Energy Policy ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at SciVerse ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Trapped in the heat: A post-communist type of fuel poverty

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ARTICLE INFO

Article history:
Received 21 March 2011
Accepted 30 August 2011

Keywords:
District heating
Panel buildings
Deep retrofits

ABSTRACT

Fuel poverty is a still insufficiently researched social and energy challenge with significant climate change implications. Based on evidence from Hungarian *panel* apartment blocks connected to district heating, this paper introduces a new variant of fuel poverty that may not be properly captured by existing fuel poverty indicators. This newly defined variant can be largely attributed to post-communist legacies – though it might also exist in other contexts – and assumes that consumers living in poor-efficiency, district-heated buildings are *trapped* in dwellings with adequate indoor temperatures but disproportionately high heating costs because (a) changing supplier or fuel is difficult because of the existing technical and institutional constraints, and (b) they do not realistically have the option to reduce individually their heating costs through individual efficiency improvements. This situation often translates into payment arrears, indebtedness, risk of disconnection, or reduced consumption of other basic goods and services. State-supported policy responses to date have favoured symptomatic solutions (direct consumer support) combined with superficial retrofits, though it is argued that only state-of-the-art retrofits such as the passive house-based SOLANOVA pilot project in Dunaújváros can fully eradicate fuel poverty in this consumer group.

1. Introduction

While fuel poverty in Central and Eastern Europe (CEE) is "virtually unknown to the relevant academic and policy literatures" (Buzar, 2007, p. xii), it is suspected that economies in transition are particularly affected by this phenomenon (Boardman, 2010). In the region, fuel poverty is associated with the economic and political changes of the early 1990s, which progressively brought energy prices to full-cost recovery levels, reduced household incomes and left a legacy of inefficient and deteriorating residential buildings lacking basic energy efficiency requirements (World Bank, 2000; Duncan, 2005; Ürge-Vorsatz et al., 2006). From a critical perspective, the notion that a "neat" single-lane transition from a centrally-planned to a market-based system could be achieved by the liberalization, privatization and unbundling of energy-related activities has been contested; over time it has contributed to the emergence of fuel poverty in CEE. Acknowledging that shared socio-technical legacies and path-dependencies determine the current functioning of CEE post-socialist energy systems, such perspective has emphasized the importance of regulatory and institutional frameworks and of power relations, frictions and conflicts of interests between actors (Buzar, 2007; Bouzarovski, 2009, 2010).

In CEE, district heating (DH) is a common source of domestic heat and hot water for prefabricated residential blocks built between the 1960s and 1980s, serving in some countries (i.e., Latvia) as many as 60% of all households (Buzar, 2007). While this type of heat source is often celebrated as one of the most sustainable forms of heating (see, for instance, IEA/OECD, 2009), its combination with other issues invites some cautions. In addition to many other documented and debated concerns, this paper identifies district heat as one of the root causes of a new variant of fuel poverty[1] prevalent in dwellings served by DH. The paper also extends the concept of fuel poverty, examining households that live in adequately heated dwellings but who still face disproportionately high energy costs.

What does this newly identified variant of fuel poverty entail? How can it be best measured? To what extent are households living in inefficient buildings connected to DH affected by fuel poverty? What is the experience of fuel poverty in these units?

[1] The authors are aware of the apparent terminological existing in the literature. On the one hand, *fuel poverty* is the original term coined in the UK for referring to the inability to afford an adequate amount of energy services (Boardman, 1991). On the other hand, key references for the CEE (Buzar, 2007) and institutional sources like the Directive 2009/72/EC refer to the same phenomenon as *energy poverty*, though other sources define it as the lack of access to quality energy services, a prevailing condition in many developing nations (e.g., Birol, 2007). In this paper, we prefer the more widely used term (in English) of fuel poverty, acknowledging that the affordability of energy services (rather than the access) is a key element.

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doi:10.1016/j.enpol.2011.08.067

How effective are the policy responses provided so far? This paper attempts to answer some of these research questions through an analysis of quantitative data sources complemented with a literature review and a few interviews with relevant stakeholders, using the case of Hungarian prefabricated buildings heated by DH (in Hungarian, *panelház* constituted in large estates or *lakótelep*) as a case of study. However, since prefabricated DH- supplied buildings are a typical feature of former socialist states (e.g., *paneláky* in the former Czechoslovakia; *Plattenbauten* in the former GDR), the conclusions of this analysis are applicable to other countries with energy-inefficient, DH-serviced buildings in the CEE and the former Soviet Union (fSU) and beyond.

With that aim, the paper first presents Hungarian DH-panel dwellings as a relevant study case (Section 2), then compares expenditure-based fuel poverty rates for all Hungarian households and for the DH-*panel* subset (Section 3) and offers a qualitative description of this yet unexplored exemplar of fuel poverty (Section 4). Section 5 reviews policy elements and two relevant residential energy efficiency pilot projects, followed by a summary of main findings and conclusions in Section 6.

2. Hungary as a study case

District heating is a combined heat supply and demand system that, when operated inefficiently, becomes a burden to decision-makers and consumers. This is often the case in the CEE region, where a number of drawbacks – namely poor consumer focus, low efficiency, excess capacity, lack of investment and an inadequate policy framework – have prevented many DH systems from proper functioning following the political changes of the 1990s (OECD/IEA, 2004). Its decline has been related to a vicious institutional trap that links consumers' dissatisfaction and disconnection, overcapacity, shrinking utility revenues to the increasing costs of DH per apartment (Poputoaia and Bouzarovski, 2010). However, its role in the occurrence of fuel poverty in the CEE region has remained largely unexplored.

In Hungary, where previous research (Kocsis, 2004; Autonómia Alapítvány, 2004; KSH, 2004; KSH, 2006; Fülöp, 2009; Energia Központ, 2009) has explored selected elements of the domestic energy affordability issue, a first comprehensive assessment of fuel poverty (Tirado Herrero and Ürge-Vorsatz, 2010) suggested that the residents of DH-served prefabricated buildings experience a particular type of fuel poverty. Though DH is not as extended as in other countries of the region[2] (OECD/IEA, 2007), many DH systems in Hungary are now obsolete and needs modernization both on the heat providers' and on the consumers' sides (e.g., installation of individual meters and control valves in apartments, improved insulation, upgrading of heat production units to cogeneration power plants, etc.), as recognized by the Hungarian Professional Association of District Heating *MaTáSzSz* (Sigmond, 2009). Since newly built residential units often choose to use other energy carriers and some households sometimes disconnect if their financial situation allows it, the percentage of dwellings served has declined in the last twenty years from 16.6% of in 1990 to 15.2% in 2007. Of the remaining 650,000 connected dwellings, more than three-quarters are prefabricated apartment blocks built between the 1960s and 1980s located in suburban areas of Hungary's largest towns and cities (KSH, 2004; Sigmond, 2009). Currently, 81% of *panel* dwellings are served by DH, with the remaining 18% and 1% being connected to the natural gas and electricity grid respectively. Other building typologies – multi-family blocks and single-family houses – are also part, though a minor one, of the DH network (Energia Klub, 2011).

This set of relevant features makes Hungary (and in particular its DH-served *panel* buildings) a suitable study case for the exploration of the new variant of fuel poverty identified in this paper.

3. Fuel poverty rates in Hungarian DH *panel* buildings

Out of the three fuel poverty rate estimation approaches identified in the literature (Healy, 2004)—temperatures, consensual and expenditure-based, the first two are regarded as not applicable, for various reasons. First, since temperatures in DH-served dwellings are typically adequate, or in cases even too high, indoor temperatures cannot be a good indicator of fuel poverty. Second, since many households (i.e., those without individual consumption meters) cannot decide on the amount of heat consumed because they pay on a per square or cubic meter basis, item HH050 of Eurostat's Survey on Income and Living Conditions (EU-SILC)[3] – *Inability to keep the house adequately warm* – is likely to produce distorted responses in the case of DH-served *panel* households. Additionally, neither surveys on indoor temperatures nor the subset of EU SILC's item HH050 responses for households living in *panel* blocks connected to DH were available for Hungarian households. Thus, only the expenditure-based approach is used for the analysis of differential fuel poverty rates in DH-*panel* households and all Hungarian households.

Estimates of expenditure-based fuel poverty rates were based on 2005 and 2008 Household Budget Survey (HBS) microdata on detailed household expenditures (by COICOP categories) and characteristics provided by the Hungarian Central Statistical Office (KSH). Since the HBS datasets did not contain a specific category of DH-connected prefabricated buildings, an *ad hoc* "DH *panel*" class was created as a combination of multi-family buildings constructed between 1960 and 1989 in urban areas (Budapest and big cities, county capitals and other cities) and having DH as their main source of heat. Energy to total household expenditure ratios were estimated upon aggregated (and not equivalent) HBS figures.

Three expenditure-based fuel poverty thresholds were applied to estimate fuel poverty rates:

i) energy costs are equal or above twice the median relative energy expenditure[4] (i.e., share of energy expenses in the total household expenditure);
ii) energy costs are equal or above the median relative energy expenditure of the three lowest income deciles;
iii) energy costs are larger than its food and non-alcoholic beverages costs.

The first two are the underlying criteria employed by Boardman (2010) to define in the late 1980s the 10% energy costs vs. net income ratio fuel poverty threshold currently in use in the UK. Total household expenditure was used because it is

[2] As of 2007, over 200 DH systems belonging to 98 utility companies supplied with heating and other services such as hot water to 650,000 households in 92 urban settlements all over Hungary. They are largely dependent on fossil fuels, mostly natural gas (82.7% of the primary energy in put in 2007). The over hundred combined heat and power DH plants in operation generate a sizeable fraction (17.5% in 2007) of the country's total electricity production (Sigmond, 2009).

[3] EU SILC item HH050 is the key source of information for the consensual approach to measuring fuel poverty (Healy, 2004).

[4] Estimated as an average of the medians of 2005 and 2008 (29%). This fixed fuel poverty threshold facilitates the comparison between years with substantially different medians of the households' relative energy expenditures, as it is the case of the two years selected. This also applies to the second fuel poverty threshold proposed (median of the 30% lowest income), which has been calculated at the 21% level (household energy vs. total expenditure ratio).

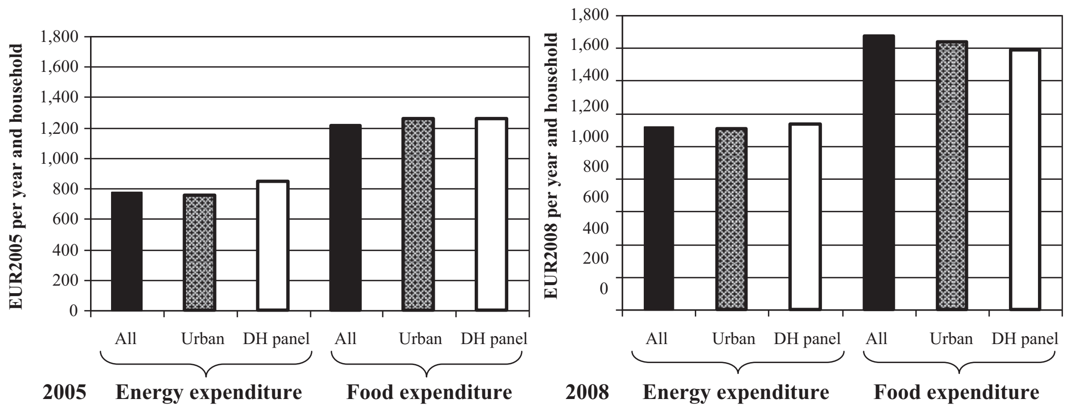

Fig. 1. Average annual food and energy expenditure of Hungarian households (all households vs. urban and DH-connected *panel* dwellings) in nominal units of 2005 and 2008.
Source: Household Budget Survey (KSH).

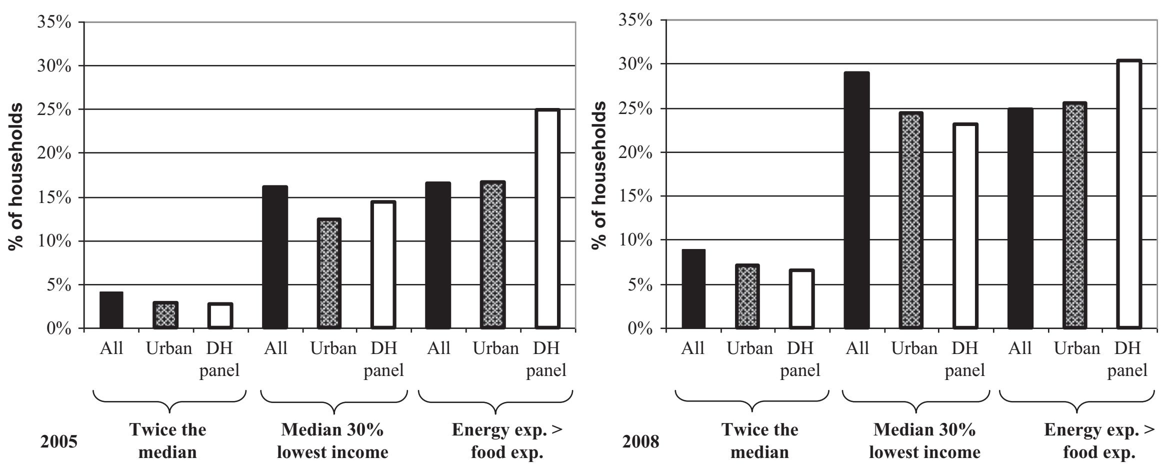

Fig. 2. Fuel poverty rates (percentage of households) estimated according to three expenditure-based criteria (all households vs. urban and DH-connected *panel* dwellings), in 2005 and 2008.
Source: Household Budget Survey (KSH).

considered a more accurate estimate of purchasing power than income, which households tend to underreport.

The third criterion, so far an untested approach, is based on the assumption that households spending more on energy than on food are probably facing difficulties related to their dwelling's energy consumption. HBS data indicate that food is in general the largest expenditure of the average household, so an inversion in the order of importance of these two domestic budget items may be symptomatic of serious energy affordability constraints, especially when heating costs are fixed like in many DH-*panel* dwellings. Evidence from the USA has also found that poor families react to unusually cold weather strains by increasing fuel expenditure at the expense of decreasing their food consumption (Bhattacharya, et al., 2003).

Results presented in Fig. 2 indicate that according to the first two criteria fuel poverty rates were lower in the DH-connected *panel* buildings category than in the all Hungarian households and urban households' samples. This has to do with the fact that even though households living in such dwellings report higher annual total energy expenditure (Fig. 1), they also report an average total expenditure (proxy of income) higher than the average Hungarian household (see Table 1). This is consistent with other socio-economic characteristics of "DH-*panel*" households, which seem better educated, younger, less likely to have a pensioner as head of the household and have fewer dependent children to look after (see Table 1), which is at odds with a general perception that *panel* blocks in Hungary house a low-income, predominantly retired population (see, for instance, Sigmond, 2009). Fig. 2 also shows the substantial increase in fuel poverty rates that followed the domestic energy price rise occurred between 2005 and 2008 (Tirado Herrero and Ürge-Vorsatz, 2010).

On the other hand, fuel poverty rates as measured by the energy vs. food expenditures criterion indicate that DH-*panel* households are more affected than the average Hungarian family unit: in 2008 over 30% of Hungary's DH-*panel* households spent more on energy than on food (the same figure for all households in that year was 25%). This is probably connected to the fact that even though households of the "DH-*panel*" category have a smaller size (see Table 1), their annual food expenditure is not much below the average for urban and all Hungarian households (see Fig. 1). At the same time, it is suspected that large surface-to-occupancy ratio (in dwelling square meters per person) households tend to spend more on energy than on food but that is not the case of *panel* apartments, which report a clearly lower figure of square meters available per household member.

4. The thermal trap: an unconventional case of fuel poverty

Residents in Hungarian DH-connected *panel* blocks do not suffer from fuel poverty in the form of cold indoor temperatures. In fact, as it is widely perceived by Hungarian householders,

Table 1
Selected socio-economic characteristics of Hungarian households (all households vs. urban and DH-connected *panel* dwellings) in 2005 and 2008.
Source: Household Budget Survey (KSH).

Socio-economic characteristics	Year	All	Urban	DH panel
Average household total expenditure (€ per year)	**2005**	7218	7634	8013
	2008	7742	8074	8168
Percentage of heads of households with tertiary education or higher educational attainment	**2005**	17.6	23.4	28.2
	2008	17.6	22.8	25.7
Average household size (number of household members)	**2005**	2.6	2.5	2.3
	2008	2.6	2.5	2.3
Average dwelling size (sqm.)	**2005**	78.5	72.6	53.9
	2008	78.0	72.5	54.1
Dwelling space available per household member (sqm. per person)	**2005**	38.1	36.4	29.4
	2008	37.6	36.2	29.8
Percentage of households that own their dwelling	**2005**	89.1	86.8	86.7
	2008	88.3	85.5	84.0
Average number of dependent children under 20	**2005**	0.5	0.5	0.4
	2008	0.6	0.5	0.4
Average age of the head of the household (years)	**2005**	54.3	54.1	52.9
	2008	53.8	53.6	51.6
Percentage of heads of households who are pensioners	**2005**	44.3	43.0	41.2
	2008	43.0	42.0	39.2

Table 2
Key energy consumption characteristics of dwellings in *panel* and other Hungarian building typologies.

	Historical and protected buildings	Traditional multi-family homes (< 1960)	Multi-family homes 1993–2010	*Panel* buildings to 1992	Single family homes to 1992	Single family homes 1993–2010	Source
Specific energy consumption for space heating (kwh m^{-2} $year^{-1}$)	207	207	121	230	300	144	Ürge-Vorsatz et al. (2010)
Percentage of total floor area heated	70	70	85	95	70	75	
	Non-panel condominiums			**Panel condominiums**	**Family houses**		**Source**
Specific energy consumption for space heating and hot water (kwh m^{-2} $year^{-1}$)	300–350			~220	400–500		Fülöp (pers. comm.)
Percentage of total floor area heated	94			98	86		Energia Klub (2011)
Percentage of households without a heating control device.	15			48	19		Energia Klub (2011).

Note: The specific energy consumption for space heating reported by Fülöp (pers. comm.) is theoretical, i.e., calculated for providing an indoor temperature of 20 °C in the heating season.

residents are often satisfied with the temperatures in their dwellings during the cold season and the whole floor area of the apartment is usually heated, unlike in other building types (see Tables 2 and 3). However, this does not imply that thermal comfort requirements are perfectly satisfied. First, notably different indoor temperatures between apartments of the same block are a common feature, with dwellings on higher floors often receiving more warmth (Csagoly, 1999) and, in some cases, in still overheated dwellings residents sometimes still use the old *communist* method to heat regulation: opening the windows. Second, *panel* apartments seem to be more affected by unpleasantly high summer temperatures (Hermelink, 2005; Faluház/Staccatto project, unpublished). This probably has to do with the structural properties of the buildings (long and exposed structures, no shading, thin walls, etc.) and may be indicative of *summertime* fuel poverty as defined by Healy (2004).

Whereas indoor temperatures in winter are not the biggest concern of DH users, high energy costs are. As presented in Table 3, prefabricated buildings served by DH report up to 50% higher annual energy and heating costs per m^2 and per person than other dwelling typologies. Also, though the annual total energy cost of the typical DH-connected *panel* apartment is lower than the Hungarian average because of its smaller floor area (54 m^2), its annual total heating cost is the largest among all categories.[5] Equally, its heating cost vs. total energy costs ratio is also the highest (75%). The paradox is that even though *panel* dwellings are only relatively energy inefficient[6] and the smallest of all Hungarian residential units, these households bear the highest heating costs per square meter and per person. This

[5] Substantial differences nevertheless exist in the annual DH costs borne by residents of DH-served *panel* dwelling in different Hungarian cities. In 2009, the average heating cost for a 50 m^2 apartment ranged between €960 and €320 . The cheapest DH was found in the city of Paks, where the waste heat of the nearby nuclear power plant is used (Energia Klub, 2010).

[6] Note that single family houses report the highest specific energy consumption for space and water heating in Table 2. In fact, it is suspected that the low-income population living in such units in rural areas are the most affected by fuel poverty in Hungary. These households often protect themselves from high energy costs by reducing the fraction of floor area heated and by substituting natural gas by firewood.

Please cite this article as: Tirado Herrero, S., Ürge-Vorsatz, D., Trapped in the heat: A post-communist type of fuel poverty. Energy Policy (2011), doi:10.1016/j.enpol.2011.08.067

Table 3
Energy and heating cost indicators of Hungarian dwellings (*All dwellings*) and dwellings in selected building typologies (2009). *Notes:* Traditional fuels include, among others, coal, fuel-wood, pellets, fuel oil and LPG.
Source: Household Energy Use survey 2009.

	All dwellings		**Single-family houses**		**Panel buildings served by DH**		**Multi-family houses with 10 or more dwellings built with traditional techniques**	
	Per household	Per person	Per household	Per person	Per household	Per person	Per household	Per person
Average heating costs (€ per year)	713	275	764	272	814	368	461	225
Average total energy costs (€ per year), from which:	1106	427	1209	431	1087	491	820	400
Annual DH costs	130	50	1	0	751	339	28	14
Annual natural gas costs	435	168	534	190	61	28	430	209
Annual electricity costs	393	152	445	159	273	123	359	175
Annual traditional fuel costs	148	57	230	82	2	1	4	2
Average dwelling size (m^2)	80		93		54		61	
Average floor area heated in winter (m^2)	70		79		54		54	
Specific heating costs (€ per m^2 heated and per year)	10.2		9.7		15.2		8.6	
Specific heating costs (€ per m^2 and year)	9.0		8.2		15.1		7.6	
Specific energy costs (€ per m^2 and year)	13.9		13.0		20.1		13.4	
Percentage of heating costs in total energy costs	64		63		75		56	

points at the overall inefficiency of the combined DH supply and demand system as a main reason behind the high heating costs borne by DH-served households living in *panel* blocks.

In addition to the inefficiency of power plants, apartment blocks and transmission systems, a main reason why energy costs are higher in DH-supplied *panel* apartments is the absence of individual heat consumption meters: as shown in Table 2, 48% of *panel* households report not having a heating control device at home, and it is likely that most of those are connected to the DH network. This is often due to the inherited outdated technical features of DH systems (i.e., single-loop heat distribution systems, see Sigmond, 2009) that prevents the installation of individual consumption meters. In those apartments, users pay flat-rate fees (e.g., per square or cubic meter) and almost the whole floor area is heated during the winter months (see Tables 2 and 3), which means that rationing the heat consumed – either by reducing indoor temperatures or the proportion of floor area heated – cannot be adopted as a coping strategy for households experiencing energy affordability constraints. This also has implications in terms of the thermal comfort of the dwelling – i.e., the use of open windows to regulate room temperatures – and removes incentives to energy efficiency investments at the household level.

This situation is further aggravated by the difficulty or even impossibility to get disconnected from the DH network or to switch to other sources of heat such as natural gas. This is related to the conditions of monopoly under which heat is often provided (OECD/IEA, 2004) and also to the characteristics of the buildings (multi-family units, often with many apartments per block). Under these circumstances, households do not realistically have the option to reduce individually their heating costs through efficiency improvements because any substantial improvement (e.g., wall, roof or basement insulation) requires agreement between neighbors. This also results in low voluntary disconnection rates, as shown in Table 4, and eventually *traps* households in sufficiently warm but high-energy-costs dwellings.

In that context, households spend so much on heat that they can be forced to reduce the consumption of other basic goods and services, such as food (as suggested in Section 3). Another strategy to deal with this imposed budget constraint consists of falling into arrears or non-payment of utility (DH) bills. However, these do not always imply disconnection, especially in the case of blocks with one-pipe, single-loop vertical systems (i.e., radiators in the same position on different floors are connected vertically) where

Table 4
Percentage of Hungarian households in DH-served condominiums having disconnected or planning to disconnect from the DH system (2010).
Source: Energia Klub (2011).

	Yes (%)	**No (%)**	**No answer (%)**
Already disconnected from the DH system	5	89	5
Planning to disconnect from the DH system	9	86	4

disconnecting of individual households is technically impossible (OECD/IEA, 2004). Negative consequences are expected on both the DH suppliers and consumers' side.

When DH companies cannot control their customers' payment behavior (because of, for instance, the lack of individual consumption meters) and non-payment rates increase, this affects negatively the financial performance of suppliers. In the long-term, it also undermines their capacity to invest in the maintenance or upgrading of the system (Poputoaia and Bouzarovski, 2010). When non-payment becomes a large scale phenomenon, it may even have wider negative macroeconomic effects: in the early 2000s, DH debts amounted to 0.25% of Romania's GDP and its reduction became a condition for future lending from the IMF (OECD/IEA, 2004).

Besides, though arrears or non-payment can initially benefit households with the privilege of avoiding disconnection (compared to gas or electricity users), growing debts will also put them in a difficult situation. As revealed by an interview with the director of the municipality's Family Help Service (*Családsegítő Szolgálat*) of a suburban area in Budapest where *panel* buildings are widespread, DH is often the main household's debt. In this quarter of the city, DH debts cannot frequently be solved through the debt-management service provided by the municipality because they are over the limit (1 million HUF, equivalent to 4000 Euros at the time of the interview) set as a condition for benefiting from this service. The situation is further complicated by the number of fee-collecting companies and utility providers (that sometimes change their denomination, which confuses customers) operating in parallel, the uncertainty about the terms and conditions for disconnection and the lack of capabilities of some consumers to deal with their utility expenses and debts.

In some serious cases, the accumulated housing utility arrears force households to move to a less valuable property as a way to repay their debts to energy (and other utilities) providers with the capital recovered in the transaction. This has occasionally resulted in illegal practices that take advantage of the vulnerability of fuel poor households (Hegedűs, 2010):

> In Hungary, a special type of the crime is closely related to the affordability issue. Households with high utility debts (typically having other social problems) are cheated by the so called 'real estate mafia', which offered a inhabitable home (typically in a dead-end village or slum area of a city) in exchange of the apartment with debt. (The registered number of these cases was more than 400 between 2001 and 2003.)

5. Policy elements

5.1. Prices and household income support

Though lacking a comprehensive fuel poverty alleviation strategy, some elements of Hungary's current social, fiscal and energy efficiency policies have some positive impacts on the welfare of affected households. For DH-*panel* dwellings, one key element is the DH-price support scheme (*távhőtámogatás)* which allows low-income households to benefit from reduced DH fees. Along with a very similar scheme for domestic natural gas consumers, it has buffered the impact of real energy price increases for a number of years. However, as noted by a representative of the Hungarian NGO *Védegylet—Protect the Future Society* interviewed in June 2009, it can be criticized because of its limited coverage (not applicable to all domestic energy consumers, e.g., firewood users), its high administration costs and the lax enforcement of its income-based eligibility criteria.

By September 2011 the scheme will have been replaced by a household maintenance subsidy that favors the provision of in-kind benefits (e.g., the municipality directly pays for the energy bills of beneficiary households) (NEFMI, 2011) and may assist consumers of energy carriers other than gas and DH. This has scope for better targeting and may for example benefit the 20% to 30% of Hungarian households that currently burn firewood for space heating (Energia Központ, 2009; Energia Klub, 2011) as an energy cost reduction strategy.

Support with paying for household energy bills has been criticized because this can lock households into fuel poverty by removing incentives to make energy efficiency investments. Furthermore, saved income may be spent by beneficiary households on other goods, not just on energy and may not be invested in energy efficiency at all (Boardman, 2010; Healy, 2004). They are also believed to distort markets, and may divert resources away from long-term solutions such as energy efficiency investments (Scott, 1996; Healy, 2004; OECD/IEA, 2007; Fülöp, 2009)

A second policy element that eases the burden of DH costs on the households' budgets is the reduced 5% VAT payable on DH, which compares favorably with the current 25% standard for other goods and services (Kubitsch, 2011). According to estimates by Hungary's Energia Klub (2010), this has brought the annual heating costs of an average 50 square-meter apartment served by DH closer to those of a flat of similar characteristics that uses natural gas for space heating. The issue remains controversial because municipalities often own totally or partially DH providers and energy payments represent a source of revenue; this creates a conflict of interest and incentives to keep DH prices high (OECD/IEA, 2004; Energia Klub, 2009;). In Hungary, the Hungarian Energy Office (*Magyar Energia Hivatal*) is in charge of approving DH prices proposed by heat distributors. Municipalities also play a role as they sometimes own DH companies. However, as noted by a researcher of the Hungarian NGO *Energia Klub* interviewed in June 2011, it seems that neither municipalities nor the MEH have enough expertise and capacity to deal effectively with DH pricing issues. The interviewee also argued that companies did not reduce DH prices after a co-generation feed-in was introduced with that purpose in the early 2000s, and noted the weakness of central government to control the sector. Company management practices and institutional regulation thus arise as issues deserving further exploration from a fuel poverty perspective.

5.2. Residential energy efficiency: how deep to go?

Residential energy efficiency programs – such as the ÖKO-program, the Grants for Renovation of Prefabricated-Panel Residences (the so called *Panel* program), the National Energy Saving Plan (NEP) and the Climate Friendly Home programs – have been in operation in Hungary for a number of years. They focus mainly on prefabricated buildings and implement component-based renovations (i.e., replacement of specific building components such as windows, façade or roof insulation or heating system). Between 2001 and 2006, 190,000 *panel* apartments underwent some sort of energy efficient renovation at a cost of 140 million Euros (Ministry of Labour and Social Affairs, 2008). According to scattered evidence collected at the municipal level, these renovations have delivered 5% to 45% reductions in the energy demand for space heating (Bencsik, 2009; Pájer, 2009; Czakó, 2010). However, this impact is thought to be insufficient for solving the fuel poverty problem, especially if they wish to contribute to other policy goals such as climate change mitigation and energy security objectives.

The Hungarian experience also provides two pilot examples of more ambitious retrofits in *panel* buildings connected to DH, the SOLANOVA and *Faluház* pilot projects. The SOLANOVA project has achieved 80–90% reductions in the energy use for space heating in a 43-apartment block in the city of Dunaújváros and has demonstrated the feasibility of retrofitting conventional *panel* buildings with passive house technology. The *Faluház* project, on the other hand, is expected to reduce by 50% the heating energy use of the largest *panel* building in Hungary, located in Budapest. As Table 5 indicates, delivering substantial reductions (over 80%) in the heating energy use requires the application of passive house technologies such as ventilation units equipped with heat recovery systems, which entail larger investment costs.

How deep should an energy efficiency program go if it aims to effectively eliminate fuel poverty among households living in *panel* buildings served by DH? It has been argued that the only long-term solution is *fuel poverty-proofing* the housing stock, "which means that a dwelling will be sufficiently energy efficient that regardless of who occupies the property, there is a low probability that they will be in fuel poverty" (DTI, 2006, p. 31). The results of the SOLANOVA project evidence a reduction of monthly DH expenses (in 2006 units) from €96 to €16 (Hermelink, 2007), the latter being affordable even for the least affluent households. If such low energy costs can be systematically achieved in DH-connected *panel* households throughout Hungary, then it is very likely that only passive house-based, SOLANOVA-like retrofits can effectively eradicate fuel poverty in DH-served *panel* buildings.

Deep retrofits are also appealing when climate change mitigation and energy security are pursued along with fuel poverty reduction goals. As estimated in Tirado Herrero et al. (2011), a large scale, near-passive house (i.e., SOLANOVA-like) retrofit of the whole residential and public building stock of Hungary would

- avoid 85% of its 2010 heating-related energy consumption and CO_2 emissions,
- notably reduce total annual and peak gas imports and
- create up to 170,000 additional net jobs per year.

However, if lower-quality retrofits (i.e., *Faluház*-like) were applied, 45% of Hungary's 2010 building stock heating-related

Table 5
Key features of the *Faluház* and SOLANOVA pilot projects.
Source: http://faluhaz.eu/; Faluház/Staccatto project, unpublished, Hermelink (2005, 2006).

	Faluház	SOLANOVA
Number of apartments	886	43
Year of completion	2010	2005
Characteristics of the retrofit	– Façade (10 cm expanded polystyrene) and roof insulation (12 cm rock wool) – Windows and balcony doors replacement (five chamber UPVC) – 1500 m^2 solar thermal panels	– Advanced heat recovery ventilation units (1 per apartment) – Walls (16 cm polystyrene), roof (30 cm with green roof) and cellar ceiling (10 cm) insulation – Windows replacement (U_W=1.1–1.4) – 75 m^2 solar thermal panels
Heating energy consumption before and after retrofit	n.a.	220 kWh m^2 $year^{-1}$ (before) 40 kWh m^2 $year^{-1}$ (after)
Cost of renovation	€90 m^{-2} (estimated, 2010)	€250 m^{-2}+VAT (2006)
Reduction in previous energy consumption for space heating	50% (expected)	82%—recorded in 2005/06 91%—recorded in 2006/07
Financing	– 33% Panel Plus State program – 40% Óbuda municipality and the EU STACCATO program – 27% owners	Mainly funded by EU's 5th Framework Programme
Self-reported assessment of the retrofit by dwellers	Expectations before retrofit: – 92/90% of respondents believe that they will pay less for heating and hot water – 84% of respondents believe that the value of their apartment will increase	Comparison of the SOLANOVA building vs. a non-retrofitted reference building: – higher level of satisfaction of winter indoor temperatures – lower level of satisfaction with summer indoor temperatures

carbon emissions would be *locked-in*. Since heating in buildings is an important source of carbon in Hungary, and heating-related emissions are difficult to mitigate in other ways than addressing them in buildings themselves, applying partial retrofits would force Hungary to either revisit and upgrade once-retrofitted buildings or to search for more expensive mitigation options, (e.g., renewables or CCS) in order to achieve stringent long-term mitigation goals such as the 50–85% reductions of 2000 emissions set as the 2050 global target by the IPCC (2007).

5.3. *The feasibility of deep retrofits and other pathways for policy action.*

No matter how technologically feasible or desirable deep retrofits look from a policy integration perspective, they face a number of obstacles, starting with high investment costs and long implementation periods. In Hungary, it has been estimated that deep retrofitting the whole residential and public building stock would require a sustained investment of €0.8–4.7 billion per year during the next 20–40 years, depending on the rate of implementation[7] (Tirado Herrero et al., 2011). Though capital costs can be borne effectively by households (through pay-as-you-save schemes) and the central government (by reallocating existing budget items), in the case of fuel poor households (and low-income families in general), such initiatives will face drawbacks such as lack of information and access to credit (Healy, 2004); furthermore pay-as-you-save schemes may not ease the burden of energy-related costs for worse off families as they will need to divert a significant fraction of the energy savings to repay the cost of the retrofit.

Because of this, acting both on the demand and supply side is required for the transition to a low-carbon, fuel poverty-free of DH systems. For that, the IEA (OECD/IEA, 2004) has suggested improving the competition between DH providers and other sources of heat, substituting direct heat production subsidies with social support programs, ensuring the right to disconnect of consumers and shifting from a production-based to a consumer-focused management model. In Hungary, building upon the aspects discussed in Section 5.1 and making the information on local DH prices available to municipalities would help local governments take more informed decisions about heating in their constituencies. Consumers would also benefit from clearer rules linking disconnection and non-payment, and mechanisms that avoid mounting debts hard to repay. Finally, installing individual consumption meters in all dwellings is probably the single most important action to reduce the average heating costs of DH-served *panel* households and a prerequisite for retrofits, though it would probably change the way people experience energy deprivation (i.e., fuel poor households may then decide to decrease their energy costs by reducing thermal comfort levels, thus fitting a more conventional understanding of fuel poverty).

6. Conclusions

Considered as a "communist relic with no value in a market economy" because of its low efficiency and flexibility (OECD/IEA, 2004, p. 9), the role of DH in the post-1990 energy deprivation landscape of the Eastern Bloc has not been previously explored. Acknowledging this gap, this paper has used the case of Hungarian DH-connected *panel* buildings to describe a new variant of fuel poverty typical of the post-communist milieu. This type of fuel poverty, so far absent in the fuel poverty literature, highlights the importance of a household's physical and institutional settings for the likelihood of fuel poverty—in particular, the inheritance of an inefficient residential stock built at a time of heavily subsidized energy prices and connected to an outdated energy supply system. This context can be found in CEE and the fSU, where 170 million

[7] These figures are mostly representative for residential buildings (92% of the total stock considered in the study).

people live in *panel* blocks (Stenning, 2004), but also in other contexts where energy-inefficient, DH-serviced buildings prevail.

The Hungarian case indicates that households living in DH-served *panel* blocks may experience the highest heating costs per person and square meter, in spite of the small size and average energy (in)efficiency of such dwellings. Though they seem to be less affected by fuel poverty as measured by conventional expenditure-based rates (probably because of their higher than median income), an alternative approach has found that almost one third of DH-*panel* Hungarian households spent more on energy than on food in 2008.

Moreover, it is argued that some households – particularly those in fuel poverty and unable to regulate their heat consumption – are *trapped* in apartments that cannot be neither easily disconnected from the network nor its energy efficiency improved on an individual basis, and therefore have to pay high energy bills without the prospect of improvement. The fuel poverty of this subset of households defies conventional notions in the sense that it is not experienced in the form of a cold indoor environment (often the opposite, in fact), but as higher than average domestic heating costs, which may translate into reduced consumption of other basic goods and services, payment arrears, indebtedness and risk of disconnection. This transfer of the energy affordability problem to the providers' side plays a role in the persistence of fuel poverty in *panel* blocks because declining DH revenues prevent the upgrading of generation and distribution systems, and may increase per apartment energy costs. It emphasizes the responsibility of DH providers to address this particular type of energy deprivation.

Though lacking a comprehensive fuel poverty alleviation strategy, some elements of Hungary's current social, fiscal and residential energy efficiency policies– namely reduced VAT for DH, the DH-price support scheme and a number of State-financed programs aimed at improving the energy performance of *panel* blocks – are having some positive impacts on the welfare of affected households. However, the former two are measures that are temporary, remove incentives for energy efficiency investments and apply conventional retrofitting technologies that reduce only a fraction of a dwelling's heating energy needs. The comparison of Hungary's *Faluház* and SOLANOVA pilot projects, both of them having successfully retrofitted conventional DH-connected *panel* buildings suggests that, whereas the large scale implementation of partial (i.e., *Faluház*-like) renovations may reduce fuel poverty, passive-house based retrofits (i.e., SOLANOVA-like) would practically eliminate fuel poverty even among lowest income households. This raises the question of viability for the often oversized DH systems, particularly if the heating energy consumption of retrofitted *panel* building falls by 80% to 90%, a feasible reduction as demonstrated by the SOLANOVA example.

Related evidence from Hungary (Tirado Herrero et al., 2011) has also demonstrated that advanced retrofits deliver more energy and carbon savings, total annual and peak gas imports reductions, create more employment and avoid *locking-in* a substantial fraction of Hungary's buildings potential to reduce emissions and energy use. This emphasizes the need to integrate policy goals to provide a strong enough pull for adopting ambitious residential energy efficiency targets.

Acknowledgments

This paper presents findings from a previous research project financed by the Hungarian NGO *Védegylet—Protect* the Future Society and is part of a larger doctoral research generously funded by the Open Society Foundation (Budapest, Hungary) and Fundación Mutua Madrileña (Madrid, Spain). We are grateful to Brenda Boardman and Stefan Buzar for first offering to contribute to this special issue and helping us locating our paper in the frame of this special issue. László Elek (*Energia Központ*) provided valuable information from the Hungarian Household Energy Use survey 2009. Orsolya Fülop (*Energia Klub*) and two reviewers provided valuable feedback on a first version of the paper. As usual, errors and omissions are responsibility of authors.

References

Autonómia Alapítvány, 2004. Energiatakarékossági kísérleti programok az Encsi kistérségben (Energy-saving pilot programs in the Encs sub-region). Unpublished.

Bencsik, J., 2009. Zöldülő Tatabánya (Greening Tatabánya). Presented at the Conference Opportunities for Climate Change and Energy Efficiency Action in an Economic Crisis: Catalysing a Green Recovery, October 20, 2009. Central European University (CEU), Budapest.

Bhattacharya, J., Deleire, T., Haider, S., Currie, J., 2003. Heat or eat? cold-weather shocks and nutrition in poor American families. American Journal of Public Health 93 (7), 1149–1154.

Birol, F., 2007. Energy economics: a place for energy poverty in the agenda? The Energy Journal 28 (3), 1–6.

Boardman, B., 1991. Fuel Poverty: From Cold Homes to Affordable Warmth. Belhaven Press, London.

Boardman, B., 2010. Fixing Fuel Poverty. Challenges and Solutions, Earthscan, London.

Bouzarovski, S., 2009. East-Central Europe's changing energy landscapes: a place for geography. Area 41, 452–463.

Bouzarovski, S., 2010. Entangled boundaries, scales and trajectories of change: post-communist energy reforms in critical perspective. European Urban and Regional Studies 17, 167–182.

Buzar, S., 2007. Energy Poverty in Eastern Europe. Ashgate, Aldershot.

Csagoly, P., 1999. Post-com pre-fab. Central Europe Review 1, 24.

Czakó, V., 2010. Energy efficiency programs in the residential buildings sector: the Hungarian experience. Presented at a 3CSEP Seminar, January 20, 2010. Central European University (CEU), Budapest.

DTI, 2006. Energy—Its Impact on the Environment and Society. Department of Transport and Industry, London.

Duncan, J., 2005. From Budapest to Bishkek: Mapping the Root of Poverty Housing. Habitat for Humanity Europe and Central Asia.

Energia Klub, 2009. Új fejezet a távhő történetében (A new chapter in the history of district heating). Energy Club, Budapest. 〈http://energiaklub.hu/hir/uj-fejezet-a-tavho-torteneteben〉 (consulted on-line on March 10, 2011).

Energia Klub, 2010. Távhő körkép és kisokos 2 (District heating at a glance 2). Energy Club, Budapest. 〈http://energiaklub.hu/hir/tavho-korkep-es-kisokos-2〉 (consulted on-line on March 10, 2011).

Energia Klub, 2011. Negajoules project. Results. 〈http://www.negajoule.hu/oldal/adatok〉 (consulted on-line on July 12, 2011).

Energia Központ, 2009. A haztartasok energiafogyasztasa (The Energy Consumption of Households)Energy Centre, Budapest.

Faluház/Staccatto project, unpublished. Report on the Social Questionnaire for the Staccato Building Renovation Project.

Fülöp, O., 2009. Ösztönzött pazarlás - Lakossági energiaárak állami támogatása 2003–2009. Összefoglaló elemzés (Encouraged waste—household energy prices public support for 2003–2009. A summary analysis). Energy Club, Budapest.

Fülöp, O., pers. comm. Researcher and Project Manager of the Negajoule Project at Energia Klub. Email exchange on May 26, 2011.

Healy, J.D., 2004. Housing, Fuel Poverty, and Health: a Pan-European Analysis. Ashgate Publishing, Aldershot.

Hegedűs, J., 2010. Housing affordability and inequality after transition. Presented at Following Transition: Urban Restructuring in Eastern Europe. November 27, 2010. Corvinus University, Budapest.

Hermelink, A., 2005. Do not forget the dwellers—surprising insights from user surveys. In: Proceedings of the Fourth International Conference Climate Change – Energy Awareness – Energy Efficiency. June 8–10, 2005. Visegrád, Hungary.

Hermelink, A., 2006. Reality check: the example SOLANOVA, Hungary. In: Proceedings of the European Conference and Cooperation Exchange 2006. Sustainable Energy Systems for Buildings—Challenges and Chances, November 15–17, 2006, Vienna, Austria.

Hermelink, A., 2007. SOLANOVA. The Real Social Housing. Presented at the EU Sustainable Energy Week. February 1, 2007. Brussels, Belgium.

Intergovernmental Panel on Climate Change (IPCC), 2007. Climate Change 2007: mitigation. In: Metz, B., Davidson, O.R., Bosch, P.R., Dave, R., Meyer, L.A. (Eds.), Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge and New York.

IEA/OECD, 2009. Co-generation and District Energy. Sustainable Energy Technologies for Today… and Tomorrow. International Energy Agency, Paris.

Kocsis, J., 2004. The housing poor in Budapest, Hungary: situation and perspectives. In: Fearn (Ed.), Too Poor to Move, too Poor to Stay. A Report on Housing in the Czech Republic, Hungary and Serbia, Local Government and Public Service Reform Initiative, Open Society Institute, Budapest.

KSH, 2004. A háztartások lakásfenntartási kiadásai (Expenditure of Households on Maintenance of Dwellings). Központi Statisztikai Hivatal–Hungarian Central Statistical Office, Living Standard and Human Resources Statistics Department, Budapest.

KSH, 2006. A háztartások villamosenergia-kiadásai (Electricity Consumption of Households). Központi Statisztikai Hivatal–Hungarian Central Statistical Office, Living Standard and Human Resources Statistics Department, Budapest.

Kubitsch, R., 2011. The Status of the Hungarian District Heating and CHP Regulation. Hungarian Energy Office/ERRA Technical Exchange Programme.

Ministry of Labour and Social Affairs, 2008. National Strategy Report on Social Protection and Social Inclusion 2006–2008. Ministry of Labour and Social Affairs, Budapest.

NEFMI, 2011. Tájékoztató a szociális alapú gáz- és távhőtámogatás, valamint a lakásfenntartási támogatás 2011. évi alakulásáról (Information on the Social-Based Gas and District Heating Subsidies, and Household Maintenance Program for 2011). Ministry of National Resources, Budapest.

OECD/IEA, 2004. Coming in from the Cold. Improving District Heating Policy in Transition Economies. International Energy Agency, Paris.

OECD/IEA, 2007. Hungary 2006 Review. Energy Policies of IEA Countries. International Energy Agency, Paris.

Pájer, S., 2009. Klímaváltozás – Energiatudatosság – Energiahatékonyság. V. Nemzetközi Konferencia (Climate Change – Energy Awareness – Energy Efficiency). V. National Conference, April 16–17, 2009. Szeged, Hungary.

Poputoaia, D., Bouzarovski, S., 2010. Regulating district heating in Romania: legislative challenges and energy efficiency barriers. Energy Policy 38, 3280–3289.

Scott, S., 1996. Social Welfare Fuel Allowances… to Heat the Sky? Working Paper No. 74. The Economic and Social Research Institute (ESRI), Dublin.

Sigmond, G., 2009. The situation of district heating, district cooling and energy supply in Hungary. Presented at the Conference & Business Forum "District heating and energy efficiency—the Danish example", March 30–31, 2009, Budapest.

Stenning, A., 2004. Urban change and the localities. In: Bradshaw, M., Stenning, A. (Eds.), The Post-Socialist States of East Central Europe and the Former Soviet Union, Pearson Education, Harlow.

Tirado Herrero, S., Ürge-Vorsatz, D., 2010. Fuel Poverty in Hungary. A First Assessment. Report Prepared for Védegylet—Protect the Future Society. Center for Climate Change and Sustainable Energy Policy (3CSEP), Budapest.

Tirado Herrero, S., Ürge-Vorsatz, D., Arena, D., Telegdy, A., 2011. Co-benefits quantified: employment, energy security and fuel poverty implications of the large-scale, deep retrofitting of the Hungarian building stock. In: Proceedings of the ECEEE Summer Study 2011, 6–11 June 201. Belambra Presqu'île de Giens, France.

Ürge-Vorsatz, D., Miladinova, G., Paizs, L., 2006. Energy in transition: from the iron curtain to the European Union. Energy Policy 34, 2279–2297.

Ürge-Vorsatz, D., Arena, D., Telegdy, A., Tirado Herrero, S., Butcher, A.C., et al., 2010. Employment Impacts of a Large-Scale Deep Building Energy Retrofit Programme in Hungary. Center for Climate Change and Sustainable Energy Policy (3CSEP), Budapest.

World Bank, 2000. Maintaining Utility Services for the Poor. Policies and Practices in Central and Eastern Europe and the Former Soviet Union. The World Bank Group, Washington.