the information and communication sectors.

11. Table: Changes in the distribution of full-time employees by sector In Debrecen between 2009 and 2011 (persons, on 31 December of the year concerned)

Sector	2009	2010	2011
Agriculture	691	962	1183
Industry	12239	10148	11621
The manufacturing industry within the industry	10293	8241	9766
Building industry	1569	1350	1231
Trade and motor vehicles repair	5130	4728	4752
Transportation and storage	4353	4164	3964
Accommodation services, catering	1391	1177	1175

Information, communication	841	1 564	1 734
Financial and insurance activities	1 140	1 113	1 051
Real estate transactions	439	354	200
Professional, scientific and technical activities	539	453	688
Administrative and service support activities	2 126	2 284	2 298
Public administration, defence, compulsory social security	6 732	6 834	6 634
Education	10 334	10 764	10 504
Human, health and social care	4 380	4 064	3 998
Art, entertainment, free time	885	882	931
Other services	195	297	230
Total	52 984	51 138	52 194

Source: Census volumes for the years concerned – Debrecen Settlement Development Concept and Integrated Settlement Development Strategy 2014–2020, preliminary examination

3.1.2. The most important residential districts in Debrecen

Downtown

The Downtown is the historical core of Debrecen, whose population number dropped significantly, more than the average of Debrecen, in the period between the 1990 and 2001 censuses, and this has continued in the new millennium. By contrast, the number of dwellings increased between 1990 and 2001. The ratio of low-comfort flats is low. The Downtown is one of the oldest districts of Debrecen considering the age structure of the town. There is a high proportion of people with a higher education degree and a relatively high proportion of people with a maximum primary education within the age group of 15–59. The significant part of the town's administrative, cultural, and commercial-catering establishments are in the Downtown.

Traditionally built-in inner residential area

The traditionally built-in inner residential area includes the ring surrounding the downtown. The small-town character dominates the constructions, broken by condominiums in some areas or continuous blocks of flats estates. The number of inhabitants in the area decreased significantly between 1990 and 2001, which has continued since. Regarding the housing stock, a slight decrease can be observed in the whole town district. There has been a rejuvenation in the western part of the district, which is, however, largely attributable to the fact that the number of people over the age of 60 decreased more, than the number of people under the age of 15. The economic functions of the traditional built-in areas are less significant. Among the institutions of

the district, the concentration of public administration and retail and catering institutions is higher.

Blocks of flats estates

Most of the districts of the blocks of flats estates are in the western part of Debrecen. Their construction began in the 1960s and continued in the 1970s, 1980s and 1990s. The number of the population decreased continuously in the blocks of flats estates between 1990 and 2001, except for two areas. One is the Epreskert (new condominiums), and the other is the Ispotály district (new residential estate).

The age structure of the population of each town district is basically related to the period of the construction of the concerned blocks of flats estate. Families with small children moved in the newly built homes, but as children were growing up, however, these homes could less and less meet their expectations, therefore the children or the entire family have moved out. The result of all these processes is the aging of the population. In the employment situation of the blocks of flats estates, favourable tendencies can be observed with only one or two exceptions. The proportion of people in employment aged 15–64 is higher than the town's average, while the proportion of people aged 15–59 without a regular income from labour is nowhere worse in this age group than the average of the blocks of flats estates in Debrecen.

Villa quarter

The Villa quarter district is in the northern part of Debrecen. Analysing the population change between 1990 and 2001, a drop of more than 10% occurred in this district (the decline has continued since 2001),

despite the constructions of new condominiums that took place in that decade, and which was nearly 15% in the Nagyerdőalja district. This district of Debrecen has the oldest population. This is particularly typical of the Nagyerdő quarter, where the aging level has been very high, because, those who moved in the condominiums built in the 1960s/70s have not thought of leaving the town even in their older age thanks to the pleasant living environment, while their children have moved out, as mentioned earlier. One of the town's most important sports and educational centreis located in the northern part of Nagyerdőalja district.

Suburb

In addition to blocks of flats estates, the Kertváros/Suburb area hosts the other large population conglomeration of Debrecen, but unlike the blocks of flats estates, in this part of town the number of inhabitants increased further between 1990 and 2001, and moreover, the population density is much smaller thanks to detached house constructions. The suburban district experienced population growth between 1990 and 2001, except for the southern suburb. Since the 2001 census, several significant housing estate investments have been carried out in the Kertváros district which have influenced the population of the given area (growth) and age composition (revitalization) in a positive direction. The third source of population growth after 2001 has taken place in the gardens area at the southern and eastern borders of the town, where a significant number of family houses have been built recently. According to the age structure of the population, this district of the town, and especially some quarters of the district have better values than Debrecen as a whole.

Industrial zone

The industrial zone comprises the town quarters that play a prominent role in Debrecen's economic life. In addition to the production facilities, commercial units have been playing an increasingly important role in the economic life of the area.

3.1.3. Housing, housing constructions

Between 2008 and 2012, the housing stock increased only slightly in Debrecen, and the growth dynamics were constantly decreasing. Compared to 2008, the number of flats in the town only increased by 1000. In 2012, the number / proportion of flats built was only a quarter of the year 2008. In the case of new homes, the number and rate of self-contained flats are high. The proportion of new flats with gas pipeline and bathroom in all new homes was 90-95%, only the supply of the public sewerage showed a smaller proportion. The average floor space of the newly built flats over the last half decade has exceeded 100 square meters. More than 60% of the new homes have three, four or more rooms, whereas the rate of one – and two-bedroom flats remains below 40% collectively. During the examined period, no service or social rental flats were built in the town, most of housing constructions were realized as private investments.

12. Table: Dwellings, housing constructions 2008–2011

Flat characteristics	**2008**	**2009**	**2010**	**2011**
Dwelling stock (pcs)	89 716	90 124	90 342	90 502
Number of dwellings built (pcs)	883	476	291	208
Number of dwellings with gas pipeline built during the year (pcs)	859	452	274	197
Total ground-space of dwellings built during the year (m^2)	78 154	52 268	33 753	26 526
Number of one-room flats built during the year	85	11	4	5
Number of two-room flats built during the year (with one and a half rooms) (pieces)	191	32	31	17
Number of dwellings built with public utility water in the year	875	469	287	204
Number of flats ceased during the year (pcs)	111	68	73	48
Number of three-room flats built during the year (including flats with two and half rooms) (pcs)	227	121	82	36
Number of flats with four and more rooms built in the year (including flats with three and half rooms) (pcs)	380	312	174	150
Number of houses built during the year (pcs)	355	282	176	143

Number of flats built by enterprises during the year (pcs)	334	108	44	31
Number of flats built by natural persons during the year (pcs)	548	368	247	177
Number of flats built for sale during the year (pcs)	368	152	47	37
Number of flats built for own use during the year (pcs)	509	324	244	171
Number of dwellings built as family house during the year (pcs)	300	255	170	159
Number of multi-storey, multi-flat houses built during the year (pcs)	453	138	83	36
Number of flats built in the form of group housing (row house, chain house) during the year (pcs)	123	77	30	11
Number of dwellings ceased for other reasons during the year (pcs)	29	10	9	3

Source: Local Equal Opportunity Program 2013–2018, Debrecen Town of County Right

According to the 2011 census data, most of the flats in Debrecen (61%) were built in the period between 1961–1990. Consequently, the comfort level of the dwelling stock is relatively high, the number and rate of no-comfort flats are quite low, and the number of flats and houses over fifty years is not high, and in 2011, only 7 per cent of the flats in use were built before 1960. According to the usage right, private ownership dominates (83%). In terms of floor space, the number of flats is the highest with a maximum of 60–79 square meters, and as a permanent result of the prefabricated constructions, the number and proportion of flats with 50–59 square meters are almost the same as that of the previous one. The number of flats smaller than 29 square meters is relatively low, 2.5 percent in the housing stock, but the proportion of flats with a floor space larger than 100 square meters is over 14 percent. According to today's standards, the total number of dwellings with an obsolete construction (cob or mud walls) is 2526, which is 2.8 percent of the total housing stock in Debrecen in 2011.

Local government's housing stock

Within the housing stock in the town, in 2011, 2858 flats were owned by the local government. Of which, 1545 flats were less than 49 square meters, the local government owned 739 ones with 50-59 square meters, 485 were between 60 to 79 square meters. The number of dwellings owned by the local government with a larger floor space is only 89. In other words, the municipal housing stock has unfavourable conditions; they are mostly small in size, consisting mostly of one or two-bedrooms residential properties.

Characteristics of the population of the different quarters of the settlement

Debrecen's most elderly neighbourhoods are basically divided into two groups. First, this includes the inner parts of the town (mainly the downtown and the traditional constructions in the north-eastern part of the town), which have been less popular among younger age groups for some time. The other group consists of the blocks of flats estates built in the 1960–70s and the Villa quarter, whose age structure was very youthful at the time of the investments, but since then, no new developments have taken place. As a consequence, their popularity decreases (or stagnates), because, the size of the apartments is less than the average (this is true of housing estates) or they are in need of renovation (e.g. Villanegyed quarter), and therefore they are not really attractive to younger settling families, and today a significant part of their populace is the original inhabitants, now in the age group of older people.

The population number in the 27 populated quarters increased in 13 and decreased in 14 between 2008 and 2013. A significant portion of the blocks of flats estates experienced 10% or greater population decline. According to changes in the spatial trend of the residential population, growth occurs mainly in the districts where large concentrated residential real estate investments (e.g. Ispotaly, Liget, Fészek residential park) have taken place in recent years, and consequently, a large number of people have moved in these neighbourhoods. The increase in the residential population number in the outskirts can be explained by the fact that, due to the high living costs, more and more people have decided to sell their flats in the central area and move to the outer parts. The primary areas of decline are the blocks of flats estates, which can be attributed primarily to the fact, that the former multi-generation families are

replaced by single-generation families, partly because, the young and the large families move out, and that small families move in.

3.2. Energy use, energy management and energy supply in the CSA

The town's energy supply expanded between 2001 and 2011, both the gas pipeline network and the low-voltage power distribution network were expanded: 11.8% for the former and 9.8% for the latter. Electricity supply in Debrecen can be considered as complete, with annual electricity consumption per household being 2,231,189,000 kWh in 2011, representing 125.3% of 2001.

In the residential heating system (Table 13), the number of household gas consumers increased between 2001 and 2011, while the number of district-heating homes in the housing estates declined minimally.

13. Table: The most important characteristics of residential energy consumption in 2001 and 2011

Year	number of household gas consumers	number of dwellings connected to district heating
2001	61 394	30 912
2011	66 919	30 895

Source: Sustainable Energy and Climate Action Plan of Debrecen – 2. Working draft document for public consultation – available in Hungarian)

The deployment of public lighting can be considered adequate in the inner areas of the town, but further developments are needed in the garden area, but especially in the outskirts. The district-heating supply of Debrecen's buildings is provided by Debrecen District Heating Ltd., a member company of Debrecen Asset Management Ltd. The company's primary target market is the people living in the blocks of flats estates (33% of the town's housing stock was supplied with district heating in 2011) in the new millennium, however, the company has sought to acquire new markets among non-residential consumers (e.g. educational, commercial, and cultural institutions).

Using renewable energy systems, opportunities for environmentally conscious energy management

In Debrecen, the demand for environmentally conscious energy management is also increasing, with more than 25% of the newly built homes – that are low in number – already have renewable energy or use other environmentally friendly technologies. These newly built apartments are mainly realized in newer housing estates and suburban areas. At the same time, this technology has, albeit only experimentally, appeared among the flats in the bulk of the housing stock that has been built with industrialized technology. The town's conditions allow for the use of geothermal energy for heating purposes, but only experimental initiatives have been made so far.

The blocks of flats program have been very popular in recent years, which indicates the environmentally conscious attitude of the population, wherein the local government has subsidized nearly HUF 1 billion to renovate more than 6,000 homes in 80 condominiums.

3.2.1. The main specialities of the case-study area (CSA) in energy policy

Energy consumption, projects and plans in Debrecen[1]

The management of Debrecen town with the commitment of sustainability, emission reduction and energy efficiency works together with the Covenant of Mayors in Europe, and undertaking to create a Sustainable Energy and Climate Action Plan (SECAP) to substantiate the relevant measures.

Debrecen undertakes the followings:

- Reduces CO2 emission by at least 40 percent in the city by 2030 (compared to 2013 as a basis year)
- Elaborates an SECAP including the emission inventory, and outlines how to performing the goals set.
- Evaluates and monitor the progress, and writes a report in every second year about the performance of the plan.
- Organizes local "energy days" on possibilities and advantages in the field of energy efficiency for the citizens together with the European Commission and other interested parties; and regularly informs the press about the performance of the SECAP.
- Actively participate the Conference of Majors organized by the European Union.

[1] The content of the chapter is based on Debrecen megyei jogú város fenntartható energia és klíma akcióterve (SECAP), 2. Munkapéldány – Társadalmasítás/ Sustainable Energy and Climate Action Plan of Debrecen – 2. Working draft document for public consultation – available in Hungarian) (https://www.debrecen.hu/assets/media/file/hu/9347/debrecen-energia-es-klimaakcioterve-secap.pdf)

The document, SECAP of Debrecen, is available in Hungarian and was realised on 31. October 2017. The action plan covers information and data of the buildings and traffic of the city as well.

By implementing the objectives set out in the Action Plan, Debrecen achieves 42 percent less CO2 emissions than the estimated 2013 emission. This significantly outperforms the EU and Hungarian average performance, due to the Green City Program and the targeted sustainability measures. The measures help to achieve the 42% CO2 emission reduction goal by 612.607 t/year emission reduction from 2013.

The CO2 emission reduction can be the most significant in the following areas of action: buildings and establishments, industry, locally produced electricity, local district heating and related energy production, and sustainable traffic development. Accordingly, energetic modernization of buildings, increasing energy efficiency, and utilizing renewable energy sources in local energy supply proves to be the most effective measures.

Energy consumption

The most important information on infrastructure of Debrecen are summarized in Table 14.

14. Table: Infrastructure of Debrecen

	2013	2015
Number of flats	95.294	95.802
Number of natural gas consumers	73.442	73.139
Number of household natural gas consumers	68.928	68.463
Number of heating consumers out of household natural gas consumers	57.557	57.332
Number of electricity consumers	122.027	122.401
Number of household electricity consumers	113.619	113.833
Number of households with district heating	31.268	31.301
Number of households supplied by warm water	31.297	31.408
Number of household in drinking water supply	89.126	89.796
Number of households connected to sanitary sewer system	81.318	81.864
Selective waste collected from the inhabitants (t)	1.068	1.706

Source: SECAP of Debrecen

Energy sources

The natural gas, as an energy carrier, plays significant role in the energy supply of Debrecen. In 2013 there were 73.4 thousand gas consumers, including 68.9 thousand households of which 57.5 thousand were heating consumers. By 2015 the number of gas consumers declined, with the number of household consumers

changing to 68.4 thousand, of which 83.74 per cent was heating consumer.

The electricity supply network of Debrecen has a length of about 1617.3 km. In the city there are over 122 thousand electricity consumers, including 113.6 thousand households. This number had a little bit increased till 2015.

In the district heating system 32.67% of the household were connected in 2015. A bit more consumer (appr. 3.4 per cent more) was connected to the hot water network. The length of the transmission line is 89 km.

Building stock

The buildings owned by the self-government were built mainly the 1950s–1970s; only 15 per cent of the buildings were built in the last 20 years. Each building is either connected to district heating or has central heating managed by heating centre. The share of building materials is the following: 50% of brick, 40% of brick and concrete, 2% of concrete and 7% of blocks.

The 20% of the residential buildings was built before 1960s, and only third of it was built after 1990. Most of the residential buildings are single-storey houses, only 10 per cent is the rate of the multi-storey houses. Between 2008 and 2013 energy efficiency modernization was carried out for 10.298 multi-flat houses and 1.048 detached houses. The use of renewable energy (soil panels or collectors) is also growing.

3.3. National policy background

3.3.1. Description of the Hungarian energy policy

In the first part of chapter we present and analyse Hungarian energy policy, legislation concerning energy production and energy use, and finally also discuss the main energy sources, and the relationship between energy sources and attitudes toward energy use. First, we show the main trends and facts of energy consumption at national level, the main energy sources and the possibilities of renewable energy use. Then we present the national plans (National Energy Strategy) on energy production and the use of renewable energy production.

Energy supply and demand

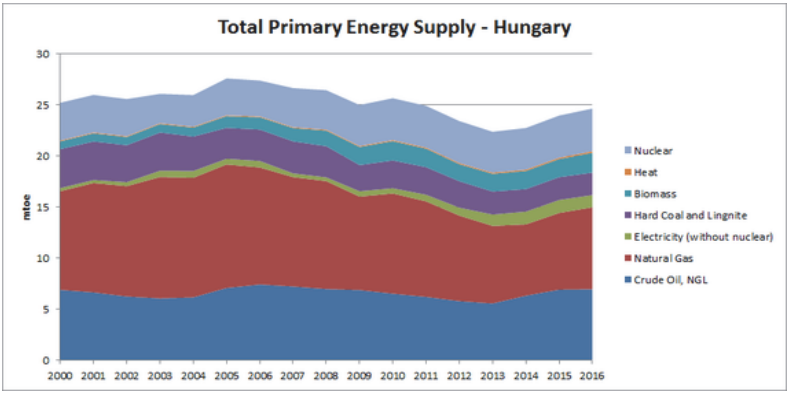
Hungary's energy use was quite balanced and uniform in the last 15 years, with a decrease between 2009–2013. The sum of primer energy use was 1019700 TJ[2] in 2015. The share of national energy sources approximately 30-35 percent of the total energy used. According to the Hungarian Energy Strategy 2030, primary energy intensity in 2007 was nearly 2.4 times the EU average.[3] „Energy consumption per capita is 2.5 toe (20% below the EU average), including 3 800 kWh of electricity (31% below the EU average) (2016)".[4]

As it stated in the National Energy Strategy 2030, Hungary is vulnerable in terms of energy supply, 62 percent of total energy requirement is supplied by the import of fossil fuels (Figure 1). In

[2] http://www.ksh.hu/thm/3/indi3_1_2.html
[3] http://www.enercee.net/index.php?id=298
[4] https://estore.enerdata.net/energy-market/hungary-energy-report-and-data.html

particular, 82 percent of the natural gas supply is imported from Russia.[5]

1. Figure: Total primary energy supply of Hungary (in mtoe) 2000–2016

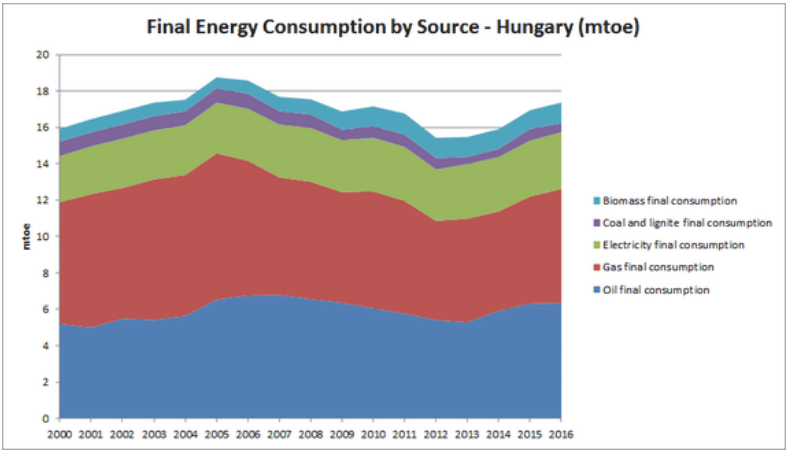


Source: Energy in Central and Eastern Europe, enerCEE.net, Austrian Energy Agency (http://www.enercee.net/index.php?id=298)

Oil (34.3%) and Gas (33.9%) remain the main energy sources for final consumption in 2016 (Figure 2). Electricity, Biomass and Coal and Lignite have only minor parts in the consumption.[6]

[5] Ministry of National Development (2012) National Energy Strategy 2030
[6] http://www.enercee.net/index.php?id=298

2. Figure: Final energy consumption by source (in mote), 2000–2016



Source: Energy in Central and Eastern Europe, enerCEE.net, Austrian Energy Agency (http://www.enercee.net/index.php?id=298)

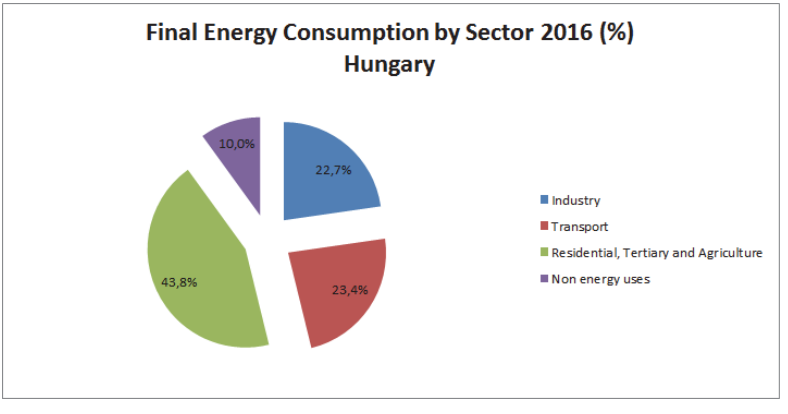
The residential sector is the largest final energy consumer, responsible for 30% of total CO2 emissions.[7] Consumption in the residential, tertiary, agricultural sector remains at a fairly stable level over the period 1990 to 2005. The years 2006 and 2007 show each a remarkable decrease. [8]

Consumption in industry was decreasing at the beginning of the 20th century. The decrease continued thereafter however at a much lower rate to reach a share of 22.7% by 2016. Non-energy uses represent a minor share of 10% in 2016. The share of transport is

[7] http://www.enercee.net/index.php?id=298
[8] http://www.enercee.net/index.php?id=298

growing steadily to reach 23.4% in 2016. The residential, tertiary sector with agriculture accounts for 43.8% of final energy consumption in 2016 (Figure 3).[9]

3. Figure: Final energy consumption by sector (in percent), 2016



Source: Energy in Central and Eastern Europe, enerCEE.net, Austrian Energy Agency (http://www.enercee.net/index.php?id=298)

The figures of energy import and export in the table below are summarized by the International Energy Agency[10].

[9] http://www.enercee.net/index.php?id=298

[10] International Energy Agency (2017) IEA World Energy Balances 2017, Hungary

15. Table: Energy import/export in Hungary

FUEL	QUANTITY	IMPORT/EXPORT COUNTRY
Crude Oil		
Imports Exports	6.3 Mt 0.1 Mt	Russian Federation (76.2%) Slovak Republic (81.3%)
Oil Products		
Imports Exports	3 Mt 2.8 Mt	Russian Federation (25.6%) Slovak Republic (28.3%)
Naturalgas		
Imports Exports	8.6 bcm 1.1 bcm	Russian Federation (95%) Ukraine (94.4%)
Coal		
Imports Exports	1.5 Mt 0.2 Mt	United States (35.2%) Romania (99.1%)
ELECTRICITY		
Imports Exports	19.9 TWh 6.2 TWh	Slovak Republic (49.2%) Croatia (77.9%)

Source: IEA World Energy Balances 2017

Nuclear power is the key element in Hungary's energy strategy and its decarbonisation plans. The portion of nuclear energy in electricity generation was more than 60% in 2015. Hungary is planning to further increase its reliance on nuclear power with the expansion of the Paks nuclear power plant, thereby strengthening its ties to Russia, which is financing the new plant and supplying all of Hungary's nuclear fuel (Schulz et al 2017).

"However, Hungary has significant potential for renewable energy and energy efficiency: according to a recent study, 2,800 MW of wind and 1,400 MW of solar capacity could be installed by 2030. […] Compared to the rest of Europe, Hungary also has a high potential for geothermal energy, and biomass could be used more efficiently. […] Looking at the actual levels of installed capacity – 23 MW for solar, 330 MW for wind and 906 MWth for geothermal energy – this potential is far from being exhausted" (Schulz et al: 6–7).

"The share of renewable energy in Hungary's energy system has increased significantly in the last decade, but this growth has levelled off in recent years. […] the recent reform of the support mechanism and the introduction of the support system for electricity generation from renewable sources (METÁR), are helpful" (Energy Policies of IEA Countries: Hungary 2017 Review: 12).

On the other hand the government has put serious obstacles in the way of increasing the ratio of renewable energy, such as a new regulation (277/2016. [IX. 15.] Gov.decree) that due the strict rules prohibits new wind power projects, and levy a tax on solar cells and power (LXXXV. Law). The 277/2016. [IX. 15.] Government decree on amending the rules on wind turbines[11] practically band the establishment of wind power station – excluding household size station – within a radius of 12 000 m around settlements. This, and other included rules, de facto prohibits new wind power stations on the entire territory of Hungary; therefore the wind power use in the country is almost impossible. In the LXXXV. Law (2011) on the environmental products fee, the Parliament accepted that solar cells belong to the Category III. – products with significant environmental pollution and load. It means that the environmental products fee, the tax to be payed at buying a solar panel is 114 HUF/kg – which is 5-7

[11] Government of Hungary (2016) 227/2016 (IX. 15.) Gov. decree

time higher than in the EU – after 01.01.2015. (Remark: from 01.01.2018 the environmental production fee of the solar cells is reduced to 57 HUF/kg, which is still above the European average, but this reduction may enhance broader the utilization of solar cells.)

Energy efficiency is the other important pillar of Hungary's energy strategy. Forty percent of energy consumption in Hungary related to the heating and air conditioning of buildings, 81% of this is the energy consumption of detached houses. As the Ministry of National Development has stated the Hungarian building stock mostly outdated regarding the energy use, so here is an untapped potential in increasing energy efficiency.[12] (National Energy Strategy 2030). The fact that the energy saving is cheaper in case of residential buildings than in public ones also underpin the importance of energy efficiency development of residential buildings. (The ration of energy saving and related costs given in the National Building Energy Strategy: 1 PJ saving for 95 billion HUF in case of public buildings and 1PJ saving for 42 billion HUF in case of residential buildings)

In spite this fact, in 2015, the government attempted to reallocate EU funding from non- refundable energy efficiency investments in residential buildings into the refurbishment of public buildings (Schulz et al 2017).

Targets of the National Energy Strategy (NES)

The main target, while considering the environmental issues, is to improve the portion of renewable energy up to 14–65%, and to save 10% more energy compared to 2005 as base year. The 13% target of the portion of renewable energy by 2020 was fulfilled in 2015 already. The greenhouses gas emission shows decrease by 39.2% compared

[12] Ministry of National Development (2012) National Energy Strategy 2030

to base year 1990, and by 24.6% compared to base year 2005 (National Reform Programme 2017).[13]

The Hungarian Energy Strategy 2030 indicates that the total primary energy saving is planned to reach 189 PJ by 2030. "The entire supply chain must be taken into consideration in order that the level of primary energy use can be maintained through the improvement of energy efficiency, as the collective result of technological solutions, economic incentives and social awareness-raising." The key elements of the entire supply chain and the share of energy saving in percentage are: Building Energy Programme (retrofitting of residential and industrial buildings) (58.7%), Replacing coal power plant (12.7%), Replacing gas power plant (19.6%), Reducing grid loss (6.3%), and Replacing low-efficiency renewables (2.65%). Numbers are calculated based on Fig 17: Milestones of the energy conservation projects up to 2030 (Hungarian Energy Strategy 2030: 59) In line with the Europe 2020 Strategy the announced new national energy efficiency target is 92 PJ primary energy saving, which means 73 PJ final energy consumption saving" (Kapros 2016: 1). "By the implementation of a substantial building energy program, the Energy Strategy would reduce the heating energy demand of the residential and communal building stock by 84 PJ, i.e. 30% up to 2030" (Hungarian Energy Strategy 2030: 125). A remark of András Rozmer (Energy Diplomacy Coordinator – European External Action Service, Brussels) at a conference[14], highlighted that the amounts and target numbers calculated – very carefully years ago – in the Hungarian NES may not be valid anymore as the circumstances are changing very dynamic.

[13] Ministry of National Development (2017) National Reform Programme

[14] The 6th Annual Forum of the EU Strategy for the Danube Region held on the 18. 10. 2017 in Budapest

3.3.2. Energy policy in the strategic documents

Relating umbrella strategic documents

National Reform Programme (NRP) 2017[15]

The energy issues in the NRP 2017 are summarized (along with employment, research-development, innovation and education) in connection with the fulfilment of Europe 2020 goals. The chapter rather describes the state of the art.

However, it is formulated in the Programme that one of the energy efficiency measures, with the highest impact, will be the establishment of an assistant network in the 18 counties and 58 district government offices. The energy engineers' tasks are planned (1) to provide technical guidance on energy efficiency for public bodies – including local governments – and businesses and (2) to advice citizens on the field of energy consumption reduction. The National Reform Program expects large-scale energy efficiency improvement by introducing the obligation of energy auditing in case of large enterprises and of the commitment of employing energy rapporteurs for bodies with high energy consumption, and also by introducing corporation tax reduction in case of energetic investments for any business.

National Climate Change Strategy 2008–2025

Climate Change Action Plans, including specific measures, are going to be developed every 3 years for fulfilling the targets set in the National Climate Change Strategy. Important issues are the de-carbonization, adaptation and awareness measures. The NCCS

[15] Ministry of National Development (2017) National Reform Programme

provides detailed and comprehensive calculation for the decarbonisation in case of different scenarios and also determines short-term, mid-term and in some cases long-term courses of actions for electricity production, buildings, industry, waste management and agriculture.

"Parliamentary Decision No29/2008 (III.20.) On the National Climate Change Strategy (NCCS) does not set out specific goals or an outlook for the use of renewable energy sources with regard to buildings. The NCCS does mention the necessity of the following renovations in the case of buildings: renovation or replacement of doors and windows, heat insulation of building enclosure surfaces (insulation of wall, attic and floor coverings, modernisation of heating installations, heating regulation, individual regulation of district heating (Hungary's Renewable Energy Utilisation Action Plan)."[16]

National Environmental Programme[17]

As the National Environmental Programme 2015–2020 states, there are great opportunities in the exploitation of renewable heat energy in Hungary, due to its natural conditions. Within this, the emphasis is on the use of geothermal energy and biomass associated with district heating. Enhancement of decentralization and local services are desired on the field of renewable energy, especially in case of solar energy.

The main goals of the Programme related to energy efficiency in the next period – in the context of climate change – must pay attention

[16] Hungary's Renewable Energy Utilisation Action Plan

[17] Ministry of Agriculture (2013) IV. National Environmental Programme in Hungarian (remark: the document is not available on the website of the Ministry of Agriculture)

that in parallel with the increase in income it does not increase again the household energy consumption:

- To develop an efficient, green and competitive economy.
- To achieve a 10% overall energy savings based on environmental considerations.
- To reduce the motorized traffic transportation needs, and facilitate the personal, non-motorized forms of transport.
- To reach a greener tax system with reduction of environmentally harmful subsidies (Kapros 2016).

Direct strategic documents

National Energy Strategy[18]

The framework of energy management in Hungary – in line with the European Strategy 2020 – is summarized in the National Energy Strategy 2030. The Strategy introduces the pillars and approaches of the energy strategy in Hungary and, as the main target, highlights the improvement of energy saving and energy efficiency. Detailed goals and targets are formulated in the National Energy Efficiency Action Plan and Renewable Energy Action Plan.

The motto of the National Energy Strategy runs: 'independence from energy dependence'. Rather than to achieve a desirable electric power mix, the objective of the National Energy Strategy is to guarantee the safe energy supply of Hungary at all times, taking into account the country's economic competitiveness, environmental

[18] Ministry of National Development (2012) National EnergyStrategy 2030

sustainability and the endurance of consumers. The preference of the plan is the Nuclear-Coal-Green[19]scenario.[20]

The document lays downs five crucial efforts:

- increasing energy savings and energy efficiency,
- increasing the share of renewable energies,
- integrating the Central European grid network and constructing the required cross- border capacities,
- maintaining the existing nuclear capacities and
- utilizing the domestic coal and lignite resources in an eco-friendly manner for power generation.

The only way to achieve the objectives of the strategy, including in particular the ensuring of affordable energy supply to consumers, is by increasing the involvement of the government. In addition to the above, Hungary cannot, for the time being, afford to renounce fossil fuels. Natural gas, purchased at a reasonable price, will continue to play an important role, whereas the Hungarian coal and lignite resources represent the strategic reserves of Hungarian energy policy as it stated in the National Energy Strategy. Since mineral resources and the geothermal and biomass potential are a national treasure, they should be employed and developed nationally and treated partly as strategic supplies. However, for supply security reasons, the eco-friendly utilization of domestic coal and lignite deposits should play an increasing role in the long term.

The three most important elements of the strategy are (1) energy efficiency, (2) the share of renewable energy and (3) maintaining (or

[19] Green energy means mainly biomass in the Hungarian Government's point of view

[20] Ministry of National Development (2012) National Energy Strategy 2030

even enhancing) nuclear power. Therefore, there is a detailed description is given.

Energy efficiency

Energy efficiency projects in the building sector are a key component of the improvement of energy efficiency. As it was already mentioned, today 40% of all energy consumed in Hungary is consumed in buildings, two-thirds of which goes to heating and cooling. 70% of the approximately 4.3 million.

Remark: the energy efficiency plans, and developments are focusing mostly on buildings, therefore a strategy has been elaborated on national level on the insulation of buildings.

Renewable energy sources

The share of renewable energy will increase to approximately 20% (indicative target) by 2030 in terms of primary energy demand. One of its prerequisites is bipolar agriculture. The cultivation of biomass for energy purposes, however, must be achieved in a strictly regulated manner. The main roles will be played by biogas and biomass power plants making the most of local conditions and retaining profits locally, generating both decentralized heat and electric power, geothermal and solar power-generated heat and wind power. To increase the share of solar and wind energy, the flexibility of the electric power system must be improved, by means of a hydro-pumped plant, among other things. Another important question is the energy utilization of communal and industrial wastes non-utilizable in their materials and of waste waters.

Remark: The most important sources of renewable energy according to the strategy are biogas and biomass. The government hardly supports, or even hamper the use of other types of renewable energy sources, such as solar and wind energy.

Nuclear energy

Nuclear energy is important means of both energy independence and climate protection in Hungary. The assumption is that the share of nuclear energy will be at least maintained at the current level over the next few decades.

Remark: The Hungarian government frames nuclear power as a guarantee for energy independence, despite the exclusive reliance on Russia. The Government is expecting energy use to increase in the future and Hungary's nuclear policy is based on this assumption. Nuclear energy is the key low-carbon technology that Hungary is relying on (Schulz et al 2017).

National Building Energy Strategy[21]

For the execution of long term and effective measures in the field of energy efficiency of buildings the National Building Energy Strategy was elaborated in 2013.

The strategy includes a detailed action plan for the government between the period of 2015–17 in the following tasks:

Achieve energy savings in existing buildings (Residential and public buildings refurbishment: 40 PJ/a, Enterprises buildings

[21] Ministry of National Development (2012) National Energy Strategy 2030

refurbishment: 4 PJ/a, Other energy savings in buildings 5 PJ/a, so the total is 49 PJ/a.)

Standards for new buildings and building renovations

A new building where the building permit is applied after 01.01.2016 and the certificate occupancy will be launched after 31.12.2020 have to be 'Nearly Zero Energy Building'

> *"In this case the planned new buildings have to be designed according to the present regulations, specifications; but the date of the certificate occupancy determines the requirements that the building has to fulfil. What they are planning now is good and if they are justified by calculation, it is still good, but if it's only going to be used after 2020, it will not work. And, in my opinion, designers are often unaware of this, nor are customers sufficiently aware of it."* (Expert interview, recorded at 11.05.2017)

Research, development, dissemination, innovation, knowledge, training and information

Building energy requirements are set in the 20/2014 (III.7.) Ministry of Interior (BM) Regulation:

- Stricter standard regulations must be used for any significant refurbishment with EU or national support, and for new building construction or major renovations: 22 new U-values for facade walls, windows, roofs, etc. are defined.

  "The problem is the excessive tightening at a refurbishment will make buildings precluded. So it is not an option that the owner significantly improves the insulation and is adequate, but must

go to new level. The inhabitants have no budget for it and at that moment the houses begin to ghetto. So I think of the buildings to be renovated, these stairs are very rough." (Expert interview)

- The cumulative primary energy performance is also stricter. The primary energy conversion factor for district-heated buildings also changes, so the CHP origin of the district heating could be evaluated also by labeling of buildings, if the CHP ratio is more than 50% (Kapros 2016).

National Renewable Energy Utilisation Action Plan[22]

The share of renewables in final energy consumption should reach 13% by 2020. Hungary's National Renewable Energy Utilisation AP 2010–2020 (2011) raised the target of energy from renewable sources in total gross energy consumption to 14,65% by 2020 based on the energy path and limiting factors, detailed in the document. By 2020 renewables should account for 10% of transport consumption, 10,9% of electricity consumption and 18,9% of heating consumption.[23]

"In the use of renewable energy sources at national level, the promotion of local applications is of special importance. A significant portion of renewable energy sources is available cheaply, and at the same time, regions in the countryside could fulfil a significant part of their energy demand through own resources in an environmentally sound manner and at lower costs. Renewable energy production and development could have a positive effect on local governments, as they could launch developments for the renewable-based energy

[22] Hungary's Renewable Energy Utilisation Action Plan
[23] http://www.enercee.net/index.php?id=298

supply of public institutions managed by them by using locally produced raw materials and local workforce."

Energy strategy in practice

Despite having detailed short-term and mid-term strategies, we can conclude that Hungary's energy strategy today has the following characteristic in practice:

- "Public utility cuts": Reduction of energy prices for domestic consumers which can have two main impacts: (1) the costumers feel that the energy has no value, it is a natural resource that was and will be available, and (2) the industry and energy suppliers have to pay the remaining expenses.
- Centralized energy supply and service (state owned National Public Utilities Ltd.) that also may hamper the development of the diversified and decentralised renewable energy production, that is completely against the goals set in the Hungary's Renewable Energy Utilization Action Plan.
- Commitment for the new nuclear capacity development.
- Restriction of establishment of wind turbines and levy tax on solar cells.
- Levy tax on energy suppliers (Robin Hood tax), which mainly effect foreign companies.

Other obstacles:

- Subsidies for building energy efficiency development, mainly insulation and replacement of windows and doors and application of solar cells.

  "We pack very well (remark: insulation of the building), but in the sense this is a living space, and fresh air supply is not ensured. So when we say that students study in a tempestuous

poor building or people live in a blockhouse, people are at the expense of their quality of life, only they do not know… The biggest pitfalls of energy modernization are fresh air supply." (Expert interview, recorded at 20.07.2017)

- The rapid changes of the legislation in the building sector can make the designers uncertain and they have more tasks to do, and also may slow down the decision-making and building certificate processes.

  "If I go to the head of the technical department and ask him something, we know each other for a thousand years, he says, "Wait!"

  - *What do you do? You do not know? – I ask.*
  - *No, every day I look at everything.*
  - *You, who have been here for a thousand years in the chair?*
  - *Yes.*

  So now consider that an official head of department looks at the letter of the law each time. I sit in the small office and many colleagues, so we who are technical people, we are not legal professionals." (Expert interview, recorded at 05.31.2017)

3.4 Subsidies for energy efficiency developments: Available programmes and initiatives aiming at household energy use reduction

Subsidies for public and local governmental buildings

The support for energy efficiency projects is expected mainly from two EU – Hungary co-financed programs (KEHOP, TOP) between 2016–2020. The TOP (Regional Development Operational Programme)

selection of projects is based on a multi-stage process, in which a key element produced by the county governments development plans and concepts which already made in 2014. The KEHOP (Environment and Energy Efficiency Operational Programme) is managed by Ministry of National Development, and the TOP is managed by the Prime Minister's Office (Kapros 2016).

> *"…it is not worth waiting for state support because there are such criteria that in the end, let say that 50% is given by the state, it is more expensive than to do it by yourself and then do what you want."* (Expert interview)

> *"The driving force is money, saving money….Inessence; they have achieved a 60% savings on heating in particular. And this is the financially serious item."* (Expert interview)

> *"So, it was possible to replace a window, thermal insulation, but for example, no dime for mechanical systems was given. So, for example, it was a shock to me, because it does not make much sense."* (Expert interview)
> *"Today, those people can do it (remark: energy saving and green energy investments) who are not necessarily aware of the environment and do it because of their wallet. The one who really needs it, usually does not have the money for it."* (Expert interview)

All the interviewed experts agreed that most of the subsidies targeting direct energy efficiency investments (modernization of heating systems, thermal insulation and replacement of windows, establishment of renewable energy production systems, etc.) support only people with own saving, as most of the programs need pre-

finance. The application forms are complicated, and the online registration closes very fast due to the limited budget. The complicated procedure and high taxes lead the people rather to the grey and black market.

It means that only in advance and well-prepared application forms have the opportunity to win. In case of luck of own saving, proper knowledge and ability, or without Internet there is no chance to get subsidies.

Other possible sources

A new element was a voluntary agreement with commercial banks. According to the contract in 2015 with the Erste Bank Hungary, the bank is required to start a new Energy Efficiency Loan Program with 100 million euros worth between 2016–2018. In addition, the Ministry of National Economy manages more residential housing modernization support programs. The purpose is primarily not the energy efficiency, but the overall renovation of the buildings. The main target is to help more young families to get the first home and help families with more children. However, some key objective, as accessibility or energy efficiency is also displayed. The achievable subsidy is basically an interest subsidy with 5 years duration. The subsidy is 50% of the government bond yield (Kapros 2016).

There is another popular operating public support, which is an additional support by own savings for housing purposes. It is necessary to open by a commercial bank a special savings account and take a regular voluntary payment for 4 years at least (and for 10 years maximum). The government gives an additional payment (+30%, but maximum 72,000 HUF/year) to this account in every year. So if the monthly payment is 20,000 HUF the guaranteed rate of return can be

achieved 12.72%. This savings can be used for every cost related to housing, including energy efficiency purposes or buying new home, etc. One time one person can have only one special account, but in one family every person (parents and the children) can have an own special account. It is freely allowed to use more contracts by one project. Another useful possibility is that the employer can provide tax-free support to its staff members for residential purposes in the cafeteria system (Kapros 2016).

4. Initiatives to reduce household energy consumption

We analyse two types of local initiatives to understand the context of energy-related practices, and the motivation of locals to start energy saving activities. The first bunch of initiatives aim at investing in solar panels to produce hot water, heating and electricity, the second bunch of initiatives are aiming at insulation of block of houses to reduce energy loss and modernize heating system.

Solar panels are usually used by detached houses; these initiatives are the examples of changing energy sources from fossil, to renewable energy source. Insulation of blocks is an example of reducing energy consumption; usually parallel to the insulation also the heating system is modernized, but it does not mean a radical shift: only a more efficient, but still fossil energy source is used. The case studies aim at revealing the motivation of the locals and also other stakeholders to start such initiatives. We analyse the conflicts among them, their interests and also the wider policy background. Both cases are illustrated by typical examples of the projects.

First, we present the projects developing energy use by solar panels, then in the second part of the chapter we present projects aiming at insulation of block-houses.

4.1. Solar panels

In Debrecen, the households equipped with solar panels can be found mainly in suburban areas. We chose houses with solar panels, and despite all our efforts, our interviewees were couples and families with a relatively high standard of living; although their financial situation slightly varied, all of them expressed that it is satisfactory.

There are two types of equipment to utilize solar energy: solar panels and solar collector. While the solar cell can produce electricity, the solar collector generates heating energy: hot water for heating and for the use. Basically, the solar cell and the solar collector can also be used flexibly – most of the electricity is used for household devices, while the solar collector is used to produce hot water, but after a small conversion, both can be used for heating an inverter or a radiator, for example. There is a significant difference between the two devices, while the solar cell is estimated to payback within a maximum of 10 years, the solar collector has a payback time of 15 to 20 years.

4.1.1. Families and their houses

In the following we present a general description on family structure, employment status, energy use (car, food, etc) of interviewees having solar panel or solar collector, then a general description of the houses and other devices follows.

Most of the interviewees belong to the upper-middle class. They share their home with their spouse, and have one, two or three older children, living apart. We had only one respondent at the age of thirty and two of them were over sixty-five, the major part were around fifty

(eight out of nine). Children over the age of 18 typically study at a university.

> *"Yes, we are a 50-year-old couple with my husband, we have three grown-up children who are only visiting their home, but they have been home for years. I have a lot of time at home because my job is to do a lot at home, but my husband does a little. So we live in a family house with a small roof garden."* (50-year-old woman with family house solar collector)

Most of the interviewees had MA or BA (seven out of nine). Our youngest interviewee is a successful business man. The rate of income varies; however, it can be stated in general that none of the respondents is struggling with financial difficulties. In most of the interviews, it turned out that a member of the family led to his own business, which provided him with a stable livelihood. The business also functions as an ancillary activity, supplementing the low pensions in the following case.

> *"(The income) is rather depressing, which is, of course, the pension of all three people. It is fortunate that, in particular, the husband's secondary activities and secondary tasks enabled the construction of this apartment and the creation of a certain amount of reserves covering some of the more luxurious objects or luxuries of the Hungarian average. I also include investments in energy efficiency that consciously notably the period when only pensions can be relied upon exclusively."* (Retired man, family house with solar panel)

Typically, in these families, males are the bread-winners, and the gender roles are distributed very traditionally: females are shopping and taking care of the homes and the children, while men make decisions concerning the car and long-term investments, like insulation.

> *"I'm not doing anything. That is, in our division of labour it looks like I'm bringing the money, making decisions, doing the car, the apartment, the big things. All of the important things that are not important to me, which is about life, are matched by mother, so what we eat, where we sit, where we travel, she is doing it. So I do not have to vacuum or wash the dishes either."* (53-year-old mansion with solar panel)

The general consumption of households is that they do not save on the use of convenient appliances, but they try to choose household machines and cars that are optimally consumed. The respondents typically travel by car, as the ordinary routine justifies, two adults in the family have two separate cars. Apart from domestic energy, heating and fuel, most of their consumption is consumed by food.

> *"Well, that's the fuel in the car, the other is the energy used for cooking. I cook with a light electric cooker, so this problem has been largely eliminated because the solar panels are the ones, so according to the last control data, the solar cells supply electricity to the apartment. In fact, there is very little difference between consumption and own production, and we usually get back to year-end billing because we are in this kind of regeneration system at E, so we can say that solar cells provide our energy power, so in this respect, I do not really care how to*

save on cooking" (Middle-aged woman, family house with solar cell)

4.1.2. Energy-related behaviour

According to our interviewees, it is general that people have several practices to save energy daily from tiny and cheap things to bigger ones. They use energy-saving bulbs and household appliances, but even make investments to reduce energy use: insulate their homes, replace the old doors and windows to plastic ones; one of the interviewees stressed even the importance of ytong brick in insulation. Some of them used more environmental-friendly vehicles for transport, they tried to use LPG instead of gasoline or hybrid cars, instead of traditional ones. Although the use of public transport and bicycles was very rare, there was one family reporting for them energy use reduction is highly important, thus they walk, go by bicycle or public transport during their everyday routines, they were among the few, who emphasized environmental values as a motivation to invest in solar panel. In another interview we found the opposite of this attitude. According to the opinion of a couple without a child, their household use unnecessarily much energy, as they have six refrigerators, five TVs. In this case, their friend's example motivated them, and they decided to invest in solar panels as soon as they have the resources.

"Because the house is big, and my income is so much I do not care ... obviously we are filled with energy saving bulbs and AA things, I have counted, we have six fridges, five TVs. And then everything is turned on it works, the jacuzzi goes all day, so there is consumption there." (53 years old man, family house with solar panel)

4.1.3. Motivations of the investment

According to our interviews there are four main reasons to invest in solar panels:

- Cost reduction
- Environmental consciousness
- Increase the prestige of the house / Follow the fashion
- Escape from energy-dependency

The interviewees' main motivation to decrease their expenses. They mentioned that the solar collector can decrease their warm water's outlay. An interviewee told that her/his gas bill decreased by 40%. Due to the solar cells the interviewees can decrease their electric bill. An interviewee who has a solar collector is planning to start a new investment plan and get a solar cell, because he would like to decrease his electric bill too.

Two other important views were appeared in the interviews. One perspective is that the holders of the solar cells don't pay attention to save energy because the sun produce back the plus energy what they use. In the other view the disadvantages of the solar collectors were mentioned. An interviewee said that they save money on the gas bill with the collector, but this increases his electric bill because of the pump. Another view shows that the collectors worth if there is a support but in another way it will goes broke before it pay for itself.

Two other explanation appeared in connection with the motivations. Firstly, one part of the interviewees wanted to protect their environment. And finally, another important point is that these investments mean a kind of prestige.

Cost reduction

Some interviewees reported that they had the necessary resources to invest in solar panels or collectors and found it an economically reasonable investment. An interviewee took advantage of a bidding source.

> *"We try to observe that what can be energy-saving and to think about the future that energy prices may change and preferably make the less dependent on these changes."* (50 years old woman, family house with solar collector)

Also, the quotation shows that cost reduction was an important reason for the investment.

Environmental awareness

Of course some interviewees mentioned environmental reasons for the investment. The interviewed family tries to live as badly as possible to nature, so they also plan to invest in an electric car.

> *"I do not think that someone wish to have a quick return of the investment would build a solar panel and getting rich out of it. and I do not think that it works. You're doing a solar panel, just to show that you did something for your environment, for the earth..."* (43 years old woman, family house with solar panel)

Prestige

Some of our interviewees reported that they saw the solar cell or solar collector on a familiar house, and because of their positive experience,

he decided to equip them. In many cases this has determined the choice between the solar cell and the solar collector.

> *"Yes, many family members who have lived in a family house have built solar cells, for example my husband's brother who used it for a year and they have already seen the difference in consumption and using their relationship we contracted with the same company"* (50 years old woman, family house with solar panel)

Increase the prestige of the house

The respondents had either solar panels, or solar collectors, we did not meet any interviewer who would have invested in more than one renewable energy system. One interviewee had solar panels and solar collectors, he installed the tools on his store. Several interviewees are planning a similar investment, but because they require substantial capital, they need a lot of savings.

A single interviewee installed both devices, he was a shop owner, he wanted to minimize the store's consumption. In his view, there is a significant difference between the return of the two instruments, while the solar cell is relatively fast, in the period of 6-8 years, the solar collector's return time is nearly twice as high. Many people mentioned that the lifespan of devices is unpredictable for the time being.

> *"So that you do not get any bidding money, so the solar collector does not have a lot of chance to get it back. So when the investment returns, it will break. I'm not talking about the solar cell, but about the solar collector. In the solar panel, I'm hoping it will still be worth it. I cannot tell you anything else; the energy of the sun should be used. If you try to do it, you will*

not have it, but the fact that these things will work in 10 years, we do not know. No one can tell" (Retired man, family house with solar panel*)*

To sum it up we can state that although usually locals started to equip solar panels to reduce energy bills, later to reason their decision they emphasize environmental aspects of the investment; by solar panels they would like to decrease problems caused by fossil fuels. The deeper analysis of the interviews shows that solar panels are kept by them as a prestigious investment. Although the main motivation was to increase the energy efficiency of the house, and before the investment owners considered long-term return on financial investment and the role environmental awareness was lower, the motivations are usually present simultaneously, according to the interviews.

As we mentioned above, households with solar panels are the more wealthy households. It has an obvious reason: these investments were financed from own resources, without subsidies.

*"What do you say about it ... so I thought I would put the solar cell on the house because that I calculated that will come back in 10 years and then I will not be long before the my income will no longer be. And then I thought I could pay for this investment now and then he will redeem me the money that we have invested." (*Retired man*,* family house with solar panel*)*

The over-production of the solar panels can be fuelled back to the electric system, although the energy-providers do not like this option and the legislation also does not encourage owners to have over-production not used in energy-poor periods.

"So, you would think that when it is hot and the sun shines like hell the solar cell produces a lots of energy, but no, you would be wrong; it does not produce that much in this great heat. It produces the most energy, when it is cool outside, but the sun is shining. Thus it is a really cyclical production: so it produces less energy in winter, although when the sun is shining it is okay, but it produces the most in spring and autumn" (retired man, family house with solar panel)

4.1.4. The investment

In almost all cases, interviewees mentioned that they had earlier experience with solar energy, as they have a friend, a family member or a neighbour, who earlier invested in it. These people also offered their experience: the name of the technical solution or the entrepreneur developing the system.

Funding

There were several criticisms about the available projects and subsidies: according to the opinions, there are no suitable applications, the existing ones would require a much larger investment or a complete modernization of the house. In addition, there were those who found the application system complicated, and many complained of too strict tender conditions.

"But we also looked at applications, but nothing was valid for us, so they are so problematic, it's not that easy to pay and ... (...) Then they were more than 20 years old. And not in such a

sum, it would have to invest much more to get 40% back." (43 years old woman, family house with solar cell)

It was the opportunity to take advantage of those who wanted to modernize several elements of their home.

„This was a very good investment, because one of these, when I remember well during the Otthon Melege program, and the application specifically called for energy efficiency investment and boiler replacement, had to improve the technical condition of the boiler." (50 years old woman, with solar collector)

Due to the problem of the tendering system, most of the interviewees financed the investment on their own. All interviewees were in a good financial position and could do so by installing an energy tool. Good financial conditions are necessary for energy modernization.

„That the rich have fun in Hungary is the eco thing and they do it when they have their money. And unfortunately, the state does not support us and it does not help, and the middle class cannot afford to be staunch enough to be responsible for the eco, so think green because it does not have the money. Simply, who has the money to allow you these hobbies that are considered expensive in Hungary today and what happens? The rich are better off." (53 years old man with a family house with solar cell)

András and his family

In the first example we present a case of implementing solar panels in a detached house lived by a wealthy local family: *András and his family*.

András lives in a suburban area with his wife and two children. They live in the house for 16 years. Their financial position is adequate, they save money and energy by using energy-saving light bulbs and minimizing car traffic. Environmental awareness is also important to them. Their latest investment was the installation of solar panels in March 2017. They hired experts to calculate the number of batteries required by their (average) household consumption, which means that 12 solar cells have been equipped to their roof, providing 3.2 kilowatts of power. They have just started to use it, but they produce more than they consume. The energy provider provides an opportunity to build a solar system where a user can regain unnecessarily generated energy from the service provider who pays for it. The idea of installing solar panels was a long-term problem for the family and ultimately decided on it because of their financial situation. The family thought it was a long-term investment that would cost over time, so their savings were spent. The contractor was selected based on a friend's recommendation. This is a company in another city as the companies in Debrecen are more expensive. The company offered several quotes, and finally the third one was accepted. During the process there were no conflicts, the assembly work went quickly, and the solar energy company took over the papers concerned. The interviewee is satisfied with the solar panels fitted in this way. According to the planning documentation, the investment will be paid back within 10 years, but they find that they produce more solar energy than they

expected, so the investment is likely to return earlier. Encouraged by the good example, they are thinking of buying additional energy-saving devices, for example electric cars.

4.2. Insulation of blocks

As we wrote in chapter 4, programmes in Debrecen have been run to insulate blocks of houses. In the following we present the main results of interviews about such projects. First, we present the interviewees and their flat, then we analyse the background and motivation of residential to insulate blocks of house.

4.2.1. Families and their houses

In the following we shortly present the interviewed families, the composition of the family, family members and their homes. We present the composition of the families, the employment status of the family members, and finally the most relevant practices influencing energy use.

Families

Respondents are divided into different categories according to their age and marital status. There are both men and women among the respondents, the youngest being a 24-year-old college student, while the oldest is a 98-year-old lady. Ten respondent had tertiary education, while twelve had secondary education. There are ten pensioners, ten employed and two students. Some of them are self-employed, but most of them are employed by public companies. Employees work for multinational companies, small companies or public institutions.

Almost half of the respondents live as retirees. In each case they are the owners of the apartments, their couple or alone. However, the qualifications did not always appear, but we can conclude that they have intermediate and tertiary education, and their monthly income is the pension.

There are also middle and high school graduates among the workers. One person works at the university as an instructor, some are skilled workers, technicians and a lady in a business executive status. We met a variety of family models: single, grandparents living with their grandchildren and married couples alike. There is no information about their income.

The two students live alone, presumably have a family background with good financial situation. Since they are still undergraduates, they are not working yet, so their family finance their university years.

In half of the cases, we talked with retired people who have been living in the property for decades. Several respondents of our research are retired widows, but many are married or living with their partner. In addition, we encountered several young and middle-aged families. In their case, it was typical that they were planning to move to another home or detached house. Among the non-retired respondents, three of them were single, one of whom was a university student and the other was a 40-year-old man. The flats are typically between 50 and 55 square meters usually one, two or three people live there, we found only one family with six members living in a flat (two parents live with four children).

Respondents belong to the middle class, most often with vocational qualifications. Ten out of twenty-two respondents have finished or going to finish in short time their BA (undergraduate) studies. The income of the respondents is highly diverse: the flats are privately owned, which means that either the respondent or the family member of the respondent is the owner of the property. We found the worse

financial situation in the case of retired people. In some cases, income is hardly enough to cover running costs:

> *"She would have to pay more than his income, and as she told the heating the granddaughter pays the electricity he pays Aunt Böbe, the phone bill, the water. So, if you paid everything to Aunt Böbe then you would not have the amount of your pension to get paid." (*98 years old woman, retired)

Housing

In this part we present the characteristics of the flats or houses and shortly the possession of other devices. The housing conditions of the respondents were almost entirely the same. The real estate is between 50 and 55 square meters, usually with two rooms, kitchen, bathroom and balcony in houses.

> *"This is a 55 sqm, one and a half bedroom, fourth floor. There is a separate toilet and bathroom part. Now if we come in, it will fall to the right if it needs to be very detailed. There is a bathroom next to the toilet. We have a small corridor that goes into the kitchen. Next to it is a karma part, followed by two rooms, one in the east and the other in the west. The larger room is the western one with a 5 sqm balcony, but it can only be 4." (*40 years old man, technician)

Apartments usually are relatively old, over 30 years old, before 1990. These apartments had a major deficiency in the lack of modern, highly insulating windows, and in every case they used so-called brick heating, heated to a common boiler, which forced the residents to pay a flat rate. This resulted in unfair cost allocation.

Many respondents who have been living in the apartment for decades have reported that the selection of the apartment was not past them, all of which came to the property by the normal lottery method at that time. Those who could choose the apartment themselves, based on their own ideas, decided to buy the apartment, because it is calm, and the area has good infrastructure, surrounded by a nice natural environment. Apart from a few cases, the majority of residents expressly love their place of residence because of their frequent location and peaceful surroundings.

> *"We love to live here. We're so close to everything. From the point of view of transport and everything. We like to live here very much, we've been living here for a long time. Well, it's already us. I'm sure this will stay. We like living here. Quiet and quiet place." (*66 years old woman, retired)

4.2.2. Energy-related behaviour

In the following section we analyse the energy-related behaviour of the respondents.

The cost of maintenance charges is generally estimated between 30 and 50 thousand forints (~100-170 euros), depending on how efficient the real estate was. It is important to note that modernization reduced heating costs, but at the same time increased the whole expenditure of the household, because of the credit used for the renovation. The amount of these costs varied, among other things, whether or not a modernization investment was carried out in a given apartment (eg plastic windows). Many of the respondents emphasized that most of their consumption is their food consumption.

*"Well, in fact, I think it's likely that food is the biggest in the case, which takes most of the cost in a household, but I think it's the case elsewhere." (*42 years old, operator*)*

In contrast, transport was generally considered as a low-cost activity, as only a few households had a car, most of them used public transport, which is free for retired people.

The aspiration of general consumption of households and the avoidance of unnecessary consumption are typical. In addition, several people have highlighted that they consciously use energy-saving household appliances, bulbs, and cooking are trying to consciously, rarely to solve.

Several respondents estimate that some households spend nearly half of their income on household expenses.

*"In the bathroom I chose a rainfall shower, which was relatively water-saving and I chose the other water fittings to be economical. It is quite natural that the refrigerator is A ++ and virtually all parts can be said to be all energy efficient." (*69 years old, pensioner*)*

Respondents do not have the power to hold other energy assets apart from trying to choose their household machines from the line of energy-efficient tools.

4.2.3. Motivations of the investment

According to our interviews the investment in insulation had the following main reasons to:

- Energy use reduction
- Cost reduction
- Renovate the block and the flat
- Increase the value of the flat
- Increase the comfort of the flat

Owners started the project to increase the comfort of the flat, and the same time to reduce energy costs. It is extremely important that none of them mentioned environmental reasons for insulation.

Compulsory act: Renovate the block and the flat

Most of the interviewees stated that "*It was a common decision, I could not influence it*", or: "*It was compulsory, the house manager offered it*"; which means that they only undergone the process. Despite most of them acknowledge that by "*keeping inside the heat we have to spend less on heating*". Also, the following quotation shows this general feeling toward the investment.

> *"It was compulsory: it is clear that the energy bills are lower. The windows, and the insulation are different. And anyone can consume as much as he or she wishes. So we can better control our costs."* (45 years old female)

The necessity of renovating the block was also a common motivation for the project: "*the house is 38 years old, it must be renovated*", and it had further advantages.

Cost and energy use reduction

Another frequently mentioned reason for the investment was to reduce energy consumption, and thus energy costs: "I always wanted it: thus, I can control heating" (69 years old, pensioner)

> *"So, I think everyone says what he or she thinks. Because if someone does not want it, he/she will say against it. And who wanted it, started it, because she knew that it saves money for her."* (45 years old female)

4.2.4. About the project, the investment

Funding

Based on the 22 interviews the project financed by a subsidy, which name is the *„Warmth of Home"*[24] programme. Beside the subsidy the residents had to complete the subsidy with own sources. This kind of programme gives a support to renovate the insulation and the heating of flats.

They started the renovation this year because the gained money for it: "It was a common decision of the residents, and we were lucky, because we could use project money for it".

> *"The residents started to organize the renovation already 4 years ago, but then only 40% supported it; we could start it only now."* (69 years old, pensioner)

> *"It is a long story; but now we could get most of the money from subsidies, so we did it."* (40 years old, entrepreneur)

[24] *In Hungarian: Otthon Melege*

> *"So, the block changed the heating system, and used the money saved by this to start the renovation. It must have been done."* (42 years old, operator)

In some cases, the residents get a loan with minimal rate. Mostly they mentioned the importance of the saving accounts, which help them to complete the subsidy. The subjects have to repay the rent from 4–10 years (depends on the blockhouses). For some interviewees it was a huge burden because of their financial situation.

> *"There is a high demand of energy, and for the family too. It must be four years before we regain our consciousness."* (67 years old, pensioner)

An important information that those who have already done the insulation didn't have to pay the whole amount of money.

4.2.4.1. Planning and construction

Most of the cases the community of the houses initiated the investment. In some cases, the building maintenance managers suggested to the community but based on information most of the time the communities had basic needs to renovate their flat. In the next parts we explain two subcategories, which highlight the main points of the supports and opposite ideas.

In support of the construction

There were various reasons for supporting renovation.

Bad condition of the house

In this citation we can see that the main reason why the subject supported the renovation is the bad condition of the blockhouse.

> *"When I came here I had my doors and windows fixed. Many doors and windows haven't been replaced in this blockhouse. It was necessary to replace because it was in a really bad condition. It is my problem or my business. But it was necessary. From my point of view we had to go in this way."* (42 years old, operator)

Good experiences

The resident made their decision based on others' positive experience.

> *"This is the achievement of the age. It has spread in several places. And finally the people realised if they could protect better the outgoing heat they would have to invest less money. Well the experiences, the residents heard it from others. When I came here it was already semi-active. They have already spoken competitions and everything. So we are here now."* (42 years old, operator)

Cost and energy reduction

In this category the community's main aim was to reduce the cost of the bills:

> *„We told this for the representative a long time ago. We had a lot of cost in winter. We paid 40-45.000 forint, which is very expensive. We have always applied for a competition. And*

luckily we signed the paper; we needed 50+1% support from the residents." (63 years old, pensioner)

Comfort

A subject complained about the temperature of the house and based on the answer we know that the investment solved this problem.

> *"It was a block heating. Its difficulty was that we couldn't set or control on your own need. And this problem appeared in the residents' meeting every year. It happened that we spent more than 30.000 forint just for heating. Some residents were cold and they raised the heating. They started to heat at the end of September, at the beginning of October. If someone didn't have need…We opened the window and we heated the street. The insulation was really bad, so there wasn't insulation and the windows were very old. In the autumn and in the winter the wind came into the room and the warm went out to the street."* (40 years old, entrepreneur)

Already had a renovation

In some cases, the subjects were against the renovation because they have already made it in their house.

> *"Tell the truth I was bothered because we bought this flat three years ago and we paid a serious amount of money to renovate it. This programme came and personally I was against it because we replaced the electricity and painted everything and it came with big dirt. It came with the tubing. We can see this in the rooms. So I was against it and I didn't think that it will much*

cheaper. As you can see at the moment it's not cheaper than the previous one." (57 years old pensioner)

Neutral in connection with the construction

A subject mentioned that he has already done this kind of renovation in his house

> *"I didn't participate in a vote, because I have already fixed the doors and windows so I wasn't interested in this topic. But the community voted so I accepted it."* (58 years old, kindergarten teacher)

4.2.4.2. Constructors

In this part we give an overview about the main views in connection with the constructors and their situation. Based on the interviews there was a competition between the companies. In connection with the selection the representative had a huge role.

> *"Well in the selection the building maintenance manager made the decision, who was charged with this activity*." (42 years old, operator)

Most of the time there wasn't so much contact between the residents and the contractors, subcontractors.

> *"Honestly, I've only met with one person, when they replaced the doors and windows*." (61 years old, car mechanic)

An interviewee mentioned that there is a monopoly on the market.

"Because of the monopoly the cost of the implementation is much more expensive than just trying to find the best deal from the market." (69 years old, pensioner)

Some subjects mentioned that they aren't satisfied with the contractors' professional skills. And there were some organizational problems.

"The subcontractors didn't provide them a restroom and toilet." (49 years old, entrepreneur)

Another important factor, which was highlighted by the interviewees, is the length of the renovation (which causes a communication problem) and in some case there was a problem with the appointment. It is an interesting fact that some subjects talk about the appointment in a very positive way.

4.2.4.3. Conflicts

Conflicts among residents

In the interviews there was a recurring part, which is about a lady who was against the renovation.

"Yes, I know there was a lady who was against the renovation because she has already renovated her apartment. And now, when there is a renovation of the heating, so that she let his flat from inside... so there was such a conflict." (40 years old, plumber)

Conflicts between residents and contractors

In connection with the competition an interviewee mentioned there was a problem with the agreement.

> *"The contract did not include the same thing and therefore it was difficult to compare*" (50 years old, university teacher)

Several people had negative experience with modernization, in some cases contractors did not do a good job, and there were examples of how the overhaul was overwhelming.

> *"It's obvious, yes, I say, it's just not aesthetically. So, every time I go into the apartment and see that anomalous tube ... Then they came and tried to fix it. But what was not drilled well at first, they do not know to drill it again. Justin that case if they break the whole thing. But I said that whatever it is, this brigade won't come into my house again."* (49 years old, entrepreneur)

Conflicts between representatives and implementers

There was a conflict between the community and main architect because of the colours of the blockhouse. The representative had to handle this conflict with the main architect. He wanted *universal colour* for the blockhouse, but the community was against this decision. And another important conflict was because of the *air conditioner*:

> *"The implementers wanted to paint our house in pink. But we didn't want to. This was one of my problems with the main architect. The other is that during the summer the owners installed the air conditioner. Quite many of them. I did the same because on the south side of the hose the sun shined all day, it*

was warm. But we can't install an air conditioner in the flats. He stated without objection." (40 years old, entrepreneur)

The blockhouses need a permission to install air conditioners and for colourful paintings. In a blockhouse the community has already started to change the doors and windows two years ago without any competition but for a change they had to pay an extra fee.

"These were white doors. But the main architect didn't let us to change the kopolit glass. Unless if it will be in grey. Firstly we had to pay an extra half-price even though we had already won in the project and we had a plan in connection with the colour. When he arrived he told us that he give a permission but just in grey for an additional cost." (50 years old, university teacher)

4.2.4.4. Results of the project

Energy saving

According to the answers the subjects' costs decreased. The ratios are different. Their savings are about 30-50%. There is an important factor, which appeared in one subject's answer: this is an environmental protection. He mentioned that his energy saving was 30-40%.

The other factor is about the length of the return: In this topic the interviewees generally talked about 5–15 years. And one of the interviewees mentioned 30 years.

An interviewee mentioned that they don't have any energy saving because the workers didn't do their job properly. And an interviewee is sceptic in connection with it.

4.2.5. Satisfaction with the financial investment

As we mentioned before most of the subjects were satisfied with the renovation because of the *savings*.

> *"Actually the heating was modernized. It is cheaper in this way. This solution is better for us because it is cheaper. We pay with 50% less. Before this we paid lump sum. "(*67 years old, pensioner)

Increased the residents' comfort

> *"The sense of comfort itself has increased significantly due to insulation. There is not much heat in the summer." (*49 years old, entrepreneur)

Modernized heating system

> *"It had been house-oriented before. So it was a boiler at the top and we were heating ourselves, but earlier we couldn't control the temperature. It was a problem that those who lived below felt colder in winter than those who lived upstairs, and they felt warmer than usual. Then this competition came, and we had a possibility to change."* (34 years old, IT expert)

We would like to highlight two points, which appeared in the interviews: aesthetics approaches. An interviewee mentioned that she/he is very satisfied because the blockhouse is much nicer. But on the other side of the coin the residents complained about the mess, which comes with the renovation (or the lack of professional skills).

> *"It's ugly, very ugly. Well, I think it's all piped, once again the apartment piped and they did a half job because they didn't*

replaced everything, not all doors are replaced, the cellar's doors are not replaced, so I think they have done a half job." (58 years old, kindergarten teacher)

And we have to highlight that most of the residents are very satisfied because the blockhouse's/their flats' values increased. In connection with the blockhouses' future renovation three main points appeared in the interviews:

– paintings,
– tiled,
– lift replacing.

40 years old married man

An interviewee lives in a blockhouse with his wife and his 1,5 years old children. The community have been wanted this construction for years. They won the competition and it wasn't a question for the interviewee and for his family to support the initiation. The state support 1/3 of the investment, the residents have to pay the remaining part of the costs. Due to the insulation their 1/3 of energy consumption decreased and their point of view that the investment has already returned. However, the implementing process of the investment was not fluent. He complained about the constructors' professional skills. Because of the lack of their professional skills they drilled the wirings three times in a bad way. This may come from that their flat was the first, which was renovated. The interviewee's opinion they were the test subjects because the constructors eliminated the problems in the other residents' flat.

5. Stakeholder analysis

For stakeholder analysis 20 tape interviews have been made: one with leader of a non-profit energy agency which has central role in management of building insulation; three with building maintenance managers of insulated block buildings where interviews have been made with flat owners; nine with architects (6 engineers and project managers, 1 technological planners, 1 passive house and solar cell specialist, 1 insulation specialist); one with engineering adviser; three with building engineers; one with solar cell specialist and two with building contractors.

Role of the different actors and institutions in the initiatives, especially in projects:

- Their contribution to aim setting
  - The non-profit energy agency has central role in building insulation projects, energy efficiency management and in organising the complex use of sustainable sources. As the manager said: "As I think we take care of whole management of energetics project from first idea to final technical delivery and acceptance." The agency is a non-profit institution owned by Debrecen University. They do not practise constructing but provide advises, mediation between all actors of insulation, energetical and solar cells projects. They draw building maintenance managers' attention to new projects, financial conditions and inform, convince and persuade of flat owners

about usefulness and advantages of complex energetic restoration, building insulation and use of solar cells.

- The building maintenance managers are representative of residential community living and owing flats in block-buildings. They are responsible generally for physical condition of residential buildings, renovation, smaller mountings, contact with utility providers, advocacy, handle the community's money. They hold liability for residential community. The general assembly of residents decides on major issues. The building maintenance managers mediate between promoter agency and residents. Their basic task is persuasion the flat owners to join energy efficiency projects, building renovations, insulation and modernisation of heating systems.
- Architects and advisors (with background in engineering) after understanding local interests try to adapt it to plan the best cost-value ratio for them. Usually owners find them after deciding about the main elements of the project, thus they have very few influence on it. Despite it, the architects have major role in aim setting. As one of them argued.

  "An investment aiming at energy efficiency cannot be implemented by developing the elements independently; it has to solve a complex problem by developing a complex system: not only the machinery, but also electric system. For example if we have a watering system in the garden, and a pump, and a pool heating parallel with each other and with an intelligent electric system, which had a remote control and in which the heating or cooling system controllable from distance. And although the house has intelligent elements, the whole building cannot be energy efficient." (engineer)

They are also opened to express their ideas and make effort to realize them.

- Their role in project management
  - The agency has a leading role in insulation and solar cell projects which is based on information monopoly, networking capacity, knowledge capital, proficiency and skills. In practice, the most of energetics restoration of private property flats use state or EU projects financial sources. The actors of house restoration and installation of solar cells (flat and house proprietors, building maintenance managers even the contractors) do not have right knowledge for complex proposal writing, administrative and financial management of a project, the bureaucratic procedures, energetics and engineering planning, announcing and organizing procurements. The contractor companies do not aspire to lead energy projects. According to agency leader "I know experienced engineers who cannot stand that for example a young girl in the project office refuses a report because she wants to see it in another format, another print. The project logic and contacts do not fit into engineers' thinking"
  - The building maintenance managers convince flat owners, persuade residential community about accepting agency offer. They are contact persons between agency, owners and contractors. As representatives of residential community, they have leading role in the selection of the contractor(s) at procurements and they manage signing the project and the loan agreement. They mediate the interests, excuses and criticisms of the residents. In the most cases, they are the administrators of the formal, bureaucratic procedures.

- Architects, engineers and advisors are employed by the agency, and officially they are responsible only for the construction. Despite it, architects consulate with house-managers and sometimes with owners to better understand their ideas.

➢ Their interests

- The non-profit energy agency's main benefit from energy project is financial profit which is limited in the Hungarian project system. The profit covers or contributes to partially cover other basic activity (counselling, planning) and operation cost. The agency's interest in maintaining its contacting and networking position through the energy project. The agency does not carry out insulation, installation of solar cell system but they can offer a suitable contractor.
- The technical modernization is duty of building maintenance managers and success of insulation, reconstruction of heating system, replacement of doors and windows can strengthen their position (paid job). They may obtain some financial benefit from mediating positions, but this is not legal, and the interviewees only referred vaguely abstrusely to this.
- Engineers have minor interest in the projects; as we wrote above they would like to realize their ideas, but several times they have to be flexible in it.

➢ Their networks

- The non-profit energy agency has a wide network: the agency is in property of Debrecen University, they co-operate with a variety of market organizations, designers, engineering and energy companies, municipal offices, project organizations,

residential communities, private and institutional customers. They have charitable activities in day-nurseries, schools and other forms of training programs.

- The building maintenance managers' mediating position links them to owners and dwellers, utility providers, local government offices and in the energy projects to agency, contractors, technical controllers and credit institutions.
- Engineers and advisors know each other: although there is a competition among them, most of them works with an established network of house managers, development agencies, and have practice either with private or with public buildings. Their most important partners are the development agencies, which link them to the owners; as one of them emphasized it is very rare that environmental attitudes would influence the decision concerning the project.

➢ Conflicts

- We have not heard about the conflict affecting the agency.
- The building maintenance managers are in the centre of conflicts between flat owners and contractors as they must mediate problems and excuses. They have to harmonize flat owners' interests and debates in the process of persuasion about joining to insulation project. They have to settle the conflicts of interest between entrepreneurs have been involved in energy projects. They often engage in conflict with the unsatisfied flat proprietors.
- Engineers have conflicts with the owners, because of the projects.

"I explained the house manager several times that we cannot reach the energy efficiency goals unless we implement the

different elements together. I can understand that they do not have too much money for the investment, but without fully renovating both the block and the heating system, the whole investment remains a waste of money." (Engineer planning energy efficiency investments)

- The conflict among planners, owners and house managers is also usually.

6. Perspectives on future energy consumption

We analysed all the interviews conducted with locals to understand their ideas and attitudes toward future energy consumption. First, we analysed the trends expected by them, then we investigated how do locals think about energy consumption and changes concerning it, and finally we analysed the push and pull factors influencing the changes of consumption patterns.

6.1. Expected trends

In the first part of the chapter we present the expected trends and analyse how respondents think about possible new energy sources, how do they see the energy consumption trends in the future, and how do they perceive the role of green and renewable energy.

The opinions about the trends in future energy-supply are very heterogeneous. According to the interviews we can set up three types of it: (1) growth of green energy, (2) growing importance of nuclear energy and (3) the balance between fossil energy sources and green energy. In the following we present the three expected trends of future energy resources.

Growth of green energy

Some of the interviewees claimed that green energy, especially solar energy will be one of the most important energy sources in the future. They also mentioned wind energy as a resource and the importance of passive houses. Respondents also mentioned the collection of rainwater; it is usually used for watering the garden. It also shows that energy use, resource use and energy resources are closely connected according to our interviews: respondents do not distinguish strictly between them.

As we asked about the future trends of energy production we noticed in several cases sceptical views in connection with green energy. In one case the interviewee argued that the life-cycle assessment of solar cells or windmills would show that these have a more unfavourable environmental impact, than fossil energy resources, because of tons of paint, aluminium etc used during the production.

> *"I am environmentally conscious at a level that I'm going to tell you, basically what's the problem with the green energy. How's the humans like? It's like that if you have a problem the humans create a machine or something to solve this problem. What is the problem with the humanity? One of the greatest problems is their needs for energy. You are destroying the environment. I mean the raw material and the energy. How nice the green energy. Why is it nice? Because it comes from the sun and from the wind. But there is an environmental load or the ecological footprint. If you look at the environmental load of the solar cells a solar cell produces 250 kilowatts, which generates a lot of energy, which isn't from coal, nuclear power or any other energetic material. We love this very much. But you generate a solar cell with so much silicon, plenty of aluminium and with*

lots of paint. The environmental load is so much. If you produce 250 kilowatt per day in a factory it is several years to reset the load at zero." (53 years old, top manager)

Nuclear energy as a productive source

Several interviewees mentioned the role of nuclear energy. At this category one of the interviewees mentioned that energy is a strategic question. His opinion is that every country needs a nuclear power station.

> *"The wind is not always blowing; the sun is not shining all the time. But everyone turns on the light and the computer automatically and in that case at all events the power station has to supply the country."* (53 years old, top manager)

The question of nuclear energy became a political issue in the last five years, although originally both the socialist opposition and the ruling parts were in favour of nuclear energy. The above quotation is also influenced by the debates around the topic.

Balance between the fossil sources and renewable energy

Some interviewees mentioned that the number of those industries, which use renewable energy will increase but the using of fossil sources will not disappear:

> *"It is a difficult question because my father is a geologist. He told me that in the fifties he learnt that the fossil sources of energy had already started to run out. But it hasn't happened*

yet. And probably this conversion won't happen soon although it would be wished." (54 years old, upholsterer)

The quotation shows also that some of the interviewees are aware of the continuous changes of science and technology: the present trends can change very quickly.

6.2. Changes in energy consumption

In this part we analyse the interviewees' efforts to reduce energy consumption. Our main aim is to understand their attitudes toward the issue, to understand how they frame it. We found that most of the respondents try to pay more attention to lower energy use by applying environmentally friendly solutions. They mentioned quite broad aims, like (1) changing everyday habits, but also practical efforts to reduce energy use: (2) like insulation, and (3) investing in renewable energy sources, like solar panels.

Everyday habits

In this topic we can make a difference between the attitude of the interviewees and their purchases in connection with energy saving products.

Attitudes

The interviewees highlighted that they try to change their everyday habits especially reducing water consumption and in connection with the electrical energy, environmental friendly solutions. For example, they mentioned that we can dispose our rubbish selectively,

switch off the light while they are not in the room/floor or the using of tube-well. Using bicycle or walking as a very important factor was mentioned in connection with the transport habits. An interviewee told – that they would think about an electric car, but they could not afford it.

> *"In our family we could do the water consumption in a more rational way. In our house there are typical techniques, which we should avoid. For example, in winter instead of having a shower we usually have a bath, which is wasted if we take into consideration the water consumption, gas consumption and warm water consumption."* (50 years old, high school teacher)

Buying energy saving devices

Based on the interviews we can say that they try to change the older and less effective devices to a new one (for example fridge) and some of them use energy saving bulbs:

> *"Obviously, the consumption of different electrical devices is high, such as television, computers. We're trying to save energy by using energy-saving bulbs because we can save a lot of energy with it."* (50 years old, high school teacher)

Insulation

The importance of the insulation appears in the interviews. In some cases, the interviewees mentioned that they improved the insulation, or they would like to do for the better insulation (for example an interviewee would like to change her entrance door because of the

inappropriate insulation etc.). The interviewees' motivations were mentioned in connection with the insulation. Their main reasons are financial advantages and the comfort of the flat. Three types of materials were mentioned: ytong brick, which insulate properly the double glass window, and the last one the fiber glass, but the interviewee do not satisfied with it.

In the 5th chapter we published more detailed information about the main motivation of the blockhouses and the satisfaction with the investment. Their main motivations consist of the residents' comfort and the financial advantages. Basically, due to the insulation the residents modernized the heating and replaced the doors and windows.

Solar collector, solar cell

The interviewees highlighted the importance of solar collectors or solar cells. If we talk about the interviewees we can set up two categories: the first category consists of those interviewees who haven't known the effectiveness of these devices yet or how they can spare with it. In the second category the interviewees can decrease their energy consumption and they claimed that it is worth and useful.

> *"My youngest daughter and her family live in Martinka but they have already had a solar collector and they generate the electric current themselves. I think it is a really great thing. And they produce the warm water with a solar cell. It helps them to decrease their heating bills I think it will be the future."* (66 years old pensioner)

Air-conditioner

One interviewee mentioned the increasing role of air-conditioners in their households. She claimed this would change the most if the climate change continues.

6.3. Push and pull factors of changing consumption patterns

In this part we analyse the push and pull factors of changing consumption patterns, the obstacles of changes, the role of society and the role of policy making. The interviewees mentioned lots of information and practices how we can decrease our energy consumption and spare money. But why are these techniques not so popular in Hungary? What are the main obstacles of the changes?

According to the interviews the first and one of the most important factor is people's income. Those who are part of the upper-class can afford using green energy or renewable energies.

Applications, supports

In this part the interviewees' opinion is that important to provide support for those who can't afford it on their own. The other important points in connection with support are that the organisations have to invite and announce applications in a proper way because only this way makes sense of the support. And last but not least the process or the specifications have to be clean and not overcomplicated because in another way the applicants will lost their motivation to compete.

6.4. Public Policy

The interviewees mention the importance of the governmental support. And in connection with public policy an interviewee mentions that is doesn't support the success of this project if the government puts taxes on the solar cells. The wished regulations have been mentioned in an interview: with new governmental and central acts the state has to abolish the using of PET bottles or polythene bags.

Previously we could read the official side of the problem. But on the other side of the coin we can mention the role of the society.

Exchange of experience

An interviewee mentions that the role of the community is one of the most important factors. They have to exchange their experience because of the knowledge expansion and maybe more people will see the sense of this investment.

For example, some subjects got information about these investments from friends, neighbours etc.

> *"One of the most important way that those who lives in a family house give their experience to the others."* (50 years old, high school teacher)

Education

According to the answers the education's and the teachers' responsibility is enormous to form their approaches. Children should have these knowledge in an early age: where the drinking water from; how much energy is needed to produce something etc.

"I think there are some teachers who are open-minded and it is an important topic in the foreign language subjects so they talk about it. But I think it is not enough." (50 years old, high school teacher)

"If the average Hungarian people won't be simple-minded. An education, I don't know. Actually, the problem is deeply rooted. I think we very far from this when I have to explain that I have a current in the dark." (30 years old IT expert)

6.5 Responsible thinking

This category appeared in the answers. Everyone should change their habits and the society has to pay more attention to this topic and try to manage their life in an environmentally friendly way. For example the way of our traffic habits: the problem is one person in one car or people should collect their dust selectively etc. An interviewee mentioned an obstacle in connection with this topic and the future of energy saving views and attitudes.

"In the media the broadcasts try to encourage people to behave in an energy saving way. But we are Hungarians it is tough for us" (41 years old, expert)

The citation above illustrates a negative auto-stereotype in connection with the Hungarian identity.

Based on the interviewee's answer there is a strong connection between the category of "Everyday habits" and "Responsible thinking".

7. Conclusions

The study aims at answering three main research questions:

1. To explore the factors influencing the interference between social status, norms which impact consumer groups' behaviour related to energy efficiency and in specific cases (renovation of buildings, applying solar cells technology) the role of governance.
2. To explore and compare varied social components, social status (income level, age, education, gender) and social norms which influence the individual and communal choice of consumers.
3. To find the social and institutional conditions necessary to foster social response to energy efficiency policies, the social determinants of novel operational knowledge and the role of knowledge.

In the first table we explore and compare social components, attitudes and norms to understand the influence of individual and communal choice of consumers.

16. Table Factors influencing environmental behaviour

influencing factors	**insulation**	**solar cell**
income level	lower	higher
social position	low middle strata	middle class
age	elderly and young generation	middle age
attitudes and norms	no sensitive	superficial value
project finance	subsidies, loan	equity
cooperation	collective action	individual action
organisation	top-down	bottom-up
governance model	redistribution	market

Source: Prepared by the authors

Based on our case-study findings we can see that the households have a different social status, different attitudes toward environmental values, and participated in projects with different characteristics.

The insulation was top-down organized, but involved several people; whole communities, and the project was financed by subsidies and bank loans. The beneficiaries were communities consisting of lower middle class people, whose main aim was to reduce their living costs, and make their homes a bit more comfortable and more valuable. We define it as redistributive governance model.

Household, investing in solar panels belong to the upper middle class and middle class, their income level is higher, they are usually middle-aged couples. It is a typical bottom-up, individual action. We define it as market-led governance model.

As the next table shows; in both cases national and local governments had minor role in the projects.

The second table shows the social and institutional conditions necessary to foster social response to energy efficiency policies, the social determinants of novel operational knowledge and the role of knowledge.

We found the following actors: national government, local government, development agency, owners of insulated flats, owners of houses equipped with solar panels, and advisors (planners and engineers).

We analysed their role, impacts in energy efficiency projects, their ideas and attitudes toward environment, their interests and finally the barriers of implementing energy efficiency projects.

We found that a local government has almost no effect on energy efficient projects, thus their interests, impacts, attitudes and the barriers are shadowed. We did not analyse deeply the ideas, impacts and barriers of national governments as we could not conduct interviews with representatives of the national government.

The development agency has a leading role in initiating and managing local energy-efficiency projects: although they are a project-oriented organization, they are highly interested in developing energy efficiency projects. The organizations have a direct and strong influence on insulation projects.

Planners has very few, indirect influence; their environmental attitudes is basic, and highly professional. Main barriers for them to reach their aims are administrative constrains.

17. Table: Actors and stakeholders influencing investments in energy efficiency

Actors and stakeholders	Role in energy efficiency projects	impact	environment: attitudes and values	interests	barriers of implementing energy efficiency
national government	define legal, administrative and financial framework	indirect, basic	adaptive	energy safety	–
local government	administrative (permissions), in some cases costumer	minimal	adaptive	administrative	–
agency	leading, initiate and manage projects	direct, strong	project related	financial, project as main activity	administrative constrains
insulated flat owners	customers	formal, moderate	no	financial, expenditure saving, property valuables	financial status, lack of knowledge
solar cell house owners	customers	direct, participative	formal	financial, expenditure saving, property valuables, prestige, environment	lack of knowledge
planners, engineers, advisers	planning, advices	indirect	basic	financial, environment, modernisation	administrative constrains

Source: Prepared by the authors

Our analysis shows that development agencies have eminent role in energy efficiency investments, but these organizations are not interested in increasing locals' environmental awareness. These enterprises are bounded by the constrains of national legislations.

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Appendix

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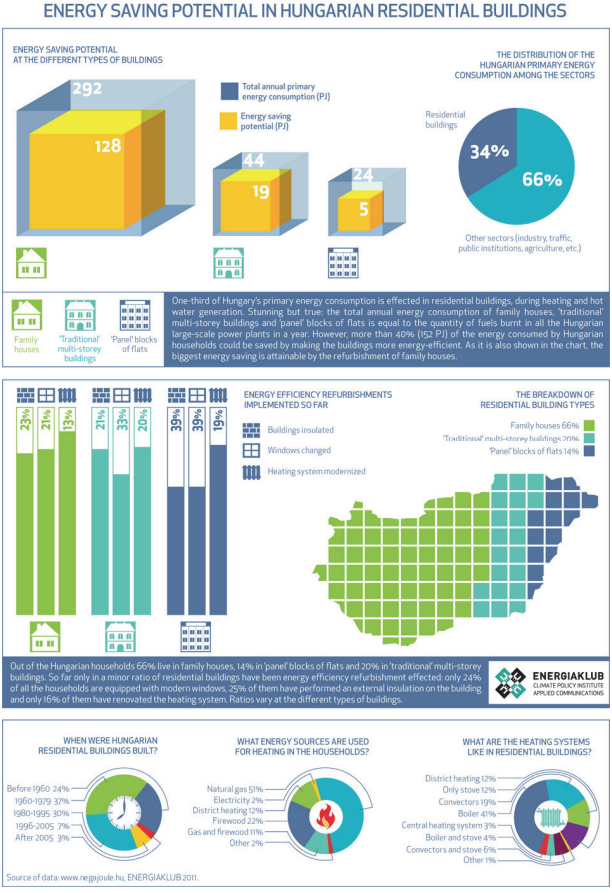

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The analysed energy plans and programs were:

1. Parliamentary Resolution on making the spreading of alternative and renewable energy sources more effective;
2. Parliamentary Resolution on the energy policy for 2008 and 2020;
3. Parliamentary Resolution on the National Energy Strategy;
4. Government Resolution on updating energy consumption forecasts of the National Energy Strategy;
5. National Renewable Energy Action Plan of Hungary;
6. Government Resolution on tasks related to the National Renewable Energy Action Plan of Hungary;
7. Government Resolution on the 2nd National Energy Efficiency Action Plan of Hungary until 2016 with forecast until 2020;
8. 2nd National Energy Efficiency Action Plan of Hungary until 2016 with forecast until 2020;
9. Government Resolution on the National Building Energy Strategy / National Building Energy Strategy;
10. Transport Energy Efficiency Action Plan

Requirement[2][1]	Quality of Response by the Respective Plans									
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
a. intra- & intergenerational justice										
b. climate protection (mitigation & adaptation (resilience))										
c. system of ecological crises										
d. preservation of a fair share of resources										
e. safe and healthy environment (see point a.)										
f. equal opportunities for all, decent housing (see point a.)										
g. non-regression principle										
h. polluter pays principle										
i. international cooperation (see point c.)										
j. institutional and financial guarantees of implementation										
k. ecological services concept (see points a. and h.)										
l. sustainable local settlements (see points a., e., and f.)										
m. integration principle (breaking down the SDP into plans and laws)										
n. alternative indicators										
o. environmental risks to be taken into consideration										
p. greening the economy (see point i.)										
q. public participation principle										
r. precautionary principle										
s. energy related goals: i) energy security (decentralisation)										
s. energy related goals: ii) energy efficiency (insulation, life cycle analyses etc.)										
s. energy related goals: iii) raising the rate of renewable sources (diversification)										
s. energy related goals: iv) avoidance of harm to agriculture (biodiesel, biomass production etc.)										

[1] We use a simple color code for expressing our evaluation: green for a good mark, red for a bad mark and grey for Not Applicable (N/A). A detailed analysis can be found in a later part of this paper.

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