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Will Plans to Ease Energy Poverty Go Up in Smoke? Assessing the Hungarian NECP through the Lens of Solid Fuel Users' Vulnerabilities

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Abstract: Hungary has one of the highest incidences of energy poverty in the European Union, and a high share of Hungarian low-income households rely on solid fuels. This paper first maps the energy vulnerabilities of Hungarian solid fuel users using six energy vulnerability factors. The mapping underlines that solid fuel users are more exposed to energy vulnerability than average households. This is followed by an analysis of energy-poverty-related objectives and measures outlined in the Hungarian National Energy and Climate Plan (NECP), a key policy document of the green energy transition. The paper outlines that the NECP fails to comply with the requirement of setting energy poverty alleviation objectives. Furthermore, the outlined energy-poverty-related policies and measures fail to provide systematic solutions to energy-poverty drivers, especially those solid fuel users' vulnerabilities. Hungary's general antiegalitarian policy environment and the weak design of energy poverty measures in the NECP suggest severe deficiency regarding a just energy transition guarantee. A just energy transition in Hungary is therefore endangered by the fact that EU energy poverty alleviation requirements fall under soft-law coordination mechanisms that make such requirements hardly enforceable in a member state with an antipoor policy bias that is reluctant to tackle energy poverty.

Keywords: solid fuel users in Hungary; energy vulnerability; National Energy and Climate Plan

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1. Introduction

Climate change mitigation requires a large-scale transformation of energy systems through a process of socio-technical change that has been labelled as energy transition [1]. This transition has a substantial effect on the situation of households in the form of job losses and new employment niches, changes in energy prices and use, availability of residential energy efficiency measures, and distribution of renewable energies [2,3]. The burdens and benefits of the transition are, however, unequally distributed [2]. Energy transition policies potentially increase already existing inequalities [1,3], but they also have the potential for energy poverty alleviation [4]. Thus, energy transition has a significant effect on vulnerable groups of society, including energy-poor households [3] and households unable to attain the necessary levels of social and material energy services [5]. How energy transition-related actions are designed and implemented is crucial in terms of the extent to which they can counterweight their negative impacts (such as energy price increases) on low-income households [6] and leverage their energy poverty alleviation potential. From this perspective, one of the most critical policies in energy transition and poverty alleviation is the implementation of large-scale energy efficiency measures [4], including deep energy efficiency retrofits [7], renewable energy access, clean and efficient heating solutions, and household appliance upgrades. If these measures become widely accessible to vulnerable households, much can be potentially achieved in terms of energy poverty alleviation.

At the EU level, the energy transition is facilitated by the Clean Energy for All Europeans package, which currently is the energy policy rulebook of the EU [8]. This package has been recently integrated under the European Green Deal, which is the framework for climate change mitigation in the EU. The Clean Energy for All Europeans framework horizontally considers energy poverty mitigation objectives, concerning each area covered by the package [8], such as energy efficiency, renewable energies, energy performance of buildings, and electricity market integration. The Governance Regulation No. 2018/1999 of the package [9] offers a framework for coordinating the transition to a carbon-neutral Europe, with National Energy and Climate Plans (NECPs) being key planning documents required by Governance Regulation No. 2018/1999. In Sections 2.4.4 and 3.4.4 of the NECPs, member states are required to describe objectives and measures regarding all fields of the Clean Energy Package, including those regarding energy poverty [9]. By being integrated into the Clean Energy Package, energy poverty alleviation has gained significant policy momentum. However, realizing the synergies between energy transition and energy poverty alleviation requires carefully planned goals, measures, and guarantees.

This article explores the energy vulnerabilities of solid fuel users in Hungary in relation of the planned energy poverty alleviation measures in the Hungarian NECP. Hungary is a central-eastern European country with a significantly higher incidence of energy poverty than core countries of the EU [10]. Solid fuel use is at the center of this study as more than one-fifth of Hungarian households exclusively heat their homes with solid fuels, mainly firewood, and a further 20% of households use a mix of natural gas and solid fuels with this purpose [11]. Furthermore, solid fuels are predominantly used among the poorest households. While the literature focusing on energy poverty in the Global South emphasizes problems related to solid fuel use (such as indoor air pollution) [12–17], solid fuel use in the Global North has not been sufficiently considered in the energy poverty literature. Current policy instruments often fail to recognize solid fuel heating issues. Therefore, this article aims to address this research and policy gap by highlighting solid fuel use as a specific and crucial driver of energy poverty in the central and eastern European context.

Post-2011 Hungary has been described as "an increasingly autocratic political system" and as a "work-based society: in which redistribution prioritizes citizens with a stable labor market position" and "social assistance is only possible in return for work" [18] (pp. 3–4). Subsequent cabinets led by Hungarian Prime Minister Viktor Orban have introduced welfare reforms and changes in general tax, family, and housing policies that have resulted in perverted redistribution and have significantly increased inequalities [18]. Social spending has been radically cut back with normative social benefit schemes ended and replaced by local, compulsory, work-based, and often punitive schemes [19]. At the same time, generous support for access to homeownership and (non-energy-efficient) renovation of housing has been introduced for middle- and higher-income groups, but is inaccessible for low-income households [20]. In the disadvantaged layers of society, the Roma population faces dramatically severe housing deprivation [21,22] and has been largely impacted by residential and educational segregation for many decades [22,23]. Despite EU initiatives to resolve these issues, the situation has not improved significantly and has worsened in some cases [21,22]. Furthermore, the Roma face persistent structural discrimination and racism [24] and suffer from political attacks [25]. Homelessness has been also criminalized at a constitutional level and rough sleeping is addressed by police measures instead of systematic policy responses [26].

Regarding the literature on energy poverty in Hungary, the first assessment of the issue based on a 2011 household budget survey estimated that 10–20% of households were affected by energy poverty, mostly those living in detached houses [27]. Households with high energy burdens and high low-income, high-costs values were "disproportionately concentrated in suburban areas, villages, and areas with poor housing" [28] (p. 15).

The high incidence of energy poverty in Hungary can be explained by this country being among the EU member states with the lowest income levels [29] and the low

energy performance of its housing stock [4], combined with inherited post-communist infrastructural legacies such as district heating systems [10].

Bouzarovski et al. [10] explored the coping mechanisms used by households in Hungary to deal with increasing energy prices, and how structural factors such as inadequate access to energy or socio-technical legacies drive household energy vulnerability. They argued that increasing the burden of domestic energy expenses results in a form of energy degradation, by which households switch from natural gas to solid fuels [10]. Solid fuel usage is disproportionately high among the households in the lowest income group, who remain trapped in energy poverty partially due to the lack of capital to increase the energy efficiency of their homes.

Increasing energy prices gained political attention in the late 2000s, and as a response, a utility price cut (*rezsicsökkentés*) was introduced by the Hungarian government in 2013, followed by the regulation of utility prices. The utility price cut brought significant political gain for the ruling government [30]; however, its positive effects have been limited regarding energy poverty and social disparities. In contrast, solid fuel users have not benefitted from the measures and "have been burdened by price increases" [31] (p. 54). The solid fuel subsidy introduced in 2011 was subsequently extended in 2013, but still, it is not universal and thus is not accessible for all low-income solid fuel users, regardless the size of their settlement. Its distribution method has increased prevalent territorial inequalities. In some cases, wet firewood and coal are being distributed, thus contributing to air pollution [32].

The ability of the utility price cut to "address the wider spatial and infrastructural components of energy vulnerability is questionable" [10] (p. 1164). In the last decade, income inequalities have been increasing in Hungary. The share of the population living in difficult conditions is the fourth highest in the EU [33]. The social safety net has become weaker as welfare policies are targeted to support middle- and higher-income groups [34]. Despite the low energy performance of the Hungarian building stock, residential energy efficiency programs in the last decade have been marginal and have not been accessible for low-income households [31,32]. Overall, the general policy environment disfavors vulnerable and low-income groups and does not prioritize residential energy efficiency.

The requirement to include specific policy measures to tackle energy poverty in the NECPs is a promising recent policy development. However, a previous analysis of the Hungarian NECP raised some concerns in this regard. The Bankwatch assessment of the Hungarian NECP highlights that a large majority of renewable energy is produced from solid biomass, and domestic solid fuel use is highly problematic in terms of sustainability and air pollution [35]. Measures to tackle issues related to solid-fuel heating are not specific enough for the extent of the problems, while the calculation of sustainable biomass use in the NECP is also questionable [35]. An analysis of the energy poverty objectives and measures in the NECPs of six central-eastern European member states including Hungary [36] highlighted that none of the six member states have set clear energy poverty reduction targets. In contrast, measures fail to address energy poverty in all its complexity. While energy poverty might be an emerging field for policy action by member states, the European Commission applies soft tools to ensure implementation [37].

Given all of the above, this paper has two aims: first, to explore the energy vulnerabilities of solid fuel users in Hungary using the framework of six vulnerability factors developed by Bouzarovski et al. [38] and, secondly, to assess the energy poverty sections of the Hungarian NECP, specifically to what extent they respond to the vulnerabilities of solid fuel users previously identified.

2. Materials and Methods

2.1. Focus of the Study

This study is based on the analysis of the Household Budget and Living Condition Survey (HBLCS) to understand the key vulnerability factors affecting solid fuels users, and on the assessment of the NECPs' [39] energy poverty-related sections' in [40] (p. 4) and [40,41] (p. 4) potential to respond to crucial energy vulnerabilities.

The six energy vulnerability factors identified by Bouzaroski et al. [38] provided the framework for analyzing the vulnerabilities of solid fuel users. The quantitative analysis of HBLCS data allowed us to explore the energy vulnerability factors affecting solid fuel users compared to other fuel users regarding expenditures in fuel, income groups, the energy need of buildings, and difficulties in heating and paying bills. Qualitative document analysis was used to assess the energy poverty alleviation potential of related sections of the NECP, and how they respond to the specific vulnerabilities of solid fuel users. To this end, we first assessed the general quality of the energy poverty sections of the NECP. We then focused on how energy poverty is recognized and defined and, on the outline of measures, whether these have specific goals, timeframes, and target groups, and whether the financial resources and responsibilities for implementation are allocated with a sufficient level of detail.

2.2. Data Sources

To explore energy vulnerabilities of solid fuel users related to access, affordability, flexibility, and energy efficiency, we used data obtained through the HBLCS of 2018, representing the year 2017 of the Hungarian Central Statistical Office (HCSO). The HBLCS annually collects representative micro-level (household) data on households' housing conditions and consumption levels based on the International Classification of Individual Consumption by Purpose (COICOP). It also provides data on socio-economic strata and demographic and economic indicators [42]. The dataset of the HBLCS survey provides the basis for the Hungarian chapter of the EU Survey on Income and Living Conditions (EU-SILC).

The HBLCS survey variables related to the dwellings allowed us to create a residential building typology based on the typologies used in the Long-Term Renovation Strategy of Hungary (LTRS) [43]. We merged the twenty-eight LTRS categories into eight larger categories. This reclassification was performed using HBLCS variables such as year of construction, construction material (adobe, brick, or prefabricated blocks), and type of dwelling (single or multiapartment building). Data regarding the price of wood and gas were acquired from the consumer price index of the HCSO [42].

The "other" category under the heating source was created by aggregating users of the following energy carriers as a source of heating: electricity and solid (or liquid) fuels, gas and other methods, alternative, and only electricity.

Qualitative data were obtained through the analysis of the energy-poverty-related sections of the NECP: Section 2.4.4 in [40] and Section 3.4.4 in [41]. Section 2.4.4 of the NECP states that member states should set objectives regarding energy poverty and a time frame for action, while Section 3.4.4 states that outline policies and measures should be outlined to reach these objectives.

2.3. Variables Selected for the Study

To quantitatively assess energy vulnerabilities among solid fuel users through HBLCS data, we relied on the following six variables (Table 1) based on the framework constructed by Bouzarovski and Petrova [38].

Table 1. List of variables to measure vulnerability factors defined by Bouzarovski and Petrova [5].

Vulnerability Factor [21]	Variable (Defined for the Hungarian Context)
Access	Household energy source mix; has access to a gas network or has access to a district heating network
Affordability	Income quintile, median energy expenditure to total household expenditure ratio; could not pay their utility bills in the last 12 months more than once
Flexibility	Has access to the gas network, has access to district heating network
Energy efficiency	Annual specific energy consumption of each building typology
Needs	Cannot heat their home adequately
Practices	Household energy source, heating method (centralized, single-space heating)

Access to modern energy services was captured through the HBLCS items access to gas and access to district heating systems. Specifically, we created one variable by merging the binary variables "connected to gas network" and the nominal variable "type of heating" (category: district heating).

To quantitatively characterize the affordability of energy services as a vulnerability factor, we used the following HBLCS items: fuel type usage by income quintile, price of wood and gas, households who could not pay their utility bills in the last 12 months more than once, and households who cannot heat their home properly. Flexibility is characterized by the HBLCS items access to gas and district heating and fuel mix of the household. Energy efficiency is captured through the derived variable annual specific energy consumption of each dwelling typology. Energy needs were determined by the share of households that could not adequately heat their homes. Regarding practices as the last energy vulnerability factor, the HBLCS items household energy source mix used for heating and heating methods (centralized or room heating) were selected. The energy source mix of the household variable was used in all categories to represent the prevalence of solid fuel heaters compared to other energy carriers, especially for households in the following categories: only heating with natural gas, heating with natural gas and solid fuels, district heating, no heating, and other.

Data for the qualitative analysis were taken from Section 2.4.4 [40] and Section 3.4.4. [41] of the Hungarian NECP [39]. Energy poverty alleviation measures listed in the NECP were assessed in terms of their suitability to respond to the six energy vulnerability factors in general, and specifically for solid fuel users.

2.4. Data Analysis

The vulnerabilities of households using different types of fuels were evaluated by cross-referencing income quintiles with the type of fuel used in the households. Then, we performed a descriptive analysis of the six energy vulnerability factors by cross-referencing the variables listed in Table 1 with the fuel mix of households.

3. Results

3.1. Energy Vulnerability of Solid Fuels Users in Hungary

Natural gas is the most used fuel among Hungarian households (39.63%), and the second most common is solid fuels. For the purposes of this analysis, solid fuels include firewood, coal, briquettes, and liquid fuels (the share of the of liquid fuel users is less than 1% of all households [44]). One-fifth (21.5%) of Hungarian households relied exclusively on solid fuels (Figure 1) with another 20.75% of households using both gas and solid/liquid fuels for heating. In addition, 15.57% of households heated their home through a district heating system. Other heating sources such as renewable energy (geothermal or non-combustible renewables) or electricity were used by less than 3% of households. Thus, the overall prevalence of solid fuel heating was high, as 41.80% of Hungarian households relied entirely or partially on these fuels. Solid fuel is more often used in the lower-income groups, while the share of natural gas users increases with household income [45]. Low-income households relying on solid fuels might face multiple vulnerabilities. The following sections explore this vulnerability.

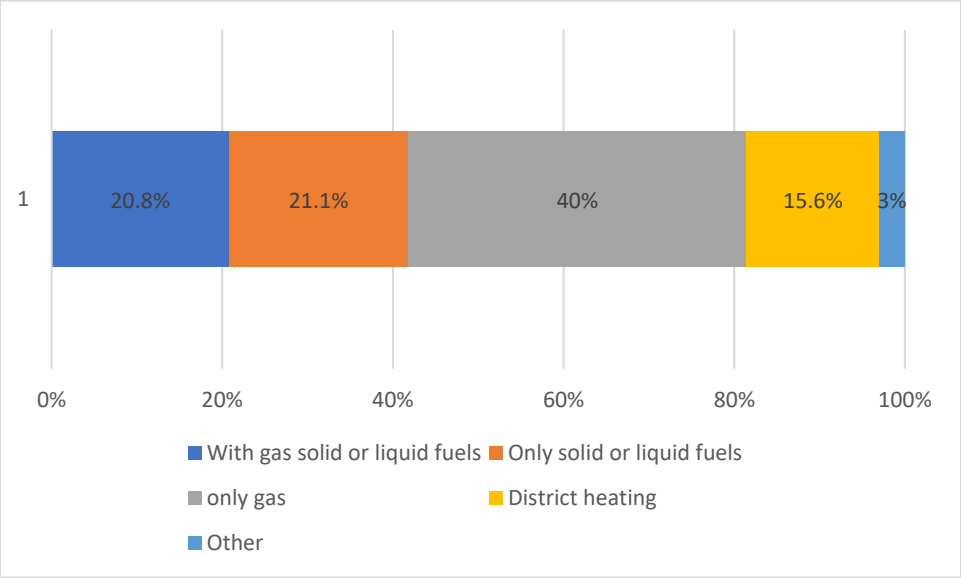

Figure 1. Share of households by energy carrier used as a source of heating (2017). Own calculation based on data retrieved from HBLCS 2018 of the HCSO. In Section 3.1, if not indicated otherwise, sources of tables and figures were all derived from [46].

3.1.1. Access

Bouzarovski et al. defined accessibility as a driving factor as "the poor availability of energy carriers appropriate to meet household needs" [5] (p. 11). In Hungary, the natural gas distribution network does not reach 8.8% of Hungarian settlements, and 27.1% of households are not connected to the natural gas supply [47]. As shown in Table 2, the share of households not connected to the gas and/or district heating system was 19%. Among solid fuel users, 77.7% of households had no access to gas or district heating networks.

Table 2. Share of Hungarian households connected to the natural gas or DH network by energy carrier used for heating (2017). Own elaboration based on [46].

Main Source of Heating	Share of Households Connected to Natural Gas or District Heating by the Source of Heating (100% = Heating Source)	
	Yes	**No**
Natural gas and solid or liquid fuels	97.7%	2.3%
Natural gas and other energy carriers (excluding solid fuels)	98.1%	1.9%
Only solid/liquid fuels	22.3%	77.7%
Only natural gas	97.7%	2.3%
District heating	100.%	0%
Other	28.7%	71.3%
Total	81%	19%

Households that heated their home entirely with solid fuels and had no access either to natural gas or district heating systems represented 16% of households (Table 3). These households could be considered vulnerable in terms of accessibility: as they are not connected to modern energy carriers, they are constrained to using solid fuels.

Table 3. Share of Hungarian households connected to the natural gas and/or DH network in 2017. Own elaboration based on [46].

Main Source of Heating	Share of Households Connected to the Natural Gas and/or DH Network (100% = Total Households)	
	Yes	**No**
Natural gas and solid or liquid fuels	20.3%	0.5%
Natural gas and other energy carriers (excluding solid fuels)	1.1%	0.2%
Only solid/liquid fuels	4.7%	16.4%
Only natural gas	38.7%	0.9%
District heating	15.6%	0.%
Other	0.6%	1.4%
Total	80.8%	19.1%

3.1.2. Flexibility

Flexibility as a driving factor of energy vulnerability is understood as the "inability to move to a form of energy service provision appropriate to household needs" [5] (p. 11). Flexibility depends on infrastructural and technical factors such as having access to the natural gas network and the heating system's adaptability. The financial possibilities of the household to invest in switching heating technologies and market factors such as the availability of alternative energy carriers are also relevant. Based on our HBLCS data, we focus on the flexibility of switching from the current heating source to another and the accessibility to alternative services.

Households using both natural gas and solid fuels for heating have the flexibility to adjust, to a certain extent, their heating habits to energy prices or other factors such as convenience and individual preferences. Households exclusively heating with solid fuels but connected to the natural gas network (4.6% of total households and 22% of solid fuel users) theoretically could move from solid fuel to natural gas heating. Still, they might face financial and technical constraints in adapting the heating system and face affordability issues related to the higher and more volatile price of natural gas. Solid fuel users that have no access to natural gas (16.4% of the total number of households) likely live in a settlement that is not covered by the natural gas distribution network (8% of settlements [47]). In other cases, the distribution network may not reach certain areas of the settlement, as it happens in segregated rural areas, where disadvantaged (mostly Roma) households live. In these locations, even if natural gas pipes are within reach, the cost of the connection may be unaffordable, while upgrading the heating system would need an even more considerable financial investment, making this transition from solid fuels to natural gas highly unlikely for low-income households. Households using district heating (16%) are infrastructurally constrained to move to other sources of heat. Since most of such households live in multi-family apartments, collective decision-making represents an obstacle to modernizing the existing heating system. Modernization would be critical in buildings where adjustable controls and thermostats are not yet part of the district heating system. In these buildings, households cannot independently control their heat consumption.

3.1.3. Affordability

In our analysis, in order to understand affordability as a force driving energy vulnerability, we focused on the "high ratio between cost of fuels and household incomes" [5] (p. 11). Solid fuel users have the highest (16%) energy expenditure to total household expenditure ratio compared to households using other sources of heat (Table 4). Solid fuel households' high energy expenditure share can be explained by their over-representation in lower-income groups [31]. In 2016, more than half of the households in the lowest income quintile heated

their home with solid fuels and less than one-third used gas for heating. At the same time, in the highest income quintile, only one-tenth of households relied on solid fuels, while nearly two-thirds of the households in the highest income groups heated with gas [45] (p. 46).

Table 4. Median energy expenditure to total expenditure ratio of by source of heating. Own elaboration based on [46].

Heating Source	Median Energy Expenditure to Total Household Expenditure Ratio
Electricity and solid/liquid fuels	12%
Natural gas and solid/liquid fuels	14%
Natural gas and other energy carriers (excluding solid fuels)	14%
Only solid/liquid fuels	16%
Only electricity	12%
Only natural gas	11%
Renewable energy	5%
District heating	11%
Average	13%

In 2017, the average energy expenditure to household income ratio was 10.33% (own calculation based on data of HBLCS and consumption data of the HCSO) [46,48]. Households in the lowest income quintile spent two times more of their income on energy than those in the highest income decile [46,48]. At the same time, despite the high energy cost burden, total energy spending within the lowest income group was 2.5 times lower than that of the highest income group, which indicates significant inequalities in energy use and expenditure across income groups.

While the utility price cut introduced in 2013 reduced electricity, gas, and district heating prices and fixed them at the level in 2013, the price of biomass was not affected by this measure. The price of firewood, the solid fuel type most predominantly used, has been increasing for more than a decade and, in recent years, at an even higher rate (Figure 2). Thus, while the utility price used by higher-income groups has decreased and stabilized, the fuel price used predominantly by households with the lowest income is becoming increasingly unaffordable.

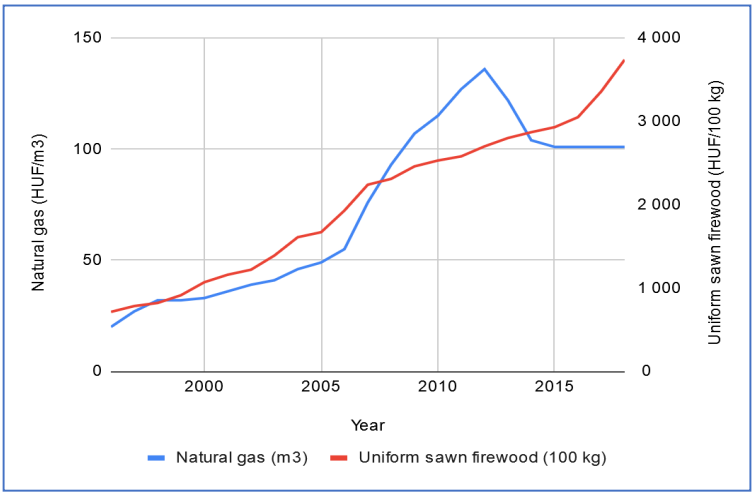

Figure 2. Price of gas and sawn firewood. Source: [31] (p. 41), based on [49].

A further factor contributing to the high share of energy expenditure is dwellings' low energy efficiency, discussed in the following section.

The share of households who could not heat their home adequately was 1.92 times higher among those who heat their homes with solid fuels (12.1%) than among the total of households (6.5%), as shown in Table 5. The share of households who could not heat their home adequately was 2.4 times higher among those who relied on solid fuels (12.1%) than those who relied on gas (4.9%).

Table 5. Share of households that could not pay their bills on time more than once in the last 12 months and could not heat their home adequately. Own elaboration based on [46].

Source of Heating	Could not Pay Their Utility Bills on Time More than Once in the Last 12 Months	Share of Households Who Could not Heat Their Home Adequately
Gas and solid fuels	4.5%	6.4%
Solid fuels	14.1%	12.1%
Only gas	4.3%	4.9%
District heating	6.9%	1.7%
Other	4.6%	14.2%
Total	6.5%	6.5%

Households using solid fuels as their primary source of heating reported the highest share of difficulties in paying their utility bills on time in the last 12 months, despite their major energy expenditure (heating fuel) not being billed but being purchased directly from sellers.

The share of energy expenditure to total household expenditure of those who exclusively heated their home with solid fuels was the highest compared to households who relied on other heating sources. Those who heated their home only with solid fuels also reported difficulties in both heating their home and paying their bills on time in higher shares than those who heat their home with gas, gas and solid fuels, and district heating. Overall, we can conclude that despite the lower relative price of firewood, solid fuel households are more vulnerable in terms of energy affordability than households that rely on gas, gas and solid fuels, and district heating. This is primarily due to the fact that solid fuel users are over-represented among low-income groups and therefore are more sensitive to the increasing price of firewood, with the low energy efficiency of homes also playing a role.

3.1.4. Energy Efficiency

Energy efficiency, defined as disproportionately high loss of useful energy during energy conversions in the home, is another factor related to energy vulnerabilities as it impacts energy costs and indoor comfort levels.

Figure 3 shows that solid fuels are more common in inefficient building typologies, while natural gas heating becomes more dominant as the energy efficiency of the dwelling increases. The share of dwellings heated by solid fuels was the highest among adobe detached houses: the category with the highest primary energy use. Houses built from adobe bricks represented 14% of the residential dwelling stock, and 46.96% of these homes were heated by only solid fuels, while 32.03% of households that heated only with solid fuels lived in these homes [46]. These figures confirm that solid fuel users are more vulnerable in terms of the energy efficiency and quality of their homes as well since they are more likely to live in inefficient homes and consequently face a "disproportionately high loss of useful energy during energy conversions in the homes" [45] (p. 11).

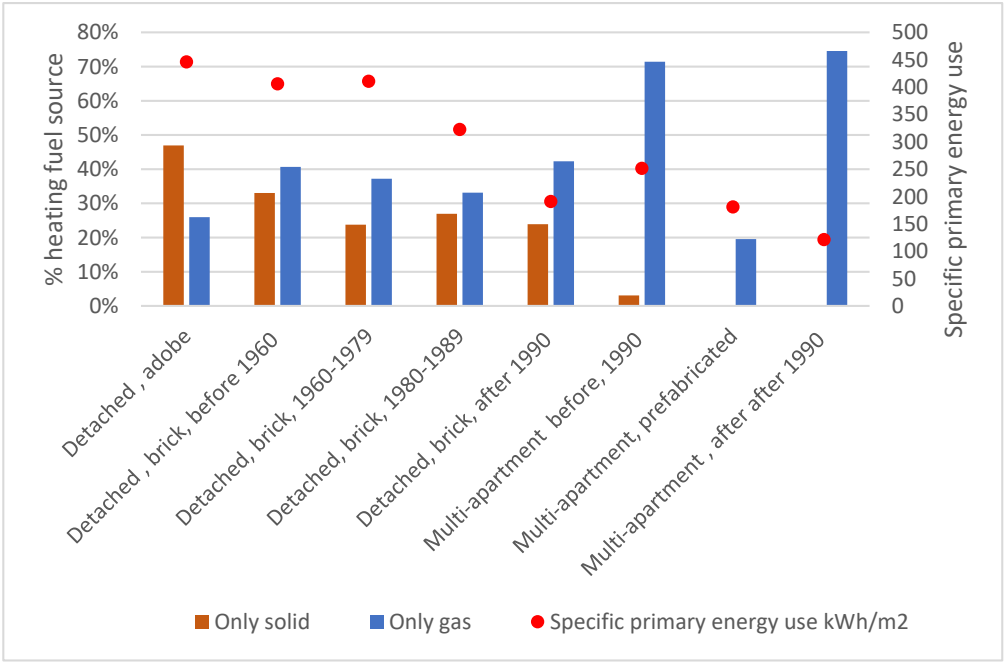

Figure 3. Percentage of solid fuel and gas heating by building type and specific primary energy use (in kWh/m^2/year) of the building types. Own elaboration based on [43,46].

3.1.5. Needs

Another of the six driving factors identified by Bouzarovski and Petrova is household needs, specifically when there is a "mismatch between household energy requirements and available energy services; for social, cultural, economic or health reasons" [38] (p. 11). Modeling the actual energy demand of households to determine the gap between energy need and spending falls outside the scope of this study. Therefore, the qualitative indicator of the ratio of households who could not heat their home adequately was used as a proxy to measure unmet energy (heating) needs. The underlying assumption is that households reporting that they cannot adequately heat their home are likely relying on a source of heat that does not meet their domestic energy services requirements.

As stated in Section 3.1.3, households that exclusively use solid fuels for heating reported difficulties in heating their home 1.92 times more frequently than the average Hungarian household, and 2.5 times more frequently than natural gas users (Table 4). Households that had no heating at home or were in the "other methods" category reported an even higher share of difficulties in heating their home. However, these two categories represent less than 3% of all households.

3.1.6. Practices

Bouzarovski et al. described this driving force of energy vulnerability as a "lack of knowledge about support programs or ways of using energy efficiently in the home" [37] (p. 11). In Hungary, most of the energy-related support programs are either non-accessible for low-income households or are universally distributed [31], which makes the lack of knowledge of support programs less relevant in this sense. Thus, under this label, we therefore analyzed the heating practices of solid fuel households (Figure 4).

The majority of solid fuel users (55.95%) heated their home with room-heating devices (e.g., stoves) and 42.12% used central heating systems. The dataset does not contain more specific data on the type, performance, or age of heaters. Local practitioners suggest that low-income solid fuel users burn fuels in the cheapest stoves available on the market that are highly inefficient and produce significant outdoor (and indoor) air pollution per unit of biomass burned [50–52]. These stoves heat up rapidly; however, they unevenly heat indoor spaces and cool down shortly after the fuel is combusted. Therefore, they

need constant feeding, also during the night. The practice of heating with solid fuels in low-quality heaters is thus associated with inconvenient operation, health risks, and low thermal comfort. Thus, it can be interpreted as a severe vulnerability factor.

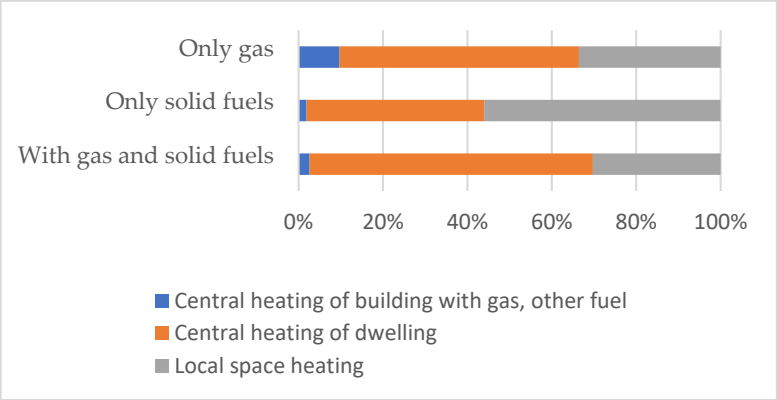

Figure 4. Heating source by type of heating method. Own elaboration based on [46].

3.2. Energy Poverty Alleviation in the NECP

Having analyzed the main driving factors of solid fuel use related energy vulnerabilities in Hungary, this section assesses the potential of the Hungarian National Energy and Climate Plan to alleviate energy poverty among solid fuel users. The EU Governance Regulation on the Energy Union and Climate Action (2018/1999) requires member states to dedicate two sections to energy poverty in their NECP. First, Section 2.4.4 of the NECP requires member states to define "national objectives concerning energy poverty, including a timeframe for when the objectives are to be met" [53] (Sec. Annex I). Second, Section 3.4.4 requires outlining "policies and measures to achieve the objectives set out in point 2.4.4" [53] (Sec. Annex I). For this analysis, we first evaluated to what extent Section 2.4.4 of the Hungarian NECP complies with the requirements of the Governance Regulation (2018/1999). This was followed by the assessment of policies and measures outlined in Section 3.4.4 of the Hungarian NECP.

Section 2.4.4 of the Hungarian NECP declares that the "Hungarian Government is committed to maintaining sustainable overhead (i.e., utility) costs for Hungarian households in the future" [35] (p. 118) in relation to the utility price cuts introduced by the Hungarian government in 2013. However, it neither sets national objectives nor timeframes regarding energy poverty alleviation. Even if no objectives are set, the success of policies outlined in Section 3.4.4 is to be measured through "the share of households spending at least 25% of their income on energy costs (9.8% in 2016)" [39] (p. 70). The document does not declare to what extent this indicator should decrease. As no clear objectives and timeframes are set, Section 2.4.4 of the Hungarian NECP fails to comply with relevant requirements of the Governance Regulation (2018/1999).

Section 3.4.4 of the NECP outlines the following policies and measures regarding energy poverty:

- Preparation of a complex strategy that includes "energy efficiency measures, an increase in the use of decentralized ('household') heating solutions, the penetration of power generation, and the optimization of supply methods";
- "A program to improve conditions for vulnerable customers" with actions "adjusted to the social needs of the groups concerned";
- Taking into consideration vulnerable consumers when planning the energy-efficiency obligation scheme, ensuring that the "planned reform of eligibility for universal service" and the "development of various service packages" do not increase "the energy fees of the most deprived persons";
- Awareness-raising, information, and consulting campaigns "promoting low-cost energy efficiency investments that can be implemented by homeowners themselves,

resulting in substantial savings. The social fuel program, for example, could be linked to the promotion of out-of-the-box floor insulation";

- A "subscription-based electricity connection scheme (prepayment meters) for households living in buildings that are deteriorated or unsuitable for renovation, which ensures the electric heating of at least one room for families with small children" [38] (pp. 118–119).

Table 6 assesses the outlined policies using the criteria of having a defined goal, timeframe, target groups, elaboration of measures, and resources allocated. Points were assigned to each policy through a semi-quantitative approach according: 0 points were given if the policy/measure was not fulfilling any of the criteria, 0.5 points were given if the criteria were partly fulfilled, and 1 point if the policy/measure entirely fulfilled the criteria. A maximum score of five points could be given for one measure.

Table 6. Assessment of policies and measures listed in the Hungarian NECP according to their degree of fulfillment of EU Governance Regulation requirements.

Policy/Measure	Goal	Timeframe	Target Group	Elaboration of Measures	Resources Allocated	Total (Max. 5)
Complex energy strategy	0.5	0	0.5	0	0	1
Program for vulnerable consumers	0	0	0.5	0	0	0.5
Vulnerable consumers and energy saving obligation scheme	0	0	0.5	0	0	0.5
Development of various energy service packages	0.5	0	0.5	0	0	1
Awareness-raising, information and consulting campaigns	0	0	0	0.5	0	0.5
Subscription-based electricity connection scheme for heating	0.5	0	0.5	0.5	0	1.5

As shown in Table 6, all policies and measures outlined in the NECP received low scores (maximum 1.5 out of 5). In the case of three out of six measures, a general goal could have been identified, but none defined specific goals. No timeframe was defined in any case. A general target group (i.e., energy poor households) could be identified for Section 2.4.4. In contrast, none of the policies or measures explicitly identifies their target group. Four policies or measures out of six were so broadly described that zero points were given for the elaboration criterion, while two were somewhat more specific, thus scoring 0.5 points each. No financial or human resources were allocated to any of the policies or measures. Thus, all six scored zero points for this criterion.

3.3. Policy Measures of NECP and Energy Vulnerability Factors

Table 7 assesses the extent to which the policies and measures of the NECP respond to the six energy vulnerability factors outlined in Section 3.1. W assigned 0 points if the measures have no potential impact, 0.5 points if it might have some impact, 1 point if it generally impacts energy poverty, and 2 points if the measure has a specific impact on solid fuel users.

The policies and measures of the Hungarian NECP generally received a low score (around 5 out of 30) when assessed from the perspective of Bouzarovski and Petrova's six energy vulnerability factors. Among those, practices is the vulnerability driving factor potentially most impacted by the policies and measures since this factor refers to a "lack of knowledge about support programs or ways of using energy efficiently in the home" [38] (p. 11) (and a few of the policies and measures specifically aim into this direction. The relatively high score of affordability reflects the price-focused policy orientation of the government [31]. Solid fuel heaters were overall rarely mentioned in the NECP document. Only the awareness-raising camping targeted them specifically, while the subscription-based electricity provision also most probably targets solid fuel heaters, even if not specified

in the documents. Section 3.4.4 refers to Section 3.1.2, which mentions support for "burning biomass in efficient individual heating equipment" with (non-specific) non-refundable funding [39] (p. 78), but this measure is not explicitly linked to energy poverty.

Table 7. Assessment of policies and measures of the Hungarian NECP from an energy poverty (and solid fuel users' vulnerability) perspective.

Policy/Measure	General Assessment [1]	Access	Affordability	Flexibility	Energy Efficiency	Needs	Practices
Complex energy strategy	1	0.5	1	0.5	1	0.5	1
Program for vulnerable consumers	0.5	0	0	0	0	0	0
Vulnerable consumers and energy saving obligation scheme	0.5	2	0.5	0.5	1	1	2
Development of various energy service packages	1	0	1	0	0	1	0
Awareness-raising, information, and consulting campaigns	0.5	0	0.5	0	0.5	0	2
Subscription-based electricity connection scheme for heating	1.5	2	2	0	0	2	2
Total	5/30	4.5/12	5/12	1.5/12	2.5/12	4.5/12	7/12

[1] Total of points from Table 6.

In summary, energy-poverty-related policies and measures in the Hungarian NECP focus on practices (primarily in relation to its knowledge of support programs) and affordability as driving factors of energy vulnerability, with energy efficiency receiving less attention as retrofits are only planned through third parties in the frameworks of the energy saving obligation schemes. No guarantees that the energy efficiency retrofits planned in the NECP will reach energy poor households are set. Furthermore, except for one measure (awareness-raising campaign), solid fuel users are not identified as a specific target group of any energy poverty measures, even if some measures may involve them indirectly.

4. Discussion

The first research question we sought to determine was how solid fuel users in Hungary are exposed to energy vulnerability drivers in comparison with average households or households using natural gas and other energy sources of domestic heat.

By quantitatively exploring Bouzarovski et al.'s six energy vulnerability driving factors for the case of Hungary, it emerged that solid fuel users are more exposed to energy poverty than average households. In 2017, total of 21.5% of households in Hungary heated their home entirely with solid fuels, and 77% of solid fuel users were not connected to natural gas or district heating networks. Issues of accessibility to modern sources of heat impact households' flexibility to transition to forms of energy service provision appropriate to their needs. Bouzarovski et al. [10] shed light on the practice of energy degradation: in Hungary, during the natural gas price hike before 2013, households turned to traditional fuels as a strategy to mitigate the impact of increasing prices on domestic finances. Still, the price of solid fuels (primarily firewood) has been on the rise for decades, while natural gas prices in Hungary have remained stable since the introduction of utility price cuts measures (*rezsicsökkentés*) by the Hungarian government in 2013 (Figure 2). In the current scenario, switching to natural gas might be rational but is not an option for those with no access to the distribution network. Together with the lack of financial and technical capacities, households are often unable to switch (back) to modern energy carriers such as natural gas.

Increasing solid fuel prices also increases vulnerabilities in terms of the affordability of domestic energy: solid fuel users are overrepresented in lower-income groups and show the highest rate of difficulties in paying utility bills on time. Solid fuel users are also

over-represented among households living in the least efficient building type. Inefficient dwellings impact affordability too, as certain homes require higher amounts of energy to be heated. Consequently, the share of solid fuel users that face difficulties in heating their homes was 1.9–2.5 times higher than among the average households and natural gas users. Thus, solid fuel users are also more vulnerable in terms of the inability to meet their energy needs. Finally, we also observed that the majority of households heating with solid fuels used individual heaters such as inefficient metal stoves. Individual solid fuel heaters are often associated with health risks (indoor and outdoor air pollution), inconveniences (collecting, chopping wood, and refilling the stove during the night), and low and uneven levels of thermal comfort. These findings suggest that households relying on solid fuels as a source of indoor heat are affected by multiple and interconnected energy vulnerabilities. Yet, recent energy and social policy measures have not provided substantial support for them [31], as we argue below.

In the second part of this study, we aimed to assess to what extent the energy-poverty-related sections of the Hungarian NECP respond to the identified vulnerabilities of the country's domestic solid fuel users. The assessment showed that the Hungarian NECP fails to comply with the requirements established by the EU Governance Regulation [53] since neither objectives nor time frames are defined specifically regarding energy poverty. Furthermore, the listed policies and measures aiming to tackle energy poverty in the NECP are short and unspecific. Most energy poverty measures and policies presented in the NECP are too generic to understand their actual content. Objectives, targets, and resources are hardly allocated to the measures, which jeopardizes effective policy design and does not guarantee implementation. The analysis of measures from an energy vulnerability point of view highlighted that the measures fail to tackle the root causes of energy poverty and, if anything, offer symptomatic treatments. Despite the consensus that energy efficiency retrofits are necessary for reaching decarbonization targets and are highly effective tools to tackle energy poverty, they are neither part of energy poverty alleviation measures of the NECP nor are they mentioned in the document. Even the summary of the NECP fails to mention residential energy efficiency retrofits among key decarbonization measures [39]. At the same time, the energy poverty alleviation measure described in the most detail is an awareness-raising campaign for households. While such measures should only accompany retrofits, alone, they are unlikely to provide a solution for energy poverty. Solid fuel users are only targeted specifically by small-scale energy efficiency measures to be carried in the frame of the awareness-raising campaign. Overall, with such weakly and briefly outlined policy measures, the NECP fails to address energy poverty in general, with only one measure specifically related to solid fuel heating, in line with the general poverty policy directions in Hungary at present.

The assessment of the Hungarian NECP, however, raises questions about the need to consider energy poverty alleviation through the lens of the three tenets of energy justice: recognition, distribution, and procedures [54,55].

First, the NECP fails to recognize the specific needs and characteristics of energy-poor households, especially those relying on solid fuel heating. Specifically, it fails to acknowledge the fact that these are mostly low-income households inhabiting some of a worse-performing building stock (pre-1990 single-family houses) in dire need of energy efficiency retrofits

Energy poverty can be also considered as a case of distributional injustice [56]. The current framework of the Hungarian energy transition raises further concerns with regard to the role of energy efficiency. As stated above, the energy efficiency retrofits of residential buildings are not part of energy-poverty-related measures in the NECP. Retrofits are left to market participants (energy providers) under the energy saving obligation scheme so that non-refundable EU and national funds become unnecessary [38] (Section 3.2). Still, without non-refundable funds, at least 30% of Hungarian households would not be able to renovate their homes as they lack any savings to invest [57]. Vulnerable households, who would be most in need of those retrofits, have no guarantee to access and benefit from

retrofit schemes at all, as either support for energy efficiency or general home renovations systematically excludes them [20,32].

Finally, the procedural justice aspects of the NECP are also weak due to the lack of stakeholder involvement in their production [58]. Stakeholder engagement in developing primary laws in Hungary is the lowest among EU member states [59]; civil society has been facing severe legislative restrictions and stigmatization in political discourses [60–64]. Consultation on energy and climate strategies seemingly serves only for box-thinking purposes [64], with evidence suggesting that residential energy efficiency retrofits were dropped after being initially considered in the National Energy Strategy 2030 [65].

It remains unclear why the current Hungarian climate and energy framework does not consider accessible, large-scale, non-refundable support for residential energy efficiency retrofits. During the previous programming period (2014–2020), the government suddenly stopped the use of EU funds from operative programs to provide non-refundable support for residential energy efficiency retrofits. Instead, funds were reallocated to public building retrofits and to a loan program targeting middle-and higher-income households [66,67]. Neither current plans for the next programming period (2021–2027) [68] nor for the use of the COVID-19 Recovery Fund foresee any non-refundable support for energy efficiency retrofits [69,70]. According to a recent survey, many Hungarian households are willing to renovate their homes, but only partial measures will be carried out without public subsidies [71]. Thus, there is a risk that most of the energy saving potential of the Hungarian residential sector will be locked in by suboptimal interventions. This is despite the fact that more than two-thirds of Hungarian residential dwellings do not meet modern efficiency requirements [43] and that the poorest 30% of the population have no financial means to undertake any kind of renovation [57]. Still, there is no sign of high demand for retrofit programs from citizens. This is probably partly because post-2013 utility price cuts effectively and swiftly stabilized the energy costs of households using natural gas, electricity, and district heating. This measure dominated public and political discourses from media to billboards throughout the years by leveraging a "battle against utility costs" narrative with open electoral purposes. Even though utility price cut measures do not provide long-term solutions for energy vulnerabilities [10], they are still probably able to prevent possible discontent regarding the lack of structural support for domestic energy efficiency.

Introducing energy-poverty-related objectives and policy measures in NECPs is a new requirement from the European Union and represents an important symbolic step toward a just energy transition. However, much depends on how well objectives and measures are designed and how far their implementation can effectively reach the energy-poor. This depends on the capability of the member states and the EU to guarantee that adequate policies are designed and implemented. Currently, neither energy-poverty-related objectives and measures nor energy efficiency of residential buildings has binding targets in the relevant EU legislation [70–72]. However, unlike previous EU energy- and climate-related policy making, member states now need to report on their progress in the key policy areas of the NECPs every second year. This must include progress reports on energy poverty and energy efficiency (but not specifically on the number of units that underwent major retrofit). In case gaps are identified by the European Commission, recommendations are issued to member states [73,74]. As part of this review process, the European Commission, in its review of the draft NECP of Hungary, raised a key compliance issue related to the energy poverty section, indicating that further development of the approach to addressing energy poverty issues and a dedicated assessment of energy poverty were needed [75]. The assessment of the final NECP highlighted that the recommendations on the draft NECP were only partially considered and that measurable targets and details regarding energy poverty policies and measures were still lacking [76]. This assessment of the Hungarian NECP also suggests to take the opportunity of the renovation wave initiative of the European Green Deal to tackle energy poverty by improving the energy performance of the existing building stock through specific measures [76]. Nevertheless, as discussed above, Hungary

does not seem to be keen on implementing large-scale energy efficiency renovations in the residential sector, nor on offering any targeted support to low-income households or to the worse-performing segment of the building stock.

When monitoring the enforcement of objectives and energy poverty targets and residential energy efficiency measures, the Commission only has soft law tools available to drive progress at the national level [37]. This governance approach may not be sufficient to fully exploit the energy poverty alleviation potential of the EU energy transition instruments in the case of member states with a low motivation to implement energy poverty alleviation and building retrofits.

5. Conclusions and Outlook

This research demonstrated the multiple drivers of the vulnerabilities affecting households heating with solid fuels in Hungary. The analysis of the energy-poverty-related section of the Hungarian NECP showed that it fails to address the multiple vulnerabilities affecting energy-poor households, especially for those who rely on solid fuels. The weakness of the energy-poverty-related sections of the NECP raises concerns in terms of the justice of recognition, distribution, and procedures. Thus, a main conclusion of this assessment is that the Hungarian NECP, in its current state, is unlikely to deliver a just energy transition through energy poverty alleviation.

As energy poverty alleviation has not been a policy priority in Hungary in the last decade, the requirement of the EU to include energy poverty alleviation related sections in the NECP has been a promising development. However, as stressed above, the energy-poverty-related sections of the Hungarian NECP fail to recognize the multiple vulnerabilities of solid fuel users identified in this article. Additionally, further significant concerns were raised regarding the sections of NECP, as it does not comply with the basic requirements of the related EU legislation (EU Governance Regulation 2018/1999). Most importantly, the NECP does not guarantee that the situation of vulnerable households will ameliorate significantly with the policies and measures defined in the relevant sections. The briefly outlined and often extremely generic measures raise serious concerns regarding their effective implementation. Furthermore, energy efficiency retrofits, a key policy instrument of energy poverty alleviation, are not part of the energy poverty measures and are not specified as a critical element of decarbonization policies. Therefore, in its current state, the Hungarian NECP misses an opportunity to use EU energy transition policies to tackle energy poverty with a just transition approach.

To realize its energy poverty alleviation potential, the Hungarian NECP should better identify households impacted by energy poverty, considering fuel typology and heating methods. Section 2.4.4 of the NECP on national objectives and timeframes regarding energy poverty should thus include a precise identification of potential target groups and energy poverty alleviation goals and timeframes to be specified. At the same time, Section 3.4.4 of the NECP on energy poverty alleviation measures should provide a comprehensive framework of specific, elaborated policy measures that tackle the root causes of energy poverty (i.e., energy efficiency of buildings and appliances, price of energy carriers, and incomes). Energy efficiency retrofits and upgrades of outdated heating devices such as inefficient stoves must be supported and prioritized among low-income households. This measure is essential to reduce the energy vulnerabilities of solid fuel users and guarantee cleaner air for all citizens. We suggest this policy element to be replaced by the upgrade or substitution of inefficient solid fuel heaters within the framework of more comprehensive energy efficiency retrofits. As the NECPs are reviewed biannually, the Hungarian Ministry of Innovation and Technology responsible for this document should ensure that the updated version of the NECP fully recognizes energy-vulnerable groups, including solid fuels users. It should guarantee that proportional funding and support will be provided for energy-poor households to overcome their vulnerabilities and secure an inclusive policymaking process in which stakeholders are involved, and their inputs are considered. As the European Commission is responsible for the biannual assessment of the NECPs, they should also

guarantee that energy-poverty-related sections provided by member states not only serve a box-ticking purpose of formal compliance with their requirements but are quality policy pieces instead. While assessing the NECPs, the European Commission should also consider Hungary's larger energy policy framework to identify critical deficiencies, such as the lack of large-scale and inclusive energy efficiency retrofit programs. Finally, a shift away from current general Hungarian antipoor policy orientations is necessary also from an energy poverty alleviation perspective. Instead of supporting the wealthy and penalizing the poor [18], policies should pursue equity on all fronts. It is of great importance that they support large-scale and inclusive residential energy-efficient retrofits with housing subsidies made accessible to low-income and vulnerable households.

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