Trapped in the heat: the post-communist genre of fuel poverty.

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Abstract:
Fuel poverty is a still insufficiently researched combined social and energy challenge with significant climate change implications. Based on evidence from Hungarian *panel* blocks connected to district heating, this paper introduces a new genre of fuel poverty that defies conventional notions and may not even captured by some of the existing fuel poverty indicators. This type of fuel poverty is largely attributed to post-communist legacies (though it might exist in other contexts), where 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, (b) they do not realistically have the option to reduce individually their heating costs through 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.

Keywords: district heating; *panel* buildings; state-of-the-art retrofits.

Research highlights:
- We identify a new genre of fuel poverty that defies conventional definitions.
- We explore this type of fuel poverty in *panel* blocks connected to DH in Hungary.
- These units are warm enough in winter but have disproportionately high energy costs.
- Households react by payment arrears or consuming less of other basic goods.
- Only deep retrofits eradicate fuel poverty while also contributing to other goals.

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 has to be necessarily connected to 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).

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 (Latvia) as high as up to almost 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. Above many often documented and debated concerns, this paper identifies district heat as one of the root causes of a new type of fuel poverty prevalent in dwellings served by DH. In fact, the paper also aims at exploring the boundaries of the fuel poverty notion because it examines households that live in adequately heated dwellings but still face disproportionately high energy costs.

What does this newly identified genre of fuel poverty entail? How is it related to other types? How can it be best measured? To what extent are households living in inefficient buildings connected to DH affected by fuel poverty? How is the experience of fuel poverty in these units? How effective are the policy responses provided so far? This paper attempts to answer some of these research questions through an analysis of quantitative and qualitative data sources, using the case of Hungarian prefabricated buildings supplied by DH (*lakótelep* or *panelház*, in Hungarian) as a case of study. However, since highly energy-inefficient 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 case of fuel poverty (Section 4). Section 5 offers a review of policy elements and two relevant residential energy efficiency pilot projects. They are 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; Fülop, 2009; Energia Központ, 2009) has explored selected elements of the domestic energy affordability issue, a first comprehensive assessment of its fuel poverty (Tirado Herrero and Ürge-Vorsatz, 2010) suggested that the residents of DH-served prefabricated buildings are particularly affected by fuel poverty. Though DH is not as extended as in other countries of the region[1] (OECD/IEA, 2007), it is acknowledged that many DH systems in Hungary are now obsolete and needs modernization both on the heat providers' and on the

[1] 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 its 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).

consumers' sides, as recognized by the Hungarian Professional Association of District Heating (*MaTáSzSz*). Since newly built residential units often choose to use other energy carriers and some households sometimes disconnect if their financial situation allows for 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 blocks built between the 1960s and 1980s located in suburban areas of Hungary's largest towns and cities (KSH, 2004; Sigmond, 2009).

This set of relevant features makes Hungary (and more in particular its DH-served *panel* buildings) a suitable study case for the exploration of the new genre 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 because temperatures in DH-served dwellings are typically adequate, or in cases even too high, and because households cannot decide on the amount of heat consumed because they often pay on a per square or cubic meter basis. 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 from 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.

Three expenditure-based fuel poverty lines were applied to estimate fuel poverty rates. According to them, a household is in fuel poverty if: i) its energy costs are equal or above twice the median energy expenditure (as a percentage of total household expenditure) for the given year; ii) its energy costs are equal or above the median energy expenditure (as a percentage of total household expenditure) of the three lowest income deciles for the given year; iii) its 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 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 main expenditure for 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 expenditures at the expense of decreasing their food consumption (Bhattacharya, et al., 2003).

Results presented in Figure 1 indicate that according to the first two criteria fuel poverty rates were lower in the DH-connected *panel* buildings category than in the all households sample. This probably has to do with the fact that even though households living in such dwellings report higher annual energy expenditure, they also report a median total expenditure (proxy of income) higher than the average Hungarian household (see Figure 2). It is also worth pointing at the fact that fuel poverty rates as measured by the "twice the median expenditure" fuel poverty line decreased between 2005 and 2008 in spite of the large increase in domestic energy prices occurred in that same period. A likely explanation is that the increase in the median energy expenditure in those three years (from 12.5% to 16% of a household's total expenditure) has pushed this fuel poverty line from 25% to 32% of a household's total expenditures, which in turn has reduced the number of households labeled as fuel poor following this criterion.

Figure 1. Fuel poverty rates (percentage of households) estimated according to three expenditure-based criteria (all households vs. DH-connected panel dwellings), in 2005 and 2008.
Source: Household Budget Survey (KSH)

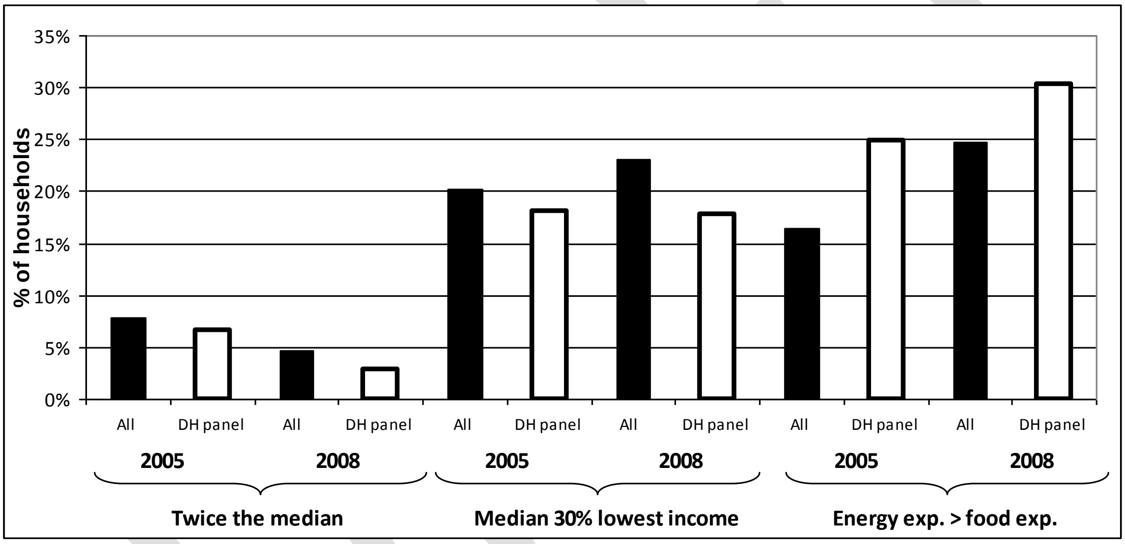
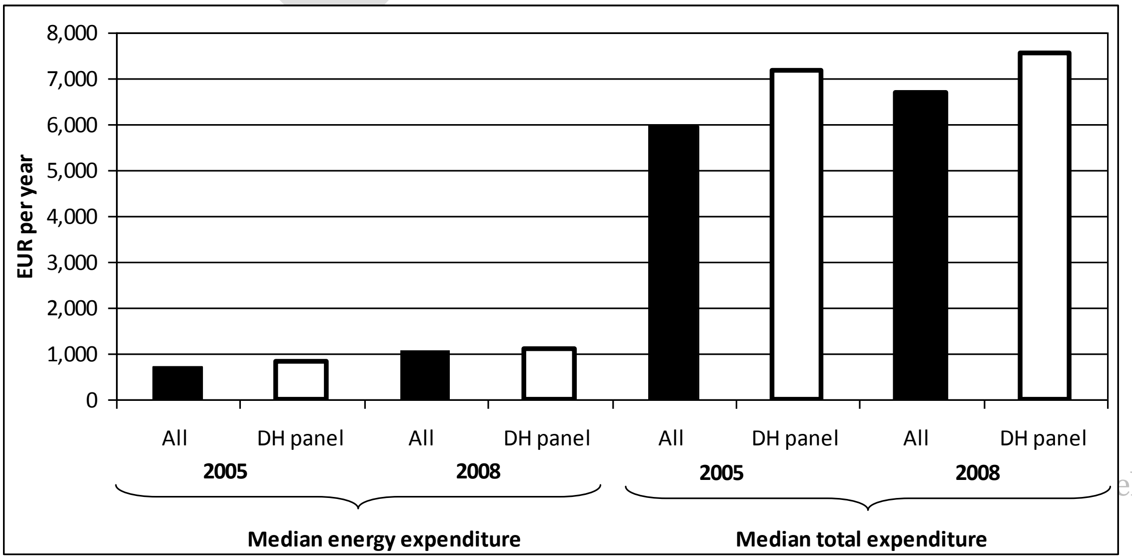


Figure 2. Median total and energy expenditures of Hungarian households (all households vs. DH-connected panel dwellings) in nominal units of 2005 and 2008.
Source: Household Budget Survey (KSH)



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%). However, it is suspected that smaller size (i.e., 1-2 members) and large surface-to-occupancy ratio (in dwelling square meters per person) households tend to spend more on energy than on food. Both features would make it more likely that DH-*panel* households fall in the fuel poor category according to this criterion.

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 inadequately cold indoor temperatures. In fact, as it is widely perceived by Hungarian householders, 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 Table 1). 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, as indicated by the results on satisfaction with indoor temperatures prior to the energy efficiency retrofit reported by the *Faluház* and SOLANOVA pilot projects implemented in conventional DH-supplied *panel* buildings in Hungary (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 1, prefabricated buildings served by DH report up to 50% higher annual energy and heating costs per m² 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 m²), its annual total heating cost is the largest among all categories[2]. Equally, its heating cost vs. total energy costs ratio is also the highest (75%). Disproportionately high heating costs are thus confirmed as the key element in this type of fuel poverty.

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, which many buildings in Hungary still lack (Sigmond, 2009). In those apartments, users pay flat-rate fees (e.g., per square or cubic metre), which means that rationing the heat consumption cannot be adopted as a coping strategy for households experiencing

[2] Substantial differences nevertheless exist in the annual DH costs borne by the average resident of a DU-served *panel* dwelling in different Hungarian cities. In 2009, the average heating costs for a 50 m² apartment ranged between 960 and 320 € per household. 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).

energy affordability constraints. This has also 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 (e.g., natural gas), which is related to the conditions of monopoly under which heat is provided (OECD/IEA, 2004). Besides, given the characteristics of the buildings (multi-family units, often with many apartments per block) households do not realistically have the option to reduce individually their heating costs through efficiency improvements. This 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 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 behaviour (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 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).

Table 1. 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)	1106	427	1209	431	1087	491	820	400
From which:								
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%	

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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 put them also in the difficult situation. As accounted by the Family Help Service of a suburban area in Budapest where *panel* buildings are widespread, DH is often the largest of item of households' debts. In fact, 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 some 4,000 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) 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 (Mester, pers. comm.).

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, which in extreme cases have been literally ripped-off (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 policy are having some positive impacts on the welfare of affected households. For DH-*panel* dwellings, one key element is the DH-price support scheme (*távhőtámogatás*, in Hungarian), which allows households with per person income levels below a certain threshold to benefit from reduced DH fees. Along with a very similar scheme for domestic natural gas consumers, it has contributed to buffer the impact of growing real energy prices on households' incomes for a number of years. However, from an implementation perspective it can be criticized because of its limited covering (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 (Kovách, pers. comm.).

Following recent political developments, 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 benefit consumers of fuels other than gas and DH. This way, the subsidy would be fully spent on energy (and not redistributed among all household expenditure items) and may also benefit the up to 20% of Hungarian households that, according to the

Hungarian Household Energy Use survey (Energia Központ, 2009), currently burn firewood for space heating, many of which have adopted this fuel as a energy cost reduction strategy.

A second policy element that eases the burden of DH costs on the households' budgets is the reduced 5% VAT of DH, which compares very 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. In spite of that, the issue of DH pricing remains controversial because municipalities often own totally or partially DH providers and the collected fees represent a source of revenue for local governments in Hungary, which creates a conflict of interest and incentives to keep DH prices high (OECD/IEA, 2004; Energia Klub, 2009;).

Consumers' support schemes such as the two described have been criticized because in the long run they lock households into fuel poverty by removing incentives to energy efficiency investments. Besides, saved income will be spent by beneficiary households on a number of household expenditure items, not just on energy, or invested in energy efficiency retrofits (Boardman, 2010; Healy, 2004). They are often poorly-targeted, distort markets and divert private and public resources that could have been used for energy efficiency investments (Scott, 1996; Healy, 2004; OECD/IEA, 2007; Fülop, 2009).

5.2. Residential energy efficiency: how deep to go?

A number of residential energy efficiency programmes – such as the ÖKO-programme, the Grants for Renovation of Prefabricated-Panel Residences (the so called *Panel* programme), the National Energy Saving Plan (NEP) and the Climate Friendly Home programmes – have been in operation in Hungary for a number of years. They mostly focus 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). This way, between 2001 and 2006 some 190,000 *panel* apartments underwent some sort of energy efficient renovation at a total cost of some 140 million Euros (Ministry of Labour and Social Affairs, 2008) which, according to some evidence collected at the municipal level, deliver 5% to 45% reductions in the energy demand for space heating (Bencsik, 2009; Pájer, 2009; Czako, 2010). These reductions are though to be insufficient for solving the fuel poverty problem, especially if this policy goal wants to be combined with climate change mitigation and energy security objectives.

Interestingly, the Hungarian experience also provides two examples of more ambitious retrofits in *panel* buildings connected to DH, the SOLANOVA and *Faluház* pilot projects. The SOLANOVA project has achieved 80% to 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 with passive house technology conventional *panel* buildings. The *Faluház* project, on the other hand, is expected to reduce by 50% the heating energy use of the largest *panel* building of Hungary, located in Budapest. As Table 2 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 also entail larger investment costs.

Table 2. Key features of the *Faluház* and SOLANOVA pilot projects
Source: http://faluhaz.eu/ ; Faluház/Staccatto project, unpublished; Hermelink, 2006; 2005.

	Faluház	**SOLANOVA**
Number of apartments	886	43
Year of completion	2010	2005
Characteristics of the retrofit	- Façade (10 cm. expanded polysterene) and roof insulation (12 cm. rock wool) - Windows and balcony doors replacement (five chamber UPVC) - 1,500 m² solar thermal panels	- Advanced heat recovery ventilation units (1 per apartment) - Walls (16 cm. polysterene), roof (30 cm. with green roof) and cellar ceiling (10 cm.) insulation - Windows replacement (U_W=1.1-1.4) - 75 m² solar thermal panels
Heating energy consumption before and after retrofit	n.a.	220 kWh m² year^{-1} (before) 40 kWh m² year^{-1} (after)
Cost of renovation	90 EUR m^{-2} (estimated, 2010)	250 EUR 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 programme, - 40% Óbuda municipality and the EU STACCATO programme - 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/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

How deep should go an energy efficiency programme aimed at effectively eliminating 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). If this assumption holds, then it is very likely that only passive house-based, SOLANOVA-like retrofits should be promoted. That is even more the case if climate change mitigation and energy security goals are pursued. As estimated in Ürge-Vorsatz et al. (forthcoming), 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 180,000 additional net jobs per year. However, if non-state of the art (i.e., *Faluház*-like) retrofits were applied, 45% of Hungary's 2010 building stock heating-related 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% to 85% reductions of 2000 emissions set as the 2050 global target by the IPCC (2007).

6. Conclusions

Sometimes 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 for describing a new genre of fuel poverty typical of the post-communist milieu. This typology, so far absent in the fuel poverty literature, highlights the importance of a household's physical and institutional settings – in particular, the inheritance of an inefficient residential stock built in a context of heavily subsidised energy prices and connected to an outdated energy supply system – for the occurrence of fuel poverty. Many of the findings elements discussed are arguably applicable to CEE and the fSU, where some 170 million people live in *panel* blocks (Stenning, 2004) as well as to other contexts with energy-inefficient, DH-serviced buildings.

One first set of findings extracted from the Hungarian case indicates that households living in DH-served *panel* blocks experience higher domestic energy and heating costs than the rest of households. 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 these consumers are often *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 carry on paying high energy bills without much clear perspective 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 (such as food), payment arrears, indebtedness and risk of disconnection. This transfer of the energy affordability problem to the providers' side plays a role in the reproduction of the fuel poverty phenomenon in *panel* blocks because declining DH revenues prevent the upgrading of generation and distribution systems and may increase per apartment energy costs.

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

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

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