Size matters: Climate change perception and carbon footprint of Czech households

"Respondents were asked, among other questions, on their assessment of climate change (questions on causes, consequences, trustworthiness, etc.)"

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ABSTRACT:
In our quantitative case study we deal with the sample of respondents from the Czech Republic, their assessment of climate change, carbon footprint of their households and relationship between their opinions and CO_2 emissions. Individuals and households are important participants in climate mitigation process – households produce substantial part of CO_2 emissions in Europe; in addition, any political and economic climate change mitigation policy must be supported by public to be successful. According to our concept of cultural ecology, we try to find links between the culture and environment, i.e. between people's mindset, their behaviour and its environmental impact. We made quantitative questionnaire survey in Spring 2010 with the sample of respondents from South Bohemian Region. Respondents were asked, among other questions, on their assessment of climate change (questions on causes, consequences, trustworthiness, etc.). They also received CO2 calculator, part of the questionnaire in which they filled energy consumption of their household in different categories: heating, electricity, car using, public transport, flights and food consumption.

For our analysis we constructed one indicator from climate change opinions, so-called climate change awareness. This construct shows how important the climate change is for the respondents. Following our own methodology we calculated CO2 emissions of the households in different sectors. Then we investigated the correlation of climate change awareness and socio-demographic characteristics as well as climate change awareness and households' carbon emissions. The climate change awareness is influenced by the number of people in household and living area (urban or rural). The effect of gender, age or education is not significant. Households produce most emissions by heating and food consumption. Public transport and flights emissions are very low. The only emission group in which the carbon footprint correlates with climate change awareness is heating, however this is due to the number of people in the household. There is no correlation for other groups. Emission footprint is probably influenced by other factors which cannot be captured due to the limited space of this paper. Detailed analysis of relations between different groups of household emissions and different demographic characteristics (age, gender, education, living area, income), type of housing (house, flat), values or lifestyles is challenge for future research and analyses.

KLÍČOVÁ SLOVA:
změny klimatu, emise CO_2, uhlíková stopa, spotřeba energie, kulturní ekologie

KEYWORDS:
změny klimatu, emise CO_2, uhlíková stopa, spotřeba energie, kulturní ekologie

ABSTRAKT:
V této kvantitativní případové studii se zabýváme hodnocením změn klimatu obyvateli České republiky, dále pak uhlíkovou stopou jejich domácností a vztahem mezi jejich názory a emisemi CO2. Jednotlivci, respektive domácnosti, jsou důležitými aktéry procesu zmírňování změn klimatu – domácnosti produkují podstatnou část z celkového množství emisí CO2 v Evropě. Navíc, žádné politické a ekonomické opatření slouží ke zmírňování změn klimatu se neobejde bez podpory veřejnosti. V duchu našeho pojetí současné kulturní ekologie se snažíme v této práci najít vztah mezi lidskými postoji, chováním a environmentálními dopady tohoto chování.

V roce 2010 bylo provedeno dotazníkové šetření na výběrovém souboru obyvatel Jihočeského kraje. Respondenti byli, mimo jiné, dotazováni na hodnocení změn klimatu (příčiny, důsledky, důvěryhodnost atd.). Také obdrželi tzv. CO2 kalkulačku, část dotazníku, ve které vyplnili spotřebu energie ve svých domácnostech v různých kategoriích: vytápění, elektřina, používání automobilu a hromadné dopravy, létání a spotřeba potravin.

Pro potřeby naší analýzy jsme z názorů respondentů vytvořili jeden indikátor, tzv. konstrukt povědomí o změnách klimatu, který ukazuje, nakolik jsou respondenti přesvědčeni o vážnosti tohoto problému. Podle vlastní metodologie jsme dále spočítali emise CO2 domácností respondentů v jednotlivých kategoriích. Následně jsme zkoumali s jakými socio-demografickými faktory je povědomí o změnách klimatu spojeno a zda koreluje s emisemi domácností.

Povědomí o změnách klimatu je nejvíce ovlivněno počtem členů domácnosti a tím zda respondenti bydlí ve městě nebo na venkově. Vliv pohlaví, věku, ani vzdělání nebyl prokázán. Největší množství emisí produkují domácnosti topením a spotřebou potravin. Téměř zanedbatelné jsou emise respondentů z veřejné dopravy a z létání. Jedinou skupinou emisí, u které koreluje přesvědčení o závažnosti změn klimatu s nižším množstvím emisí, je vytápění. Toto je ovšem ovlivněno velikostí domácností. U ostatních skupin nebyla žádná korelace prokázána. Množství emisí je velmi pravděpodobně ovlivněno jinými proměnnými, které vzhledem k omezenému rozsahu tohoto článku, nebylo možné postihnout. Podrobná analýza vztahu uhlíkové stopy domácností v jednotlivých emisních kategoriích a různých socio-demografických charakteristik (věk, pohlaví, vzdělání, bydliště, příjem), typu obydlí (dům, byt), hodnot či životních stylů je výzvou pro další výzkum.

INTRODUCTION

This study, which tries to inquire into present-day problems of energy demand and carbon emission of Czech households, is backed up with the ideas of current cultural ecology. Traditional anthropological cultural ecology is rooted in the half of the 20th century in the work of anthropologist Julian Steward who defined it as the "ways in which culture change is induced by adaptation to the environment" (Steward 1955: 5). In our approach (authors 2012a; 2012b) cultural ecology is the integrative attempt to reflect contemporary global ecological problems by various social sciences. In intentions of cultural ecology we ask whether there is a potential for culture change, respectively whether the culture reflects the environmental problems (in our case climate change) and how the culture does contribute to this problem, tries to adapt or seeks for the solution.

Environmental issues are of raising awareness among global population in last decades. Probably the most challenging global environmental problem of today's world is the problem of climate change. No matter how controversial and uncertain the human effect on climate change is sometimes portrayed in public discussion in the Czech Republic, the scientists generally agree that not only natural cycles (e.g. changes of sun activity, concentration of aerosol in atmosphere), but human activity contributes to the current climate change as well (e.g. Collins et al. 2007; IPCC 2007). Intergovernmental Panel on Climate Change claims that there is "very high confidence, that the net effect of human activities since 1750 has been one of warming" (IPCC 2007: 22). Human contribution to the concentration of carbon dioxide and other greenhouse gases in the atmosphere is caused mainly by burning fossil fuels, agriculture and deforestation.[1)]

New environmental global problems and increasing environmental awareness raised interest of social scientists in perception of these problems. Environmental issues and environmental attitudes became regular part of social research. Some of the classical studies confirm that the environmental awareness in the Western societies is increasing, i.e. Ingelhart's materialistic and post-materialistic values (Ingelhart 2008) or Catton's and Dunlap's shift from Human Exceptionalism Paradigm to New Ecological Paradigm (Catton & Dunlap 1980; Dunlap et al. 2000). Contrary to these findings, number of studies dealing with the inconsistencies between values, attitudes or self-reported behaviour on one hand and the real behaviour on the other hand points to discrepancy known as "value-action gap". These studies often show human tendencies to present their behaviour better than really is, like in case study of waste recycling of Hong Kong university students by Chung & Leung (2007). Other studies go deeper into the motivation and study how different factors (like values and beliefs) influence both environmentally friendly behavioural intention and behaviour itself (Barr 2004).

In our research we aim to study awareness of climate change and households' carbon footprint of respondents and households from the Czech Republic, respectively from South Bohemian Region. Four aspects of climate awareness are surveyed: anthropogenic causes, outcome efficacy, exaggeration of problem and negative consequences. The carbon footprint is measured in six sub-groups: heating, electricity, car using, public transport, flights and food consumption. Previous studies explored opinions on climate change usually together with opinions about other social, political or environmental problems (i. e. Bord et al. 1998; Heath & Gifford 2006; Lorenzoni & Pidgeon 2006). In Czech conditions there are some studies comparing the climate awareness among Czech and international samples of students (Lapka & Cudlínová 2007) and long-term opinion polls (CVVM 2011). The long term poll results show perceived lower importance of climate change compared to other environmental issues (like waste management or drinking water pollution and decrease) and decreasing importance of climate change from year 2009 up to the present day. European Union opinion polls portray Czech population as more climate change sceptical compared to the EU average (EC 2009). Regarding the effect of socio-demographic characteristics, EU opinion polls (EC 2008, 2009) suggest that more educated and younger people are more aware of climate change (in overall European sample). Heath and Gifford (2006) find out that older people are slightly more sceptical about human causes and negative consequences of climate change in Canadian population. According to the Czech opinion polls (CVVM 2011), women are more climate change sensitive than men.

However few studies try to put together the attitudes towards climate change and energy relevant behaviour (not only intention to behaviour or acceptance of policies). Peter Preisendorfer in his study dealing with environmental awareness and behaviour (1999) interestingly distinguishes these two axes (behaviour and attitudes) and comes up with the four categories of people according to them. Vera Peters (2011) uses this approach for the analysis of international sample of respondents, including ours. Among the Czech respondents, two important categories emerge, "climate ignorants" (29 % of population) and "protectionists with other reasons" (26 %). The category of "consequent climate protectionists" is least important with only 9%. We employ slightly different way of constructing the climate change awareness measurement and we compare it with the real carbon footprint of the households, instead of the index of

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[1)] See IPCC (2007: 5) for detailed numbers. Despite that most of the scientists and NGOs stress the role of the fossil fuels, some of the scholars accent the changes of water vapour in atmosphere (caused also by human activities, like deforestation, land cover change and change of water bodies). See e.g. Pokorný et al. (2010).

[2)] We use the term "assessment" of climate change or "climate change awareness". We asked respondents many questions which inquired the knowledge, opinions and behavioural intentions, however these questions did not include the affective dimensions, so it should not be named as attitudes towards climate change.

[3)] Carbon footprint is the amount of carbon dioxide (CO2) and other greenhouse gases emitted to the atmosphere by an entity (household, company, state) in given period. Usually it is measured in equivalents of CO2 (CO2eq), in our case CO2eq/person/year. ▶

climate friendly behaviour used in Peters' study. This approach allows us to analyse respondents' assessment[2] of climate change and outcomes of their behaviour, which is affected by the infrastructure in which they are embedded.

While calculating the carbon footprint[3] for social or regional subgroups of states, it is possible to choose one of two approaches. Works of Wiedman et al. (2006), Baiocchi et al. (2010) or Duarte et al. (2012) represent the "top-down" approach. They used the statistical analysis to find the differences of carbon footprint of various socio-economical groups or regions in United Kingdom, respectively Spain. Duarte et al. (in Spain) as well as Wiedman et al. (in UK) show that the carbon footprint grows with the income. These results support the need for further more detailed analysis of relationship between households' or individuals' carbon footprint and their socio-demographic characteristics.

This is possible through so-called carbon footprint calculators (or carbon calculators), algorithms which turn input information about respondents' energy relevant behaviour (e.g. heating, electricity consumption, transport habits, etc.) into the amount of tonnes of CO_2eq emitted by the energy consumption. This brings more detailed results than the post-hoc analyses of the macro data, however we must keep in mind a lot of possible pitfalls of this approach. We rely on the self-reported information about respondents' behaviour; some data are often not filled and must be substituted by data from literature or calculated using the other filled data. The results of the carbon footprint calculator are very sensitive to the conversion factors selected, methodology of calculation and data substitution.[4] Thus it is not possible to easily compare the results of different carbon calculators, even though they cover the same behaviours or categories.

With knowledge of Peters' (2011) findings and existence of environmental value-action gap as explained above, it would be naïve to expect clear and strong relationship of climate awareness and overall carbon emissions. Carbon intensive (energy relevant) behaviour is affected not only by socio-demographic factors, psychological or social specifics (Fischer et al. 2011), but by many infrastructural and systemic factors (economical, geographical, and natural) as well. We see this infrastructural influence in our previous analysis of partly similar dataset, which focused mainly on the rural-urban differences of households' emissions (Vávra et al. 2012). Finally, only one member of the household filled the climate change perception questionnaire, while the CO_2 emissions are calculated for whole household and then divided by number of household members. Thus we must be aware of possibly different opinions of other household members and low capability of one member to influence the other.

These possible pitfalls must be acknowledged, but we believe, they do not bring down our approach. The focus on households and individuals is important, because households produce directly substantial amount of all CO_2 emission in Europe and their indirect production is even higher. Any mitigation or adaptation climate policy must be accepted (or demanded) by the individuals, who judge the outcomes of these policies through their everyday lives in their households. With this respect, the opinions on climate change are crucial factors.

Following the ideas explained, we raised three main research questions:

1. How strong is climate awareness among the respondents and which socio-demographic factors influence it most?
2. How big is carbon footprint of the households in total and in different categories?
3. Is there any relation between climate awareness and carbon footprint?

[4] See Padgett et al. (2008) for the comparison of differences of results in10 US carbon calculator.

[5] For detailed information about the study site see Vávra et al. (2010).

TAB. 1
DEMOGRAPHIC CHARACTERISTICS OF SAMPLE AND SOUTH BOHEMIAN REGION

		SAMPLE	SOUTH BOHEMIAN REGION
Living area (%)	Urban	51,9	65,4*
	Rural	48,1	34,6*
Gender (%)	Male	51,0	49,3*
	Female	48,4	50,7*
Age groups (%)	18-39	44,2	41,5**
	40-59	38,1	32,0**
	60+	17,7	26,5**
Education (%)	No/primary	2,7	18,6*
	Sec.-low	26,8	34,7*
	Sec.-high	45,1	31,5*
	Vocational	4,4	
	University	20,1	11,1*
Average number of people per household		2,7	2,7***
Net income per capita per year in CZK (EUR)		11 931 (477)	11 456 (458) #
N		637 460	339

Note: Total sum of percent could not be 100 due to rounding and missing data.

Sources: Own empirical survey and Czech Statistical Office (CZSO).

* 2011 data (CZSO 2012a); ** 2010 data (CZSO 2011); *** 2001 data (CZSO 2005a); # 2011 data (CZSO 2012b).

METHODS

Study sites and sampling

The data were collected in a questionnaire survey in Spring 2010 as a part of international research project GILDED focused on European households and their carbon emissions. The South Bohemian Region was selected as a study site in the Czech Republic. It is relatively agricultural, less industrial area with low population density. The project aimed to cover both urban and rural regions equally, thus the urban centre with its rural surroundings was chosen. The urban centre was represented by the city of České Budějovice and the rural areas by the villages and small remote towns in the former administrative districts of České Budějovice and Český Krumlov.[5] Except this urban-rural specific, the sampling followed the gender and age quota of the area. For detailed socio-demographic characteristics of our sample and population of South Bohemian Region see Tab. 1. Most important difference between the research sample and South Bohemian Region is the higher education of our sample (but the analysis shows that this is less important than could be expected). The whole questionnaire asked for respondents' demographic characteristics, opinions on climate change, their real energy demand (see part CO_2 calculation below) and other energy relevant issues. Together 500 respondents filled the questionnaire. For the purpose of our analysis we use data from 339 respondents who answered all questions on perception of climate change.

Climate change awareness construct

Respondents were asked for 4 aspects of climate change awareness: anthropogenic causes, outcome efficacy, exaggeration of problem and negative consequences. We present these 4 aspects separately and we also build 12 item construct of climate change awareness, which combines all of the 4 aspects. The relationship of this construct and socio-demographic characteristics and carbon footprint of households is analysed.

The questions on different aspects of climate change awareness were inspired mostly by previous study of Heath & Gifford (2006). The respondents had to express their level of agreement with the statements; the scale of answers was from 1 (strongly disagree) through 3 (not agree, not disagree) to 5 (strongly agree). The questionnaire should not look pro-environmentally biased, so some of the questions were phrased negatively and then recoded for the analysis. The constructs are made by means of the items.

Anthropogenic causes construct consists of these four statements: 1. Any present-day climate change is mainly due to natural causes, not human activity. 2. Any climate change is part of a natural cycle. 3. I think that human lifestyles are a major contributor to any present-day climate change. 4. The main causes of any present-day climate change are emissions caused by humans. First and second statements were recoded negatively for the analysis. Reliability of this aspect was high enough (Cronbach's $\alpha = 0{,}70$).

Outcome efficacy construct consists of these three statements: 1. I think I can contribute to tackling climate change by saving energy. 2. It is pointless to save energy to tackle climate change. 3. I think it is useful to save energy to tackle climate change. Second item was recoded for the analysis. Reliability of this aspect is lower, but still useful ($\alpha = 0{,}57$).

Exaggeration construct consists of these three statements: 1. Too much emphasis has been placed on climate change. 2. It seems to me that the issue of climate change is exaggerated. 3. It is doubtful that climate change is occurring. All of the items were recoded for the analysis. Reliability of this aspect is high enough ($\alpha = 0{,}72$).

Negative consequences construct consists of these two statements: 1. Climate change will have serious negative impacts on future generations. 2. Climate change will bring about some serious negative consequences in my lifetime. Reliability of this aspect is not high, but still useful ($\alpha = 0{,}61$).

Reliability of all 4 aspects of climate change awareness is sufficient. This fact allows us to build the final climate change awareness construct, which is made by the mean of the 12 items mentioned above. All of the items are phrased in the same way (some were recoded). The higher on the scale 1-5 the climate awareness is, the more climate aware respondents are: they agree with anthropogenic causes of climate change; they find it useful to save energy to tackle climate change and they are willing to contribute; they do not think the climate change is exaggerated or doubtful; and they expect negative consequences. Reliability of this 12 item construct is high ($\alpha = 0{,}85$).

CO_2 calculation

Respondents filled information about six aspects of their energy demand (for year 2009), five of them direct, one indirect.[6] These categories were: heating demand; electricity demand; car using; public transport; flights and food consumption. This information included housing characteristics, number of appliances, number of cars and kilometres driven, number of kilometres travelled with public transport, number of flights and food consumption (and production) habits. Due to the international scope of the original research project for calculation of some categories (car using; public transport; flights; and food consumption), foreign (mostly German) CO_2 emission equivalents were used. Heating and electricity CO_2 conversion factors reflect Czech specifics. Here we briefly summarize the core of the calculation methodology and conversion factors (Tab. 2), for detailed information see Vávra (2012).

For respondents who filled their heating demand the emissions were calculated with the appropriate CO_2 emission conversion factors regarding the type of heating source. Heating demand of respondents who did not fill this information was calculated with respect to the space of their houses or apartments and national average data derived from previous study (CZSO 2005b).

Electricity emissions were calculated from the demand filled by the respondents. If they did not fill it, the electricity demand was calculated with linear regression using relevant housing characteristics (number of people living in household and whether is electricity used for heating water). Car emissions were calculated using the data on number of cars, fuel consumption and kilometres driven. For public transport emissions people filled their everyday commuting habits (frequency, distance, type of transport) and other travels using public transport. We asked only for commuting and personal trips not for business travels, both for cars and public transport. For both type of transport the national average data (Kastlová & Brich 2010) were used to replace missing data. Flights emissions were divided into three groups, regarding the length of the flight. Only leisure and holiday flights were taken in account, not the business travels.

The project aimed to cover both urban and rural regions equally, thus the urban centre with its rural surroundings was chosen.

[6] The methodology was inspired by the CO2 Rechner, official German carbon footprint calculator developed by the Federal Environment Agency (http://uba.klimaktiv-co2-rechner.de/de_DE/page/) and adapted to the Czech conditions.

TAB. 2
CO_2 EMISSION FACTORS

	kg CO_2eq
heating	
natural gas	1,91 kg/m3
district heating	135,8 kg/GJ
wood logs	44,7 kg/m3
coal	2,5 kg/kg
electricity	0,688 kg/kWh
car using	
petrol	2,78 kg/l
diesel	2,84 kg/l
public transport	
long distance train	0,064 kg/personkm
regional train	0,101 kg/personkm
public transport in city	0,076 kg/personkm
regional bus	0,076 kg/personkm
long distance bus	0,032 kg/personkm
flights	
short flight (< 500 km)	130 kg/flight
European flight	360 kg/flight
intercontinental flight	2200 kg/flight
food	1200-1860 kg/person

Source: Fott (2010); Schächtele & Hertle (2007); IRZ (2011); Conversion factors and its sources (2010); Teplárna ČB (2011); DECC (2009); TZBinfo; EkoWATT (2008) and own calculations based on these sources.

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▶ Meat consumption, food self-supplying and some consumption habits (buying seasonal, regional and organic food) were used as a proxy for carbon footprint of households' food consumption, using the coefficients of Schächtele and Hertle (2007).

TAB. 3
CLIMATE CHANGE AWARENESS AND ITS ASPECTS

	Minimum	Maximum	Mean	Std. Deviation	Agree (%)	Disagree (%)
Climate change has anthropogenic causes	1	5	3.17	0,79	43	27,7
Outcome efficacy (energy saving)	1	5	3.5	0,71	53	9
Climate change is exaggerated	1	5	2.84	0,85	22	39
Climate change will bring negative consequences	1	5	3.7	0,86	69	11
Overall climate change awareness	1	4,67	3,34	0,65	51	17

Note: N = 339. The percent value consists of answers strongly agree + agree, respectively strongly disagree + disagree.

TAB. 4 – CORRELATION OF CLIMATE CHANGE (CC) AWARENESS AND DEMOGRAPHIC CHARACTERISTICS

	1	2	3	4	5	6	7
1 CC awareness	1						
2 living area	-0,15**	1					
3 gender	0,01	-0,12*	1				
4 age	-0,13*	0,32**	-0,18**	1			
5 education	0,05	-0,23**	0,08*	-0,29**	1		
6 people in household	0,20**	0,11*	-0,12*	-0,15**	-0,07	1	
7 income per person	-0,10	-0,20**	0,09	-0,32**	0,31**	-0,24**	1

Note: N ranges from 308 to 339. Two climate change awareness cases with extremely low values were omitted. Pearson correlation,* p < 0,05; ** p < 0,01 (2-tailed).

TAB. 5 – AVERAGE HOUSEHOLDS' EMISSIONS (TONNES OF CO2EQ/PERSON/YEAR)

	Minimum	Maximum	Mean	Std. Deviation
Heating	0,03	13,76	2,32	1,83
Electricity	0,07	11,77	1,25	1,12
Car using	0	13,79	1,1	1,43
Public transport	0	1,41	0,13	0,19
Flights	0	6,6	0,19	0,77
Food consumption	1,38	1,88	1,68	0,11
Total	2,5	24,9	6,68	3,08

Note: N = 339.

Statistical analysis
Data were statistically processed with IBM SPSS Statistics 19 software. For the purpose of Pearson correlation and regression analysis, some demographic characteristics were categorized: living area (1 urban, 2 rural); gender (1 male, 2 female); education (1 no/primary education, 2 secondary low/apprenticeship, 3 secondary high and vocational, 4 any university degree). Number of people in household uses categories 1 to 5, where 5 stands for 5 and more.[7] Income categories are calculated from weighted mean income per capita[8] (1 less than 6 000 CZK, 2 from 6 000 to11 999, 3 from 12 000 to 17 999, 4 from 18 000 to 24 999, 5 more than 24 000).[9] Age is also categorized: 1 (18-29), 2 (30-41), 3 (42-53), 4 (54-65) and 5 (66+).

RESULTS

Table 3 shows the average climate change awareness and its four aspects. Higher number indicates stronger agreement. All of the single components are above average value (3). While the component "exaggeration of climate change" is phrased negatively, if recoded, the value would be 3,16. The opinion of usefulness of energy saving (to mitigate climate change) and belief in negative causes are stronger and more widespread than the belief of anthropogenic causes of climate change.

It is interesting, however, that despite some level of uncertainty about the anthropogenic causes of climate change, only small part of respondents disagrees with saving energy as an effective way how to tackle the climate change. Table 4 represents the correlation between the overall climate change awareness and the socio-demographic observed in the study.

Linear regression was used to test the influence of correlated variables on the climate change awareness. Stepwise method indicates best model with two variables:[10] people in household (β = 0,23; t = 4,267; p = 0,000) and living area (β = -0,20; t = -3,757; p = 0,000). This model is statistically significant (F = 14,610; df = 331; p = 0,000), however with relatively low explanatory power (adjusted R2 = 0,08).

The result of an average household carbon footprint per year per person (amount of CO_2 emissions per capita) is divided into 6 categories (see Tab. 5). Most emissions come from heating, second most important source is food consumption, followed by emissions from electricity demand and car emissions. Carbon footprint of flights and public transport are almost marginal.

We tested the correlations[11] of overall climate change awareness with all six categories of households' emissions as well as with total amount of them. The results are significant in heating category (r = -0,15**). The other categories show no significant correlation: electricity (-0,07), car using (0,01), public transport (0,01), flights (-0,04) and food (-0,09). With the knowledge of the links between the climate change awareness and size of the household and urban-rural differences, we tested the correlation of climate change awareness and heating emissions controlled for number of people in household (-0,06) and living area (-0,15*). These results show, that the relationship between climate change awareness and heating emissions could be explained mainly by the effect of the size of the household.

DISCUSSION

The results show quite common belief, that climate change will bring negative consequences, irrespective of the level of uncertainty about their causes. Very low disapproval of the idea, that saving energy is useful is in line with our previous findings from qualitative study in the same region, suggesting that the idea of unsustainability of our resource use in general is widespread (Fischer et al. 2012). Our findings show no influence of demographic characteristics, like gender or education on climate change awareness of respondents. This contradicts to some previous studies or opinion polls (CVVM 2011; EC 2008, 2009) which connect higher education and lower age (EC 2008, 2009) or being a woman (CVVM 2011) with higher climate change awareness. Some studies support the connection of education and pro-environmental attitudes, but emphasize values as more important factor (Inglehart 1995). Study of Heath and Gifford (2006) supported only very slight influence of age, not gender, neither education.

We find very interesting effect of number of people per household and the living area (relatively weak, however significant socio-demographic factors). We hypothesize, that people with more populated households (mostly probably bigger families with more children) could have stronger biospheric or altruistic values, which could lead to pro-environmental attitudes (de Groot & Steg 2008), however it is impossible for us to claim what is the driver, whether these values lead to bigger households or the fact of having more children leads to these values or attitudes. This hypothesis should be analysed in further studies. It is quite surprising, that there are statistically significant differences of climate change awareness between urban and rural dwellers, controlled for any other socio-demographics. This implies some persisting cultural difference between towns and the countryside, which cannot be explained by any other socio-demographic factor. The question for next research is whether this is influenced by different values, lifestyles or other distinctions (may be the different everyday immediate experience with the sources of energy and energy consumption).

The total household carbon footprint 6,68 t of CO_2eq per capita per year combine direct (heating, electricity, personal transport) and indirect emissions (food consumption), but it does not include the rest of total carbon emissions of the country (general consumption, business, industry). When compared to the total amount of Czech emissions (12,3 t CO_2eq/person/year), household emissions of our sample make more than one half of the total emissions. Czech overall emissions belong to the highest in EU, the average is 8,34 t (DG TREN 2010), World's average is 4,3 tonnes (IEA 2011).

As mentioned in the introduction, it is not surprising that climate change awareness of respondents does not strongly influence overall carbon footprint of their households. The individual categories of emissions will be discussed separately. Heating emissions are driven by heating sources (most often natural gas, district heating, wood, coal, electricity or combination of these types) and energy demand for heating. Significant correlation of climate change awareness and heating emissions was explained by the size of the household. Following our results, we can state, that larger families (or households) produce by heating less emissions per capita, and their members tend to be either "consequent climate protectionists" or "protectionists with other reason" using the Preisendörfer's terminology (1999). Electricity emissions could be more affected by the lifestyle of households (number and efficiency of appliances). But if they do not have own energy source (i.e. solar panels) or they do not choose to buy so called "green electricity" from renewable sources (only 1 household from our sample did) their carbon emissions are mostly ▶

[7] Only 6 respondents reported more than 5 household members.

[8] First person weights 1, any other person 0,5. This is simplified version of OECD consumption units weights: first adult 1, other adult 0,7, any child 0,5.

[9] The categories in Euro: 1 (< 240), 2 (240-479), 3 (480-719), 4 (720-959), 5 (> 960).

[10] The model includes 336 respondents, three are omitted due to extreme values of standardized reziduals. Without these filtered cases, the distribution of standardized reziduals is normal, according to Shapiro-Wilk test (W = 0,992; df = 336; p = 0,069).

[11] N = 337, two climate change awareness cases with extremely low values were omitted. Pearson correlation, * p < 0,05; ** p < 0,01 (2-tailed).

The results suggest either strong value-action gap or strong infrastructural limits of the system in which is the life of the individuals and households embedded.

▶ defined by the national energy mix still dominated with 57% of steam power plants running on coal (ERO 2012). Comparison of car emissions and emissions form public transport show that the first exceeds eight times the latter. The total distance driven by car per person per year is 7 215 km, by public transport 1 951 km (this includes also marginal distances by feet and by bike). Even if the number of km driven by public transport would be the same as by car, the emissions would be less than half. Flight emissions are quite low. Considering the high amount of emissions for one flight, this is caused by small number of flights. 84% of respondents expressed that no one from their household flew by plane in year 2009. It is probable that number of flights and number of km driven by car will increase in future with increasing wealth of population.[12] Neither food emissions correlate with the climate change awareness. Most of the respondents and their families' members eat meat for their main meal of the day 4-6 times per week. Respondents reported only 12 vegetarians in their families and no vegans (these diets lower the carbon emissions embedded in the food mostly).

Lack of correlation of climate change awareness and five out of six areas of households' emissions show either big value-action gap or crucial impact of the infrastructure (system) which does not allow the individuals to express their pro-environmental views in their behaviour. Previous qualitative study from five EU countries (including the Czech Republic) supports the existence of value-action gap in terms of climate mitigation or energy saving behaviours and importance of overall trust for any behaviour changes (Fischer et al. 2011).

Typical system-limited emissions are from heating. Respondents living in block of flats have almost no possibility to influence the heating source used. Unfortunately our sample is not big enough for the analysis of correlation of climate change awareness and heating emissions in subgroups made by households with different heating sources or housing types. However our results show, that it is possible to influence per capita heating emissions by number of people in household. No correlation of climate change awareness and car or electricity emissions is caused probably by mixture of value-action gap and infrastructure. For electricity the distrust to the concept of renewable "green energy" could also play its role. Flight emissions represent the category, in which we could most likely expect negative correlation of climate change awareness and emissions. It is relatively easier to decide not to fly on a holiday trip than to change the source of heating or car using, if it is necessary due to geographic conditions. Nevertheless there is not any correlation of climate change awareness and flight emissions, neither there are differences between climate change awareness of people who flew (or member of their family) and those who did not fly. This could be described as purest example of value-action gap from all categories of emission studied.

Although we mentioned the number of people in household for several times in our study, we would like to stress it once again in context of future evolution of carbon emissions. The total carbon emission per capita depend substantially on the size of the household, ranging from 9,5 tonnes (single household), through 7,2 t (2 people) and 5,7 (3 people) to 5,4 (4 or more people). Despite the increasing efficiency of household equipment and cars, the individualization trend together with increasing long-term wealth of the Czech society can lead to considerable growth of households' carbon emission, if no structural measures or distinctive behavioural changes will occur. It does not seem to us, that we are witnessing any of these possibilities.

CONCLUSION

The results suggest either strong value-action gap or strong infrastructural limits (either real or perceived) of the system in which is the life of the individuals and households embedded. This opens big area for future research of infrastructural factors, deeper analyses of geography, demographics, values and lifestyles as compared with the different areas of households' carbon emissions.

In the framework of cultural ecology we can conclude that there are some indications that the culture reflects the problem of climate change, but this reflection is probably partly rhetorical. The system is still rather causing the problem than seeking for its solution.

For the policymakers and practical climate change mitigation we can say that people perceive the climate change as an important problem. The results suggest that even if the value-action gap would be overcome and individuals would take part in energy saving and climate change mitigation through changes in everyday practices of their households, without infrastructural and system changes, these mitigation actions would not lead to real success (relatively high heating, electricity, car and very low public transport emissions could be used as hints for policymaking).

And previous studies imply that without the real system and political changes, the individuals would really not be willing to participate in any behavioural changes. ●

[12] Total capacity of private car transportation in the Czech Republic (number of passengerkilometers per year) is sixth lowest in EU, this suggests an opportunity for future growth (MoE 2012).

REFERENCES:

- BAIOCCHI, G., MINX, J., & HUBACEK, K. (2010). The impact of Social Factors and Consumer Behavior on Carbon Dioxide Emissions in the United Kingdom. Journal of Industrial Ecology 14 (1). 50-72.
- BARR, S. (2004). Are we all environmentalists now? Rhetoric and reality in environmental action. Geoforum 35. 231-249.
- BORD, R. J., FISHER, A., & O'CONNOR Robert E. (1998). Public perceptions of global warming: United States and international perspectives. Climate Research 11. 75-84.
- CATTON, W. Jr., & DUNLAP, Riley E. (1980). A New Ecological Paradigm for Post Exuberant Sociology. American Behavioral Scientist 24(1). 15-47.
- CHUNG, S., & LEUNG, M. M.-Y. (2007). The Value-Action Gap in Waste cycling: The Case of Undergraduates in Hong Kong. Environmental Management 40. 603-612.
- COLLINS, W., COLMAN, R., HAYWOOD, J., MANNING, M. R., & MOTE, P. (2007). The Physical Science Behind Climate Change. Scientific American 297. 64-73.
- Conversion factor and its sources (2010). Retrieved from http://www.display-campaign.org/doc/en/index.php/APPENDICES#Conversion_Factors_and_their_Sources.
- CVVM (Centrum pro výzkum veřejného minění) (2011). Česká veřejnost o globálních problémech - květen 2011. Tisková zpráva oe110622. Retrieved from http://cvvm.soc.cas.cz/media/com_form2content/documents/c1/a3883/f3/101161s_oe110622.pdf.
- CZSO (Czech Statistical Office) (2005a). Sčítání lidu, domů a bytů - data pro Jihočeský kraj. Czech Statistical Office. Retrieved from http://www.czso.cz/sldb/sldb2001.nsf/tabx/CZ0310.
- CZSO (Czech Statistical Office) (2005b). Spotřeba energie v domácnostech ČR za rok 2003. Czech Statistical Office. Retrieved from http://www.czso.cz/csu/2005edicniplan.nsf/p/8109-05.
- CZSO (Czech Statistical Office) (2011). Statistical Yearbook of the Jihočeský Region 2011. České Budějovice: Czech Statistical Office. Retrieved from http://www.czso.cz/csu/2011edicniplan.nsf/t/60003BA085/$File/e31101111.pdf
- CZSO (Czech Statistical Office) (2012a). Předběžné výsledky Sčítání lidu, domů a bytů 2011 - Jihočeský kraj. Praha: Czech Statistical Office. Retrieved from http://www.czso.cz/csu/2012edicniplan.nsf/t/950049F8F9/$File/pvkrcz031.pdf.
- CZSO (Czech Statistical Office) (2012b). Expenditures and Consumption of Households Included in Household Budget Survey in 2011. Praha: Czech Statistical Office. Retrieved from http://www.czso.cz/csu/2012edicniplan.nsf/engpubl/3001-12-eng_r_2012.
- DECC (Department on Energy & Climate Change) (2009). Act on CO2 Calculator V2.0: Data, Methodology and Assumptions Paper. Retrieved from http://www.decc.gov.uk/assets/decc/what%20we%20do/global%20climate%20change%20and%20energy/tackling%20climate%20change/ind_com_action/calculator/1_20091120174357_e_@@_actonco2calculatormethodology.pdf.
- DG TREN (European Comission - Directorate-General for Energy and Transport) (2010). EU ENERGY IN FIGURES 2010 - CO2 Emissions by Sector. Retrieved from http://ec.europa.eu/energy/publications/doc/statistics/ext_co2_emissions_by_sector.pdf.
- DUNLAP, R. E., VAN LIERE, K. D., MERTIG A. G., & JONES Robert E. (2000). Measuring Endorsement of the New Ecological Paradigm: A revised NEP Scale. Journal of Social Issues 56(3). 425-442.
- DUARTE, R., MAINAR, A., & SÁNCHÉZ CHÓLIZ, J. (2012). Social groups and CO2 emissions in Spanish households. Energy Policy 44. 441-450.
- EC (European Comission) (2008). Europeans' attitudes towards climate change - Special Eurobarometer 300 - Wave 69.2. Retrieved from http://ec.europa.eu/public_opinion/archives/ebs/ebs_300_full_en.pdf.
- EC (European Comission) (2009). Europeans' attitudes towards climate change - Special Eurobarometer 322 - EB72.1. Retrieved from http://ec.europa.eu/public_opinion/archives/ebs/ebs_322_en.pdf.
- EKOWATT (2008). Dřevo. Retrieved from http://ekowatt.cz/uspory/drevo.shtml.
- ERO (Energy Regulatory Office) (2012). Roční zpráva o provozu ES ČR. Praha: Energy Regulatory Office. Retrieved from www.eru.cz/user_data/files/statistika_elektro/rocni_zprava/2011/Rocni_zprava_ES_CR_FINAL.pdf.
- FISCHER, A., PETERS, V., VÁVRA, J., NEEBE, M., & MEGYESI, B. (2011). Energy use, climate change and folk psychology: Does sustainability have a chance? Results from a qualitative study in five European countries. Global Environmental Change 21. 1025-1034.
- FISCHER, A., PETERS, V., NEEBE, M., VÁVRA, J., KRIEL, A., LAPKA, M., & MEGYESI, B. (2012). Climate change? No, wise resource use is the issue: Social representations of energy, climate change and the future. Environmental Policy and Governance 22(3). 161-176.
- FOTT, Pavel (Ed.) (2011). National greenhouse gas inventory report of the Czech Republic, NIR (REPORTED INVENTORIES 1990 - 2009). Praha: Czech Hydrometeorological Institute. Retrieved from http://www.chmi.cz/files/portal/docs/uoco/oez/nis/NIR/NIR-2011-2009-CZ-UNFCCC.pdf.
- GROOT de, J. I. M., & STEG, L. (2008). Value Orientations to Explain Beliefs Related to Environmental Significant Behavior. Environment and Behavior 40(3). 330-354.
- HEATH, Y., & GIFFORD, R. (2006). Free-Market Ideology and Environmental Degradation: The Case of Belief in Global Climate Change. Environment and Behavior 38(1). 48-71.
- IEA (International Energy Agency) (2011). CO2 emissions from fuel combustion. Highlights. Paris: International Energy Agency. Retrieved from http://www.iea.org/co2highlights/CO2highlights.pdf.
- INGLEHART, R. (1995). Public Support for Environmental Protection: Objective Problems and Subjective Values in 43 Societies. Political Science and Politics 28(1). 57-72.
- INGLEHART, R. (2008). Changing Values among Western Publics from 1970 to 2006. West European Politics 31(1-2). 130-146.
- IPCC (Intergovernmental Panel on Climate Change) (2007). Fourth Assesment Report - Climate Change 2007: Synthesis Report. Retrieved from http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf.
- IRZ (Integrovaný registr znečišťování) (2011). Retrieved from: http://tomcat.cenia.cz/irz/.
- KASTLOVÁ, O., & BRICH, M. (2010). Transport Yearbook Czech Republic 2010. Ministry of Transport. Retrieved from https://www.sydos.cz/cs/rocenka_pdf/Rocenka_dopravy_2010.pdf.
- LAPKA, M., & CUDLÍNOVÁ, E. (2007). Problem of Global Warming and Emerging Patterns of Global Consciousness. International Study. Journal of Landscape Ecology 0(0). 91-104.
- LAPKA, M., VÁVRA, J., & SOKOLÍČKOVÁ, Z. (2012). Cultural ecology: Contemporary understanding of the relationship between humans and the environment. Journal of Landscape Ecology 5(2). 12-24.
- LORENZONI, I., & PIDGEON, N. F. (2006). Public views on climate change: European and USA perspectives. Climatic Change 77. 73-95.
- MoE (Ministry of Environment) (2012). Zpráva o životním prostředí České republiky 2010. Praha: Ministry of Environment. Retrieved from http://www.mzp.cz/C1257458002F0DC7/cz/zprava_zivotni_prostredi_2010/$FILE/OZV-Zprava_o_zivotnim_prostredi_2010_20120326.pdf.
- PETERS, V. (2011). Energy consumption patterns and climate change perception in international comparison. Paper presented at konference Energy and People: Futures, complexity and challenges held on 20-21 September 2011 at University of Oxford.
- POKORNÝ, J., BROM, J., ČERMÁK J., HESSLEROVÁ, P., HURYNA, H., NADEZDHINA, N., & REJŠKOVÁ, A. (2010). „Solar energy dissipation and temperature control by water and plants." International Journal of Water 5 (4). 311-336.
- PREISENDÖRFER, P. (1999). Umwelteinstellungen und Umweltverhalten in Deutschland. Empirische Befunde und Analysen auf der Grundlage der Bevölkerungsumfragen "Umweltbewusstsein in Deutschland 1991-1998". Opladen: Leske + Budrich.
- SCHÄCHTELE, K., & HERTLE, H. (2007). Die CO2 Bilanz des Bürgers. Recherche für ein internetbasiertes Tool zur Erstellung persönlicher CO2 Bilanzen. Endbericht. Heidelberg: Institut für Energie- und Umweltforschung. Retrieved from http://www.umweltdaten.de/publikationen/fpdf-l/3327.pdf.
- STEWARD, J. (1955). Theory of Culture Change: The Methodology of Multilinear Evolution. Urbana: University of Illinois Press.
- Teplárna ČB (2011). Výroční zpráva 2010. Teplárna České Budějoivce, a.s. Retrieved from http://www.teplarna-cb.cz/files/teplarna-cb/uploads/files/vyrocnizpravy/zprava-10.pdf.
- TZBinfo. Výhřevnosti a měrné jednotky palivového dřeva. Retrieved from http://vytapeni.tzb-info.cz/tabulky-a-vypocty/12-vyhrevnosti-a-merne-jednotky-palivoveho-dreva.
- VÁVRA, J. (2012). Zrození post-uhlíkové společnosti? Kulturní změna očima lokální komunity. Dissertation thesis. Praha: Faculty of Arts, Charles University in Prague.
- VÁVRA, J., LAPKA, M., & CUDLÍNOVÁ, E. (2012). Uhlíková stopa jihočeských venkovských a městských domácností. Pp. 9-27 in J. VÁVRA, M. LAPKA (eds.). Měnící se společnost? Praha: Vydavatelství FF UK.
- VÁVRA, J., LAPKA, M., CUDLÍNOVÁ, E., & DVOŘÁKOVÁ-LÍŠKOVÁ, Z. (2010). Energy governance in České Budějovice shire - The Czech case. Pp. 76-109 in N. GOTTS, I. KOVÁCH (eds.). Climate change and local governance: Alternative approaches to influencing household energy consumption (A comparative study of five European regions). Budapest: Institute of Political Sciences Hungarian Academy of Sciences. Retrieved from: http://mek.oszk.hu/09300/09355/09355.pdf
- WIEDMANN, T., MINX, J., BARETT, J., WACKERNAGEL, M. (2005). Allocating ecological footprints to final consumption categories with input-output analysis. Ecological Economics 56. 28-48.