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to the entitled Ph.D. dissertation

Veronika Kiss

"Energy Use Caps under Scrutiny:

An Ecological Economics Perspective"

Supervisor:

György Pataki, Ph.D
Associate professor

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Department of Decision Sciences

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1. Research background and relevance

According to research, global warming keeps rising and will cause further long-term change to the climate system (IPCC, 2018). Based on the World Energy Outlook, energy production and energy use is the largest source of global greenhouse-gas (GHG) emissions (International Energy Agency, 2015). According to forecasts, energy consumption will increase in the future, notwithstanding goals defined in line with environmental and energy policies (IEA, 2018; UN, 2018). In order to avoid any additional associated harmful impacts of climate change on humanity and nature, global CO_2 emissions need to decline well before 2030. For this to happen, we need to develop energy policies based on a vision of a low-carbon economy/society and implement policy tools that radically reduce our energy demand. Due to the fact that in the EU 27.2% of final energy consumption is used by households (Eurostat, 2017), while this proportion in Hungary is 31-35% (MEKH, 2017; Sáfián, 2019), controlling household energy use would have significant consequences in terms of helping regulate energy-related CO_2 emissions and thus mitigating the impacts of climate change.

One of the scientific proposals for radically decreasing global CO_2 emissions is capping energy use. Schemes for energy capping set absolute limits on energy use. Their proponents usually claim that they can enhance ecological sustainability together with social justice, while – within the defined quantitative boundaries – increasing allocative efficiency too. Energy-capping schemes (among the so-called Personal Carbon Trading schemes, or PCTs) have been developed to limit household energy use.

In my doctoral research, I scrutinized the impacts of energy-capping tools on households using ecological economics as a research paradigm. Ecological economics defines the following three goals: 1) sustainable scale, 2) fair distribution, and, 3) efficient allocation. Scale refers to the amount of resources that are extracted and traded due to global economic activity. The physical limits of our globe, which are currently being widely trespassed, define the scale of sustainable resource use. Analysis of the distribution of resources and benefits of the use of the latter highlights the issue of fair distribution. The fair distribution of resources as well as the fair distribution of benefits arising from resource use are preconditions for just societies and thus for sustainability. The third aspect of ecological economics reveals how efficient the allocation of resources is, which is the primary concern of neoclassical environmental economics.

With my doctoral research, I would like to advance, both on the scientific- as well as the policy agenda, the need for setting a cap on the use of residential energy resources to re-calibrate the economy within sustainable ecological boundaries. This capping should, however, consider the implications of social justice and lead to a fair share of benefits from the use of energy being distributed to all societal parties, particularly vulnerable ones. Therefore, I investigated how energy-capping schemes – among the Personal Carbon Trading schemes designed for households – contribute to meeting the three goals of ecological economics. Since PCTs (Fawcett, 2010) are designed to distribute equal per-capita entitlements for individuals in line with a defined and annually decreasing cap, and the social enhancement of energy-capping schemes is the most questionable issue in relation to this goal, I posed the following research questions:

Q1. What are the interlinkages between residential energy consumption and social justice?

Q2. How does an energy entitlement scheme with an equal per-capita distribution mechanism influence the interconnectedness of residential energy consumption and social justice in Hungary?

I chose to investigate Hungary and Hungarian residential energy use data since I carried out my PhD studies in this country, and one of the energy-capping schemes has been developed in this country (Gyulai, 2011). Through my research I aim to inform climate and energy policies about the potential social justice implications of policy tools that have been proposed to reduce household energy use.

2. Methodology

In order to scrutinize energy-capping schemes based on the perspectives of ecological economics, but especially to scrutinize the achievement of the second goal of ecological economics, just distribution, I more deeply investigated justice theories linked to sustainable and fair energy use. Regarding sustainable scale, I detailed the need for an absolute reduction in energy use, and also investigated the tools that have been proposed for achieving this objective.

With regard to just distribution, one can assume that growing resource use implies enhanced well-being for all. Social inequalities, however, are rising both within and between nations, while hunger and malnutrition have not been eliminated globally. The more unequal the income per capita, the more difficult it is to achieve environmental agreements (Teixidó-Figueras and Duro, 2015). With my dissertation, I aimed to find out how equal per-capita energy entitlement distribution would impact households with different socioeconomic backgrounds. Therefore, I investigated to what extent energy-capping schemes deliver benefits to marginalized groups of societies such that their well-being and living standards are enhanced. I consider that environmental or climate justice touches upon the principles of distributive justice and corrective justice (i.e. on the questions who can use more than their fair share, and to what extent) in relation to reducing unequal chances – not only from an intra and intergenerational perspective, but also between and within nations. Furthermore, I also considered that sustainable and sufficient energy use needs to take into account distributional justice in order to ensure that every member of society can afford a sufficient amount and quality of energy. Moreover, with regard to energy poverty as energy injustice, I consider distributional justice and procedural and recognitional justice, which need to be considered when attempting to reduce the energy poverty level, especially of the poor and marginalized. Besides sufficiency, whereas with distributional justice income distribution and the variable levels of housing energy efficiency are tackled, energy poverty as a form of energy injustice touches upon the other two aspects of justice. Procedural justice addresses – for instance – access to information, such as information about loans for energy efficiency investments. Recognition justice, however, touches upon the recognition of the poor and marginalized, and questions such as whether it is prestigious to have solar panels, or retrofit a house.

In light of the need for effective allocation, the third goal of ecological economics, my dissertation highlights the importance of having ambitious energy policies, such as the proper formulation and enforcement of energy-capping methods.

Regarding practical policies and policy tools for achieving the goals of ecological economics, I investigated carbon tax versus cap-and-trade regimes (C&T) in the related literature and policies, including to what extent they deal with the first aspect of ecological economics (sustainable scale). I found that C&T schemes, if caps are set properly, have the potential to contribute to achieving sustainable energy use. From the C&T regimes I investigated and compared more deeply different PCT schemes and revealed how they contribute not only to achieving sustainable scale, but also to meeting the second principle of ecological economics: just distribution (in this case, of energy and of the benefits arising from its use). In this comparison, it turned out that a provisional research agenda for enhancing PCT-related research was needed to increase understanding of the wider set of personal and social factors that influence the impacts of PCTs (Seyfang et al., 2009), especially concerning the distributional impacts of PCTs. My dissertation contributes to filling this research gap, partly by showing that it is important to explore alternatives to the equal distribution of emissions rights based on understanding household patterns of energy use in the respective countries.

Besides the theoretical review, my methodological review, which touches upon the international literature when examining residential energy use, reveals that decreasing energy consumption should occur with full consideration of social justice, based on which proper policies should be formulated. In order to achieve this, support for differing strategies for different consumer groups should be enhanced that can change consumption patterns (Sütterlin et al., 2011), while demographic-economic characteristics should be taken into account, in addition to physical ones related to energy consumption patterns, when designing energy efficiency policies (Longhi, 2015), and more complex approaches are needed (Jensen et al., 2018). Furthermore, based on the methodological review, the most deeply researched areas in relation to identifying the drivers of residential energy use are income, poverty, environment consciousness, energy prices, and household composition.

Among the methodological reviews, I collected several types of data related to Hungarian residential energy consumption. In Hungary, people from the richest income decile spend almost three times more on energy than people from the poorest income decile (KSH, 2016). The amount spent by the poorest, however, does not reflect non-reported energy resource consumption, such as from non-officially-harvested firewood. Thirty-three percent of Hungarian households spend more than 15% of their income on energy (Kőszeghy, 2019). On average, 74-76% of Hungarian household energy consumption goes on heating (MEKH, 2017; Sáfián, 2019). Proper insulation against winter temperatures could result in a significant reduction in household energy use. Two-thirds of the building stock is very outdated and strongly in need of renovation (Sáfián, 2019), while one quarter is in bad condition, with leaking and damp roofs and walls, and degrading windows and floors (Eurostat, 2018; Bertram and Primova, 2018). According to a national survey, 44-46% of respondents say that the major challenge associated with reducing household energy costs related to heating and cooling is the lack of loans and subsidies for renovation and refurbishment (Csutora et al., 2017). Approximately 11-14% of the Hungarian population are in arrears related to utility bills, while the EU average is 6.6% (Eurostat, 2019). Furthermore, 9.2% of the Hungarian population cannot keep their home adequately warm due to financial constraints (Bertam and Primova, 2018, Neuberger, 2017).

Based on the theoretical and methodological literature, I aimed to find answers to my research questions. Through examining Hungarian household energy consumption from a social justice perspective, my research was designed to reveal what kinds of social-justice-related indicators play a significant role in household energy consumption patterns. Furthermore, I aimed to reveal whether specific groups or clusters of households can be identified in the Hungarian population based on their different types of energy costs, and what kinds of socioeconomic factors specify those clusters. Furthermore, I aimed to reveal how an energy quota scheme based on equal per-capita distribution would impact households in each of the latter clusters.

In order to reveal the energy and poverty interlinkages in the case of households, as well as to evaluate the potential impact of energy-capping schemes on the Hungarian population, on the one hand quantitative statistical tools were applied. On the other hand, I aimed to better interpret and contextualise the analysis based on quantitative statistical data through expert-based qualitative inquiry. To carry out the quantitative research, I first identified the database from which the most adequate data could be obtained. I aimed to collect variables from the chosen database based on the aforementioned justice theories and concepts. I then compiled the list of variables and finally defined the method for the quantitative data analysis. With my quantitative research, I aimed to test the following hypotheses:

H1: Household clusters can be formed based on variables defining costs spent on different energy source use.

H2: Variables related to social justice significantly influence the household clusters defined by the amount spent on different energy source consumption.

H3: The implementation of an energy entitlement scheme with an equal per capita distribution mechanism would not benefit all the poor households.

During my quantitative research I distinguished clusters based on household spending on types of energy. Furthermore, I selected variables from the chosen database (SILC) or created new variables from pre-existing ones that define 1. household characteristics; 2. maintenance and energy costs; 3. type of property; and, 4. socio-demographic data.

Social-justice-related variables could be associated with the latter groups, which I incorporated based on both theoretical as well as methodological literature. Different statistical tools were applied to the thus-created clusters to identify how the chosen social justice variables would significantly affect them.

In order to put into context the secondary statistical data, I carried out expert interviews with key informants who could assist in revealing the connections (patterns and causal mechanisms) between poverty and household energy use. By using different data sources and applying diffuse data collection methods, I aimed to draw a clearer picture of Hungarian energy use patterns, the socioeconomic drivers behind it, and the potential impacts of an energy-quota scheme based on equal per-capita distribution on households with different socioeconomic backgrounds and energy consumption patterns.

3. Results of the dissertation

In my dissertation, I aimed to find the answers to my research questions:

Q1. What are the interlinkages between residential energy consumption and social justice?

Q2. How would an energy entitlement scheme with an equal per-capita distribution mechanism influence the interconnectedness of residential energy consumption and social justice in Hungary?

Therefore, I first list how the analysed energy-capping scheme based on an equal per-capita distribution mechanism would contribute to meeting the three principles of ecological economics: sustainable scale, just distribution, and effective allocation. I then list my findings in relation to the social justice aspect of ecological economics: just distribution, based on the results of analysing Hungarian household energy consumption patterns.

3.1. The contribution of energy-capping schemes to the three principles of ecological economics

- The analysed energy quota schemes aim to contribute to achieving **sustainable scale** through reducing energy consumption and thus the size of the economy. The proposals would reach their goals through setting an absolute ceiling for fossil energy use, which would be lowered year by year. The continuous ceiling reduction would ensure that energy use decreases gradually until it reaches a sustainable level. Fossil-energy-use caps are necessary and need to be fixed in physical terms, independent of any allocation mechanisms like trading. Caps should be established at 'entry gates' to the economy – meaning input-side regulation, which is the case with limiting fossil energy use.

Regarding **just distribution**, energy-capping schemes also have a role to play.

- Distributional justice is embedded in all of the three theories linked to fair and sustainable energy use: environment or climate justice, sufficiency, and energy poverty defined as energy injustice. Equal per-capita quota distribution aims to achieve distributional justice, as primarily defined by sufficiency; namely, to ensure an adequate, sufficient amount of energy for all. Distributional justice as defined by environmental or climate justice also needs to be considered via developing and implementing energy-capping schemes in terms of mitigating the situation that the poor and marginalized are usually more exposed to environmental problems and pollution. Last but not least, distributional justice as defined by energy poverty (an energy injustice concept) needs to be enhanced to improve the livelihood and well-being primarily of the poor and marginalized. The equal per-capita distribution mechanism is built based on the principle of equality. The challenge, however, lies in how to distribute the related energy quotas amongst inhabitants in order to enhance social (distributive) justice.
- Procedural justice also needs to be ensured via developing energy-capping schemes. This includes creating ownership and motivation to reduce household energy consumption, which is also part of the sufficiency debate. For this, it is essential that information and knowledge is continually provided to citizens, especially to the marginalized (Herpainé Márkus et al., 2011) about how they can benefit such a system and how they can realize the benefits thereof. For this, digital inequalities defined primarily by education, type of settlement, level of income and wealth need to be mitigated. Ensuring the provision of proper information and knowledge contributes to enhancing procedural justice (as defined by energy poverty, an energy injustice concept).
- Among the social benefits, the expenses of households could be reduced if energy-capping schemes were implemented. Those who consume less energy than the fair share (number of units) under the energy cap would earn extra income from the system through selling their unused units through a central authority to those who consume more than their share. With this income they could invest in energy reduction, thus lowering their energy use and reducing household costs. Via reducing the energy cost of the poor, energy poverty as energy injustice can be mitigated, while the capabilities of the poor and vulnerables can be enhanced through making them capable of heating their homes

adequately.

- Energy-capping tools have the potential to create jobs directly in the construction, renewable energy, and energy-efficiency sectors. According to Hungarian data (Tombácz and Mozsgai, 2009), only in the construction sector alone 40,000 new workplaces would be created. According to solar experts (Energy Shifts, 2021, first panel '45), new solar industrial employees can be trained up very easily from coal industry workers. Due to the newly created jobs and related wages, demand for vital goods would increase, leading to further job creation. Furthermore, new jobs would be also directly established within the advisory and support system set up to provide proper lifestyle-related recommendations to citizens affected by the schemes. Moreover, due to the spread of sustainable, labour-intensive practices and the income generation of 'under-consumers', access to environmentally friendly goods and services would be enhanced, contributing to enhanced wellbeing. Even though new jobs would be created and people who could not formerly afford to consume would be able to do so, the overall system would move towards sustainability due to the presence of a constantly decreasing absolute consumption ceiling.
- A defined limit on energy use would push all stakeholders impacted by the system to use their allocated units in the most effective way possible, and thus achieve the third goal of ecological economics: **effective allocation**. The proposals, however, give the choice to stakeholders regarding how to do this by letting them choose from different options (buying extra quotas, investing in energy reduction, or changing energy use patterns) according to what the most effective solution is for them (Derruine, et al., 2017). Furthermore, the schemes provide an alternative to the casual and popular 'rationing-by-price' approach that is currently in effect. Energy-capping tools however, should ensure, via enhancing effective allocation, that the framework within which the market is constrained is in line with the defined energy use ceiling.

3.2. Results of the empirical research

- Household clusters created in accordance with costs allocated to different types of energy sources (gas, electricity, other fuel – including solid fuels, central heating, and gasoline/petrol) can be clearly distinguished in line with the variables defined in Table 1.

Groups of variables	**Variable name**	**Codes in the database**	**Type of variable**

1. Household characteristics	1.number of household members	HLETS	ordinal
2. Maintenance and energy costs	2.heating source (energy type used for heating - created variable)	heating_source	nominal
	3.share energy (created variable: energy cost and household maintenance cost ratio)	share_energy	ordinal
3. Type of property	4.settlement type	DF2	ordinal
	5.dwelling type (created variable)	dwelling_type	ordinal
	6.size of living area	living_area_pps	ordinal
	7.conditions of dwelling	HLAKA	ordinal
	8.whether roof is damp	HH041M	ordinal
	9.whether floor is damp	HH042M	ordinal
	10.whether doors and windows are inadequate	HH043M	ordinal
	11.pollution, environmental problems	HS180	ordinal
4. Socio-demographic data	12.level of education of the reference person	DF21	ordinal
	13.spending on food and beverages	SUM01	ordinal
	14.health-related costs	SUM06	ordinal
	15.cost for culture+entertainment+vacation	SUM13	ordinal
	16.ability to keep flat warm	HH050	ordinal
	17.burden of flat maintenance cost	HS140	ordinal
	18.ability to make ends meet	HS120M	ordinal
	19.satisfied with place of living	SZINT	ordinal
	20.income decile	DF1	ordinal

Table 1: Explanatory variables

- The *Heating_source* and *dwelling_type* variables have the greatest explanatory power in terms of defining clusters. The first one, *heating_source,* nicely mirrors the creation of clusters using energy cost variables, since the *heating_source* variable reveals households' primary source of energy used for heating. The *dwelling_type* variable consists of six categories, from family houses to traditional apartment blocks. Households in different dwelling types use different energy sources to satisfy their energy needs. Gas and solid fuels are typically used in family houses, while electricity and central heating is common to apartment houses, including panel-block apartments. Furthermore, *settlement_type* and the ordinal version of the *share_energy* variables also play a significant role in distinguishing the clusters. The smaller a settlement in which a household is situated, the higher the proportion of the energy cost in the total housing cost within the household budget.
- Households that mainly use other fuels are associated with larger flats than in those that use primarily other energy sources. These households usually live in small settlements in Kádár-era housing blocks or family houses built before 1960. They pay proportionately more for food and beverages as well as for energy as a share of total housing cost than households in other clusters, even though these households may consume energy sourced from unreported or illegal sources, which are not counted here. This means that covering energy costs represents an even greater burden for these households than the share-of-energy proportion shows. Furthermore, proportionately more households that use 'other fuels' live in dwellings that are in a bad condition, meaning a greater burden in terms of heating, and thus spend significantly less on culture, entertainment, and vacations than households that belong to the other three clusters. Their living conditions are also reported to be the worst, and there are proportionately more households in the lower income deciles that use 'other' fuels. People in these households are proportionately far less educated than in the other three clusters. In relation to how an energy quota scheme based on an equal per-capita energy entitlement distribution would impact those households which primarily use firewood and coal, I found that the implementation of the scheme would not automatically benefit them, since households in this cluster spend slightly more on energy than the Hungarian average. If the equal per-capita distribution were based on the Hungarian average, and did not consider social justice, households in this cluster would not be able to spare any of their allocated budget (quota) for additional financial support. This slight but existing overconsumption of energy compared to the Hungarian average

is reported even though many of these households use energy from non-reported or illegal sources. If an energy quota scheme is planned for implementation, it is crucial to consider whether social justice and other factors, including dwelling conditions, are considered instead of an equal per-capita distribution mechanism.

- Households that mainly use gas spend proportionately more on food and beverages, and the second most on energy from their total housing cost, and tend to live in larger flats in mostly Kádár-era blocks or family houses built before 1960. Households that use gas, however, reported to having the best living conditions, and proportionately more individuals in these households belong to the top five income deciles than in the 'other fuel' and 'mixed' clusters. I found that the implementation of an energy-capping scheme would not benefit them at all, since households in this cluster spend significantly (almost 1.5 times) more on energy than the Hungarian average. If the energy entitlement distribution were based on per-capita distribution and did not consider social justice and dwelling conditions, households in this cluster would clearly be forced to buy extra quotas to satisfy their energy needs or to drastically decrease their energy consumption.
- Households that mainly use central heating pay significantly less for energy as a proportion of total housing cost than households that use mostly gas and other fuels, and are mostly found living in Budapest and in big cities in apartment houses, especially in panel-block houses. Within this cluster, the higher the income decile, the greater the proportion of households in it, meaning that proportionately more households can be found in the five top income deciles in this cluster than in the other fuel and mixed clusters. It is interesting that the highest proportion of households that reported pollution or other environmental problems in their neighbourhood are found in this cluster, although it is well known that serious pollution is caused by the improper heating habits of households that use non-reported heating sources, including waste. According to the interviews, the latter phenomenon occurs mostly in those dwellings where other fuels, namely firewood and coal, are used. These households may not want to report on environmental problems caused by their heating habits, or may not even be aware of the scale of the problem that improper heating habits cause. I found that the implementation of an energy-capping scheme based on equal per capita distribution would be neutral for this group, since households in this cluster spend approximately the same amount on energy as the Hungarian average.
- Households that use mainly a mixture of electricity and gas pay significantly less for energy as a proportion of their total housing costs than households that mainly use gas

and other fuels, but their dwellings are still the second worst in terms of their condition, as are living conditions. Among the households that spend anything on education, households in this cluster spend more. These households are the second least likely to be among the top income deciles, following households of the 'other fuel' cluster. Regarding how an energy quota scheme based on equal per-capita energy entitlement distribution would impact these households, I found that the implementation of the scheme would significantly benefit them. Households in this cluster spend significantly (almost 1.5 times) less on energy than the Hungarian average. If the energy entitlement distribution were based on a per-capita scheme, households in this cluster could sell their unused quotas and receive support in exchange.

- Environmental-justice-related concepts are mirrored in the connections between household energy use and poverty level, according to which poor and marginalized people are often exposed more to environmental problems and pollution due to inadequate heating equipment and heating sources, not to mention to usurers, who heavily exploit their vulnerability. Furthermore, the latter are also exposed to sudden changes in their opportunities, and may lack access to others (e.g. an inability to invest in energy efficiency measures), sometimes due to the lack of information, creating procedural injustice. Furthermore, members of poor households often live in dwellings in poor condition and use inefficient household equipment – especially inadequate stoves, which increases the burden of satisfying their energy needs and thus enhances energy poverty as energy injustice. Due to the fact that they cannot afford to invest in energy-use reduction measures (such as purchasing inadequate stoves), they are forced to save on heating, violating the guarantee of sufficient use of energy, and harming their capabilities. These people are stuck in an unbeneficial situation of living day to day without the ability to plan, which violates their capability to relax in a properly heated home. Moreover, poor and marginalized people are often not recognized by other members of society and are left alone with their problem of struggling to afford energy, revealing the problem of recognitional injustice.
- Regarding the impacts of an equal per-capita energy-capping scheme on poor Hungarian households, ensuring procedural justice – which is one of the preconditions of mitigating energy poverty and energy injustice – is crucial. This means that access to information on energy efficiency opportunities, the advantages of using energy from legal sources, and constantly reducing energy demand, need to be improved, including details about changes in heating habits. Paying extra attention to those who are not motivated to reduce their

energy use (who use illegal sources, have small flats to heat, etc.) and to educating from childhood is also essential. Furthermore, training people in need and thus enhancing procedural justice is also crucial. Training should also include providing individuals with adequate equipment, and involving them in developing supporting measures targeted at their real needs.

- Proper data collection concerning the links between different socioeconomic characteristics and energy use is needed. In relation to revealing the impact of an energy-capping scheme using statistical data, energy-cost-related variables as indicators of household energy use should be re-considered, since they do not give a complete picture of household energy use. The amount of energy resources used can be an adequate proxy, but official databases, which also contain indicators on social justice, often lack this information. Besides financial income, other indicators that reveal social justice issues should be used when examining residential energy use patterns (e.g. size of the flat, education, dwelling conditions, proportion of energy cost and housing costs). Therefore, I included into my analysis these indicators, since they are available in the official dataset.
- To tackle injustice in the field of energy and poverty, holistic approaches and system-level thinking have to be applied.

3.3. Recommendations and suggestions

- The use of a hard energy cap is not a popular topic among politicians, businesses, or often among NGOs either. The governance of the transition to low-carbon energy involves a complex set of regulatory, legislative, and financial obstacles that hinder the promotion and implementation of respective policies on local, national, and international levels. Energy transition policies, such as the energy-capping scheme examined here, require strong and consistent public support and understanding, self-directed change in many domains of society, and collaboration among diverse social actors. Without strong public and governmental level support, inequalities might stay the same – also because adequate information about the benefits of such a scheme might not reach the most disadvantaged groups.
- Energy-capping schemes will need to address the issue of ensuring proper information flow considering the energy-use patterns of the population concerned. According to the social assessment of the Hungarian Climate Bill Proposal (one of the proposed energy quota schemes), in order to ensure the smooth implementation of the scheme 2-3000 people should be included in a social and advisory system, meaning 2-3 people per

microregion in Hungary (Tombácz and Mozsgai, 2009). As most poor and marginalized people in Hungary live in the countryside (Herpainé Márkus et al., 2011), access to information as well as rural energy represent a big challenge. I question if involving this number of people would be enough to ensure smooth and proper information flow. The number is especially questionable if we consider that marginalized and poor people often do not possess information and knowledge about issues that are much simpler (e.g. composting in the countryside) than saving energy, or how to invest in energy reduction measures.

- There seems to be a simple ideological case for the energy quotas being distributed on an equal per-capita basis (natural resources are not manmade; they are a 'free gift' from nature, and ought to be considered our common inheritance). However, there are at least two problems with this proposition: since we live in a diverse and deeply unequal society, some groups are clearly more able than others to adapt to a tightening cap. To enhance distributional justice, more focused mechanisms aimed at increasing social justice are needed instead of an equal per-capita distribution mechanism. In order to solve this challenge, one solution might be to allocate a share of the energy budget to assist vulnerable groups who consume extremely high amounts of fossil energy, often through no fault of their own. Furthermore, even if the distribution of energy quotas is supposed to be equitable, there will always be have-nots. For them, one could imagine providing an unconditional basic income, partly consisting of essential resources (e.g. heat, water, and mobility access). This basic income combined with progressive tariffs for high-level consumers, which would pay for the basic functioning of this system, would build an element of social justice and redistribution into the supply of basic goods at no extra cost to society.
- Another suggestion for enhancing distributional justice is incorporating dwelling characteristics into the development of quota distributional mechanism. Households that use mostly firewood and coal are more liable to be located in dwellings that are in bad condition than households that use other energy sources to satisfy their needs. Furthermore, households members who live in panel-block apartments or other apartment houses with central heating cannot influence their energy bills since the latter are allocated centrally. Since their energy bills do not reflect real consumption, people will not be motivated to change their heating or other energy-use related habits. Furthermore, households that mainly use central heating to satisfy their energy needs consume energy at the average level in Hungary, thus implementing an energy quota scheme based on an

equal per-capita distribution mechanism would have a rather neutral effect on them, and their motivation to reduce their energy use would remain low.

- In terms of defining quota distribution mechanisms, individuals' overall energy use should also be considered. There are different approaches to this, including the idea that individuals should decrease their per-capita energy expenditure on average by 6-30% (Department of Business, Energy and Industrial Strategy, 2020) and by 32–38% (Longhi, 2015). The Hungarian Climate Bill Proposal, for instance, suggests that the following method should apply to quota distribution: 100% quota after the first child, 75% after the second, 50% after the third, and so forth (Gyulai, 2011).
- The quota distribution mechanism should consider country-level differences too. According to national research (White and Thumim, 2009; Dresner and Ekins, 2004), TEQs, the system developed in the UK (Fleming and Chamberlin, 2011) primarily rewards marginalized people who use less energy. According to the Strategic Environmental Assessment (SEA) of the Hungarian Climate Bill proposal (Tombácz and Mozsgai, 2009), the Hungarian proposal would also benefit the poor. However, the results of my research does not mirror this finding; results are more in line with those of the social impact assessment of the Hungarian Climate Bill Proposal (Herpainé Márkus et al., 2011) – namely, that poor people in efficient dwellings may consume more energy than the Hungarian average.
- In every country people are currently slipping into poverty, thus extra attention should be paid to them. These people already cannot afford environmental friendly, energy efficient solutions which are affordable to the rich, but since they created their living conditions and consumption habits before they became poor, they would definitely use up their entitlements quickly and thus deserve special attention (Tombácz and Mozsgai, 2009). If schemes are implemented that pay extra attention to the poor, they have the potential to prevent the imposition of an excessive burden on the poor and the vulnerable in the transition through ensuring fair and just access to energy in times of scarcity.
- There are also concerns whether such schemes would decrease the household energy cost. The provision of appropriate information (enhancement of procedural justice) and the raising of awareness have the potential to reduce energy use, but a study in Hungary (Hoffmeister-Tóth, 2016) on environmentally conscious behaviour shows that the impact is rather limited, and reinforcement is needed to identify appropriate alternatives to activities.
- Access to basic services (such as education, health, social, and communication services

such as the internet) should be analysed when evaluating households' energy consumption. Furthermore, the social capital of households should be adequately monitored and considered when analysing their energy consumption. These variables might include the level of trust in public institutions, strengths of network relations (at a neighbourhood or at community level), the level of civil activity, and the acceptance of innovative ideas. These factors clearly influence the level of acceptance and openness towards an energy quota scheme, and without their consideration the implementation of an innovative tool might be impossible. Besides these socioeconomic indicators, further research is necessary to reveal the impacts on energy-capping schemes and to collect data about other forms of energy consumption, such as car usage and other non-renewable energy resource use.

- Besides these social-justice-related variables that I used in the quantitative research (see Table 1), I recommend monitoring the health status of household members, since health status and health-related costs might influence household energy consumption habits. In relation to income, not only should the amount of income be monitored, but also the proportion of income from work and social transfers, as well as capital and income obtained from financial capital (wealth). This is especially important since wealth inequalities are much higher than income inequalities (Magyar Nemzeti Bank, 2019; Kolosi and Fábián, 2016), and income can also be generated from being health due to saving costs on health related expenditures and being able to work. Regarding new variables, the level of efficiency of household equipment is not mirrored in the official database but can be used as a variable or proxy to reveal energy poverty as energy injustice, since it is a significant driver of energy poverty.
- Trading mechanisms (related to how consumers can sell their saved quotas to those who will pay more for their overconsumption) should be constructed with proper consideration to avoid selling the remaining quotas at below the ideal price. Therefore, I support those energy quota scheme proposals which would designate a central authority (e.g. the Hungarian Climate Bill proposal) through which each quota transfer takes place. In this case, quotas would be sold at the national market price and through a central authority. Although it would require more administrative work, it would avoid those who need financial compensation selling their quotas at below market price, as happens in Hungary in the case of holiday vouchers or hot meal vouchers, which are usually distributed not only among the poorest. In the case of an energy quota, savings on quotas by the poorest could otherwise be rapidly sold at well below price since those not familiar with financial

speculation, who are unable to plan in advance, and live one day to another may be much more willing to obtain financial compensation rapidly. If a central authority or a registrar were established to implement each and every quota transaction, speculation with quotas would be lessened. However, this would not mean that financial speculation with quotas can be fully eliminated, since every citizen who is not familiar with financial speculation could be taken advantage of, as can happen with every kind of product and service. Therefore, any additional measures that could be built in to minimise such speculation are needed in case of minimizing this harmful effect on society.

- With regard to creating workplaces, it is questionable, however, whether such an approach would generate job opportunities for those who live in marginalized areas, are less well educated, and have been unemployed for a longer time.
- In terms of the impacts of the scheme on middle-class people, who can choose between investing in energy reduction or simply changing their way of living, their choices would need to be examined more deeply. Arguments support the choice of investment, because this does not require any additional expenditure (in contrast to purchasing entitlements), as well as adds value, and avoids future quota shortage problems. On the one hand, this approach would be very beneficial since it is assumed that implementing the scheme would result in a significant reduction of energy use. On the other hand, this could mean that everyone would choose to invest and not to purchase a larger quota, which would result in a lack of utilization of quotas saved by ‘under-consumers’. Managing this contradiction is a big challenge. A combination of setting the ceiling for investment might serve as a good solution to solve this challenge.
- Formulating and implementing energy quota schemes should involve addressing and mitigating the use of non-reported or illegal sources of energy in poor and marginalized households. Firewood from sustainable sources is an appropriate source of heating from a climate perspective (Bajomi, 2018). Pollution that arises from solid fuel burning depends on the quality of the energy source, as well as the quality of the heating system. The amount of pollution as well as heating-related costs can be mitigated, besides enhancing the energy efficiency of dwellings, by using the proper quality and quantity of firewood and a good quality, well maintained heating system.

4. Summary of conclusions

To avoid climate catastrophe, ambitious approaches are needed that incorporate social justice. Energy use contributes significantly to carbon-dioxide emissions, while energy-capping schemes have been more deeply developed for the residential sector. Therefore, I investigated how energy-capping schemes based on equal per-capita distribution can be applied, as an ambitious approach. I especially scrutinized to what extent the latter may help achieve the third goal of ecological economics: a state of just distribution, and enhancing the well-being of the poor and marginalized. Among the justice theories that were analysed that are linked to fair and sustainable energy use (environmental justice, sufficiency, and energy poverty), I considered justice as composed of the following elements:

- distributive justice: in order to ensure that every member of society can afford sufficient amounts and quality of energy; and, attached to this, corrective justice, to identify who can use more than their fair share and to what extent (in order to tackle unequal intra and intergenerational inequity, as well as promote international and international justice).
- procedural justice: this addresses access to information, such as information about loans for energy efficiency investments.
- recognitional justice: this touches upon the recognition of the poor and marginalized

To answer my research questions, I analysed Hungarian household energy-use data as well as carried out expert interviews to validate and interpret the quantitative research. I aimed to reveal the interlinkages between residential energy use and social justice, as well as how a potential residential-energy-capping scheme would influence the well-being of the Hungarian population. According to the results of my empirical research, groups of Hungarian households can be differentiated based on how much they pay for different energy resources; namely, households that use 1. mostly solid fuel, 2. mostly piped gas 3. mostly central heating, or 4. a mixture of electricity and gas. The 20 socioeconomic variables (see Table 1) that were selected help define these four groups. According to my analysis, households that mostly use solid fuel are have the least favourable dwellings and living conditions, while they consume slightly more energy than the Hungarian average, meaning that if an energy quota scheme based on equal per-capita distribution were implemented, it would not benefit them automatically. Households that primarily use piped gas and households that primarily use central heating have the best living conditions. The implementation of an energy-capping scheme would not benefit mainly gas-using households at all, since in general they use 1.5 times more energy than the Hungarian average. Households with central heating and those categorized into the mixed clusters pay proportionately much less for energy as a share of total housing costs than their counterparts from the mainly 'other fuel' and 'gas' clusters. Furthermore, centrally heated households have the least dwelling-related problems. Households classified into mixed clusters are reported to have the second-worst dwelling and living conditions as well as financial income, while spending the most on education. These households, however, would definitely benefit from an energy-capping scheme based on equal per-capita distribution, since they use much less energy than the Hungarian average.

Further results of my empirical research are in line with environmental justice theories which claim that the poor and marginalized are more often exposed to pollution and environmental problems, while lacking the opportunity to reduce household energy use. Due to the bad conditions of their dwellings and equipment, their burden associated with paying energy-related costs is greater, increasing energy poverty and thus energy injustice. These people live from day to day, but cannot access sufficient energy and their capabilities are also hindered. These violations of capabilities are not recognized by other members of society, leading to recognitional injustice. Based on my research, any energy-capping scheme needs to be implemented with caution. Procedural justice (meaning access to information about opportunities provided by the scheme, as well as education from childhood onwards on energy use) needs to be ensured, fulfilling one of the preconditions for mitigating energy poverty and energy injustice. Furthermore, addressing the challenge of the use of illegal energy sources and ensuring proper data collection that reveals the underlying causes of energy use is necessary for achieving sufficiency for all of energy use.

In order to develop energy-capping schemes that deliver social justice, strong public support needs to be established through the proper and sound flow of information. Moreover, it is crucial that social justice and other factors, including dwelling conditions, are considered, instead of a simple, equal per-capita distribution scheme. Furthermore, trading mechanisms should be consciously developed to close loopholes and protect citizens, especially the poor and marginalized, from financial speculation. Moreover, job creation efforts should also consider those who have a lower level of education and increase their employment rate too, while investment costs need to be limited to motivate individuals to reduce their energy use, or their need for a full quota.

5. Main references

Bertram, R., Primova, R. (2018): Energia Atlasz. Heinrich-Böll-Schiftung, Prague.

Csutora, M., Harangozó, G., Zsóka, Á., Werthschulte, M., Galarraga, I., Foudi, S., López, E., Chubyk, A., Gonchar, M., Magdalinski, E. (2017): Synthesis report on the "heating & cooling" case study. ENABLE.EU project

Department of Business, Energy and Industrial Strategy, 2020. Fuel Poverty Methodology Handbook (Low Income High Costs). Department of Business, Energy and Industrial Strategy. United Kingdom.

Derruine, O., Mastini, R., Hajdu, K., Alcott, B. (2017): Capping. (emailing on caps)

Dresner, S., Ekins, P. (2004): The Distributional Impacts of Economic Instruments to Limit. Policy Studies Institute. London, UK.

Energy Shifts (2021): Panel 1 – The urgency of integrating social dimensions into the European Green Deal. Energy-Schifts project. https://energy-shifts.eu/ (accessed 02.02.2021)

Eurostat (2017): Final energy consumption by sector, EU-28, 2017 (% of total, based on tonnes of oil equivalent). Eurostat. Luxembourg.

Eurostat (2018): Can you afford to heat your home? (accessed 17.09.2019) Eurostat. Luxembourg.

Eurostat (2019): Complete energy balances - Final energy consumption. (accessed 17.09.2019) Eurostat. Luxembourg.

Fawcett, T. (2010b): Personal carbon trading: A policy ahead of its time? Energy Policy 38, 6868–6876. https://doi.org/10.1016/j.enpol.2010.07.001

Fleming, D., Chamberlin, S. (2011): TEQs. Tradable Energy Quotas: A Policy Framework for Peak Oil and Climate Change. The Lean Economy Connection. London, UK.

Gyulai, I. (2011): Climate Change Act for Sustainable Society. Ökológiai Intézet Alapítvány. Gömörszőlős, Hungary.

Herpainé Márkus, Á., Gyuris, T., Jász, K., Ladányi, E., 2011. A Magyar Temrészetvédők Szövetsége - Klamítörvény Tervezetének Szociális Nézőpontú Elemzése. Társadalmi Összetartozásért Alapítvány. Budapest.

Hoffmeister-Tóth, Á. (2016): Fogyasztói értékek, trendek és magatartás. Budapest Corvinus Egyetem. Budapest. URL: http://unipub.lib.uni-corvinus.hu/2326/1/VT2016n4p26.pdf

IEA (2018): World Energy Outlook 2018. International Energy Agency. Paris.

IPCC (2018): Global warming of 1.5. Intergovernmental Panel on Climate Change. Geneva, Switzerland.

Jensen, C.L., Goggins, G., Fahy, F., Grealis, E., Vadovics, E., Genus, A., Rau (2018): Towards a practice-theoretical classification of sustainable energy consumption initiatives: Insights from social scientific energy research in 30 European countries. Energy Research & Social Science 45, 297–306. https://doi.org/10.1016/j.erss.2018.06.025

KSH (2016): A háztartások életszínvonala. KSH. Budapest.

Longhi, S. (2015): Residential energy expenditures and the relevance of changes in household circumstances. Energy Econ. 49, 440–450. https://doi.org/10.1016/j.eneco.2015.03.018

MEKH (2017): Éves adatok. Magyar Energetikai és Közmű-szabályozási Hivatal. Budaepst.

Neuberger, E. (2017): Választaniuk kell: egyenek vagy fűtsenek. abzug.hu. Szekszárd, Hungary. URL: https://abcug.hu/valasztaniuk-kell-egyenek-vagy-futsenek/

Sáfián, F. (2019): Energiafogyasztás és energiahatékonyság a hazai háztartásokban. Magyar Energiahatékonysági Intézet. Budapest. elosztoprojekt Conference 25. 11. 2019.

Seyfang, G., Lorenzoni, I., Nye, M. (2009): Personal Carbon Trading: a critical examination of proposals for the UK, Working Paper. Tyndall Centre for Climate Change Research. UK.

Sütterlin, B., Brunner, T.A., Siegrist, M. (2011): Who puts the most energy into energy conservation? A segmentation of energy consumers based on energy-related behavioral characteristics. Clean Cook. Fuels Technol. Dev. Econ. 39, 8137–8152. https://doi.org/10.1016/j.enpol.2011.10.008

Teixidó-Figueras, J., Duro, J.A. (2015): The building blocks of International Ecological Footprint inequality: A Regression-Based Decomposition. Ecol. Econ. 118, 30–39. https://doi.org/10.1016/j.ecolecon.2015.07.014

Tombácz, E., Mozsgai, K. (2009): Az éghajlatvédelmi törvény tervezetének Stratégiai Környezeti-Vizsgálata. Öko Zrt. Budapest.

UN (2018): SDG 6 Synthesis Report 2018 on Water and Sanitation. United Nations. New York.

White, V., Thumim, J., (2009): Moderating the distributional impacts of personal carbon trading. Centre for Sustainable Energy. Bristol.

6. Related own publications

Kiss, V., Hajdu, K. (2020): New approach in educating about innovative climate policy - a case study at the ISDRS in Sustainability in Transforming Societies : Proceedings of the 26th Annual Conference of the International Sustainable Development Research Society p. 42

Potocnik, J., Spangenberg, J., Blake, A., Kiss, V., Coote, A., Reichel, A., Lorek, S., Mathai, M. V., Rijnhout, L., Mastini, R. (2018): Sufficiency: Moving beyond the gospel of eco-efficiency (48 p.) Friends of the Earth Europe. Brussels.

Kiss, V. (2018): Energy use caps under scrutiny: An ecological economics perspective. Society and Economy. 40: 1 pp. 45-67., 23 p. https://doi.org/10.1556/204.2018.40.1.4

Kiss, V., Hajdu, K. (2020): www.decarbonisegame.com