**Book title: Energy Poverty Alleviations: New Approaches and Contexts**

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First Online: 01 January 2022.

DOI: https://doi.org/10.1007/978-3-030-91084-6_8.

Publisher: Springer, Cham.

Print ISBN: 978-3-030-91083-9

Online ISBN: 978-3-030-91084-6

**Energy poverty in Finland: Reality and challenges in the face of climate change**

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**Keywords:** summer energy poverty, energy efficiency, social policy, housing policy, district heating, district cooling

**Abstract**

Energy poverty is a multidimensional issue, with root causes that vary from country to country, and therefore requires each country to develop its own strategies and policies. In Finland, the incidence of wintertime energy poverty is relatively low according to European indicators, and hence largely unrecognized as a social issue. These current low levels of energy poverty are largely due to generally energy efficient housing, extensive district heating infrastructure, and social security measures to support citizens' well-being; however, energy poverty still exists within the most vulnerable groups. In addition, there is growing evidence of increasing levels of summertime occupant discomfort from high indoor temperatures due to a warming climate and housing stock that is designed for a cool rather than a hot climate. In the absence of passive cooling measures, this might lead to higher energy demands for active cooling in homes, and the subsequent risk of energy poverty in households unable to both install cooling measures and/or afford the related increases in cooling expenses. This chapter brings to the foreground overlooked issues in winter and summer energy poverty in Finland, providing a brief overview of the situation, and describing the measures employed to reduce winter energy poverty to current low levels. The potential building cooling energy increase in a warming climate, and the lack of research data to properly understand this phenomenon in Finland, is then discussed. Context-specific considerations are made with regards to the need for inclusion of Nordic-region specific energy poverty approaches. Finally, this chapter provides a starting point for the reflection on what strategies should be implemented to effectively mitigate energy poverty now and in the future.

## 1. Introduction

Energy poverty is defined as the difficulty or inability to maintain an appropriate temperature in living spaces due to the poor energy efficiency of the dwelling and/or a lack of monetary resources to pay for the energy costs (Castaño-Rosa et al. 2019a). Energy Vulnerable households are those that are unable to secure a materially and socially needed level of energy service in the home (Bouzarovski, Stefan, Petrova, Saska and Tirado-Herrero 2014), putting them at risk of energy poverty.

The European Commission does not support a common energy poverty definition for all EU member states due to socio-economic disparities across EU countries (Thomson et al. 2016) and because energy poverty is a complex issue that cannot be uniformly assessed by using standardized indicators but instead requires different criteria for each country. Energy poverty rates vary drastically among European countries. For example, in 2018, 33.7% of Bulgarian households, 27.9% of Lithuanian households, and 22.7% of Greek households were unable to keep their homes adequately warm (European Commission 2018a). In the cold climate of Finland, energy poverty rates were comparatively very low, with only 1.7% of households considered to be in energy poverty, though others estimated this to be 3% (Oja et al. 2013).

To tackle energy poverty across the EU, the EU Energy Poverty Observatory, recommends assessing energy poverty using four primary indicators (European Commission 2018a):

1. An inability to keep a home adequately warm;
2. Arrears on utility bills;
3. Low absolute energy expenditure (below half the national median household energy expenditure);
4. The share of energy expenditure in household income is more than twice the national median share.

These primary indicators are supplemented by twenty-four secondary indicators. Therefore, energy poverty rates can vary in each country depending on which indicator is used, leading to inaccurate estimates or difficulty comparing energy poverty vulnerability between populations, especially when these indicators are used in isolation (Castaño-Rosa et al. 2019a). The issue is further complicated by the fact that energy poverty in Europe has traditionally been considered as a problem unique to countries with severe winters and low-income households living in poor quality buildings.

The Nordic welfare state perceives energy poverty as a social issue which the state should take care of and, consequently, to provide alleviation measures via social benefits. In Finland, wintertime energy poverty mainly affects low-income households living in sparsely populated rural areas, and living in oil and electrically heated detached houses (Castaño-Rosa, R. et al. 2020a). Older people, whose income - by means of pensions - do not rise in proportion to housing expenditure, are considered to be the most vulnerable. To combat energy poverty, the Finnish state offers various social-security schemes for vulnerable people: general housing allowance; pension security; housing renovation grant for older and disabled people; social credit; and a state guarantee fund (Gullman 2019). The comprehensive social benefits are one of the main causes for relatively low levels of wintertime energy poverty when using different indicators (Oja et al. 2013)). If people suffering from energy poverty are not aware of the available support systems, or are unidentified by the comprehensive social security system, they remain under the radar, making the extent of energy poverty a difficult-to-identify problem in Finland.

Complicating the issue is the fact that Finnish buildings have traditionally been designed for cold winters, reducing the energy poverty risk to its population. However, the health and well-being impact of increasing summer temperatures due to climate change has led to summertime energy poverty being considered in other European countries, for example Spain and the UK (Sanchez-Guevara et al. 2019). Current measures and policies to address energy poverty across Europe fail to take into consideration the increasing prevalence of summertime heat and, consequently do not properly assess energy poverty in its totality (Castaño-Rosa et al. 2020b). The lack of reliable and accurate energy poverty measures has led to the future energy poverty risks being underestimated as a social problem across the EU, and in Finland in particular.

This chapter provides a brief overview of the energy poverty situation in Finland, describing the mechanisms by which energy poverty has been reduced to the current low levels, and then by reviewing existing studies with special attention on the potential increased need for cooling energy due to the changing climate, and the existing research gaps. Results from the literature review are then discussed according to three different aspects, namely:

1. Who are the energy poverty vulnerable households in Finland, and what are the limitations of current policies to address energy poverty?
2. What is the role of energy-efficiency interventions as a long-term solution to prevent energy poverty in Finland? And
3. What is the current and potential future state of summertime energy poverty in Finland, and how might winter energy poverty policies in Finland be adapted to also address summertime energy poverty?

## 2. Wintertime energy poverty in Finland

The levels of energy poverty vary drastically among European countries; even within the same country different energy poverty estimates are obtained depending on the indicators used. In this section, the current state of wintertime energy poverty in Finland is analyzed, followed by a review of the existing policies which have helped mitigate the issue. Finally, the vulnerability risk to be in energy poverty and the limitations of current policies are presented.

According to the EU Energy Poverty Observatory, in Finland, 1.7% of the population were unable to keep their home adequately warm, and 7.7% had arrears on utility bills (such as heating, electricity, gas, water) in 2018 - all of which are primary indicators for energy poverty (European Commission 2018a). These rates are similar to Sweden (2.2% arrears in utility bills; 2.3% unable to keep their home adequately warm), but are comparably low to elsewhere in the EU, such as Bulgaria and Greece where 33.7% and 22.7% of population were unable to keep their home adequately warm respectively, and 30.1% and 35.6% had arrears on utility bills.

Finland does not have national policies specific to energy poverty mitigation, but rather addresses energy poverty as part of its general social policies - ensuring that all citizens have the right to basic needs - as well as an energy efficient housing stock and extensive district heating infrastructure in urban areas. In this respect, the social and economic causes of energy poverty in Finland are mainly addressed through various financial-support mechanisms, such as social loans, sickness insurance, or transfers for the poorest households (see section 3 below).

In 2013 and 2015, the Finnish Ministry of the Environment investigated energy poverty in Finland through two large surveys, determining that a small proportion of households are energy poor (Oja et al. 2013; Runsten et al. 2015). The first report on energy poverty (Oja et al. 2013) aimed to analyse and assess energy poverty in Finland, broadly defining energy poverty as the difficulty of a household to afford basic energy needs, including maintaining adequate temperatures in the home; the difficulty to pay for energy-related services, such as domestic hot water and electricity; and the cost of transporting fuel, for example delivery of oil to households in sparsely populated areas. It concluded that energy poverty affects around 3% of households in Finland (Oja et al. 2013). Those affected are typically households suffering from general poverty, and most commonly in large energy-inefficient dwellings in rural areas (Oja et al. 2013).

The second report on energy poverty focused on the energy poverty risk related to housing heating system renovations and energy costs (Runsten et al. 2015), and investigated the link between dwelling retrofit to heating systems and the risk of suffering energy poverty in single-family households living with low incomes. The study estimated that around 60,000 – 100,000 households with low- and middle-incomes were at risk of suffering energy poverty in Finland, particularly those living in energy-inefficient houses built before 1980 with oil-heated systems. As with Oja et al (2013), the study found that the incidence of energy poverty is relatively low in Finland, but that there is a need for further data to effectively identify the most vulnerable groups to energy poverty. They also presented recommendation measures to reduce energy poverty based on developing forms of funding to enable low-income households to renew their heating systems and improve the energy efficiency of their dwellings.

Finally, the ASSIST2GETHER project focused on reducing energy poverty and supporting vulnerable consumers (ASSIST2GETHER 2018). The aim of the three-year project was to reduce energy poverty by removing barriers to vulnerable consumers in the energy market and supporting them in improving the energy efficiency of their homes. This included assisting them to change their behaviours to more effectively meet their energy needs and, consequently reduce the energy bills. A household survey, conducted in 2018 as part of the ASSIST2GETHER project, aimed to assess the prevalence of energy poverty among vulnerable consumers by asking whether they knew about the free energy advice services available for those people who wanted to know more about their energy use. As in the previous energy poverty studies carried out by the Ministry of the Environment, they focused on low-income households living outside urban areas and households living in large single-family houses. The target group was reached in cooperation with the Association of Detached Homes and the Confederation of Elderly Work. Therefore, the results did not represent all Finns comprehensively, but rather helped to identify the specific characteristics within the most vulnerable groups and to collect information on their energy needs. Results showed that 35.4% of the respondents were aware of the free energy advice service and knew where they could find it if needed; 43.2% had heard of the service, but they did not know where to get it; 21.4% had never heard of the free energy advice service; and only 8.5% of respondents had received financial support to improve the energy efficiency of their dwelling. Therefore, over a fifth of the respondents (21.4%) were not aware of the possibility to apply for financial support (ASSIST2GETHER 2018), meaning that although Finland has a strong social security model to ensure citizens' livelihood and well-being, the most vulnerable people may not be aware of the support, and therefore may not be registered in the energy poverty statistics.

A number of different housing and occupant characteristics can influence energy vulnerability in Finland. Here, we examine these characteristics across the Finnish housing stock and population in order to get a better understanding of the energy poverty vulnerable households in order to understand what the situation of energy poverty is in Finland, and what the main barriers to prevent it are.

## 2.1. Housing typology and tenure status

In Finland, the most common typology of dwelling as of 2019 are apartment blocks (46.9%), followed by detached houses and row houses (37.9% and 13.5%, respectively) (Official Statistics of Finland (OSF) 2019a) (Table 1). Around 56% of dwellings are owner-occupied and 32.8% rented, while 10% have other forms of tenure. Furthermore, 16.5% of people are considered to live in overcrowded dwellings (Official Statistics Finland, 2019b); overcrowding is defined as the available rooms being under the necessary number of rooms in the dwelling[1].

**Table 1.** Percentage of dwellings according to typology, tenure and occupancy (Official Statistics of Finland (OSF) 2019a).

| **Typology of dwelling** | | | **Tenure status** | | | **Overcrowded dwellings** |
|---|---|---|---|---|---|---|
| **Detached** | **Attached** | **Flat block** | **Owner** | **Rented** | **Others** | |
| 37.9% | 13.5% | 46.9% | 55.6% | 32.8% | 10.0% | 16.5% |

When identifying vulnerable groups with a higher risk of suffering energy poverty, according to (Gullman 2019), energy poverty levels are higher among those households who live in detached dwellings (Table 1), as they often are reliant on old oil- and electric-heating systems, which are less affordable to maintain and less energy efficient than district heating. For example, households connected to district heating in urban areas do not have to assume the maintenance costs of their own heating system.

## 2.2. Fuel typology and energy consumption in housing

[1] Statistics Finland (Accessed 15/06/2021) https://www.stat.fi/meta/kas/ahda_asu_en.html.

In Finland, households' energy consumption is mainly for space heating and domestic hot water heating, followed by 'other electrical equipment' (see Figure 1) (Official Statistics of Finland (OSF) 2019c). Including household appliances, electricity, with 35%, is the most used energy source in the energy consumption of households (see Figure 2), followed by district heating and wood with 28% and 22%, with wood likely to constitute the primary fuel in cottages, which are secondary summertime residences for many Finns. Households that use electricity and oil for space heating have a higher risk of suffering energy poverty, while the use of district heating reduces such risk and households are not responsible for the costs associated with system maintenance and repairs (Ministry of the Environment 2015). However, recent increases in district heating prices could have a negative impact for households that cannot use another heating system or make their homes more energy-efficient, and, consequently, pay more for heating.

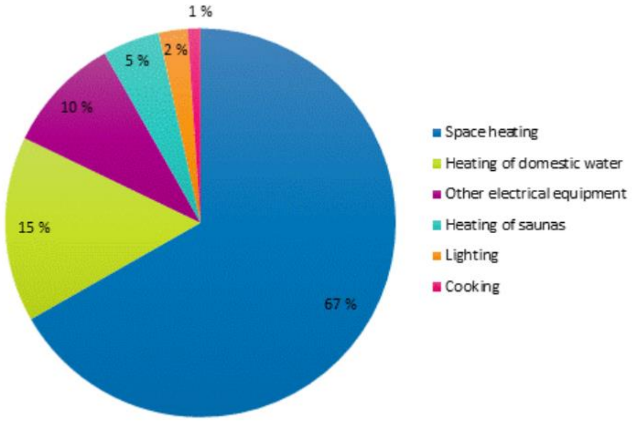


**Figure 1.** Households' energy consumption by use in 2019 for all energy sources (Official Statistics of Finland (OSF) 2019c).

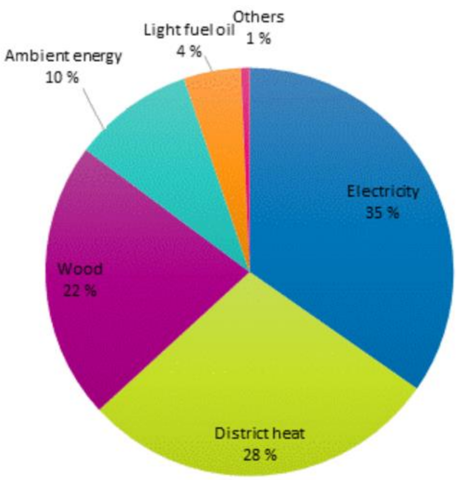


**Figure 2.** Households' energy consumption by energy source in 2019 (Official Statistics of Finland (OSF) 2019c). Note: the group 'others' is composed of natural and liquid gas (0.6%), peat (0.07%), heavy fuel oil (0.02%), and coal (0.002%).

### 2.3. Monetary poverty and housing costs

The European Union defines poverty not only at income thresholds, but also according to the At Risk of Poverty or Social Exclusion (AROPE) indicator. According to the AROPE indicator, the risk of poverty or social exclusion is calculated through three factors: low income, severe material deprivation, and underemployment in the household. Persons or households are defined as at risk if one of the three criteria are met (European Commission 2018b).

Poverty and inequality are multidimensional phenomena that are not easy to understand for society overall, as the systemic drivers behind them are diverse and often overlapping. In this respect, individual and collective action are needed to address social inequalities and contextualise ‘good’ and ‘poor’ inclusion (Tuomenvirta et al. 2018). Unemployment rates and low-income levels are also good indicators of inequality and quality of life (Tuomi and Sarajärvi 2017). For instance, unemployed people have a higher risk of suffering health illnesses, such as depression or stress, with a higher incidence in children in unemployed households (Mohan 2021). Furthermore, people living with low income have a higher risk of social exclusion, mainly due to the lack of monetary resources to undertake day-to-day activities (Burlinson et al. 2018). Finally, an increase in depression, loneliness and hunger, as well as poor health and impaired satisfaction with life is observed among people living in poverty (Jessel et al. 2019), alongside food expenditure reduction, affecting their quality of diet and caloric intake (Anderson and White 2019).

In 2018, there were an estimated 640,000 low income individuals, or 11.8% of the Finnish population (Official Statistics of Finland (OSF) 2019d), who received benefits from any of the social security schemes available. This means that while they are not in absolute poverty, they experience relative poverty because they can’t achieve a certain expected social status (Eskelinen 2011). In Finland, the lack of information and awareness about the social welfare benefits among the most vulnerable groups regarding what kind of financial support they can apply for and how to access them, is a likely cause of household energy poverty.

Housing expenditure also plays an important role in energy poverty vulnerability affecting the household’s net income, which helps the household cover its basic needs. In this respect, Finnish households have the highest levels of housing expenditure in the EU, including costs for housing, water, electricity, gas, and other fuels. In 2019 more than half of the average household budget (52.3% of the total budget of the household) was spent on housing related expenditure (Eurostat 2019). However, the proportion of the household's net disposable income for housing expenditure varies depending on the household’s characteristics. For instance, housing expenditure takes around 20% of the income of a family with children living in an apartment building, while a retired person living alone in a detached house might spend up to 40% of their monthly income on housing costs. Housing expenditure is expected to increase up to 1.1% every year (Pellervo Economic Research 2019), however, this compares to an estimated annual growth in earning-related pensions of only 0.6%, which may lead to increased energy vulnerability among pensioner households in the near future. While housing expenditures of pensioner households living in an oil-heated detached house may exceed 20% of its net disposable income; this percentage is even higher (up to 24% of the net disposable income) for households with underage children living in oil-heated houses, and up to 22% for those households living in electricity-heated houses (Pellervo Economic Research 2019).

In terms of the risk of poverty and social exclusion, the share of people at risk of poverty or social exclusion fell by 1.5% in 2018 (Official Statistics of Finland (OSF) 2019d). Being at risk of poverty and social exclusion means that a household is living either in a low-income household, with low-work intensity, or experiencing severe material deprivation. The risk of poverty or social exclusion was higher among women than men: 16.1% of women were at risk of poverty or social exclusion in 2018, while 15.4% were men (Official Statistics of Finland (OSF) 2019d), highlighting some potential gender differences in being at risk of poverty or social exclusion, primarily due to the income-level differences. Finally, 4.5% of the population lived solely on basic income benefits in 2018, increasing by almost 49,000 individuals from 2010 (Grekula et al. 2020). In terms of energy poverty mitigation, long-term solutions are needed to effectively eradicate energy poverty among those households more vulnerable to energy poverty.

## 3. Policies that have helped mitigate energy poverty in Finland

In Finland, the social welfare system, as well as housing and energy policy has helped to contribute to the relatively low levels of energy poverty. In this section, we review these policies, as well as describe their limitations in addressing current issues of wintertime fuel poverty in Finland.

### 3.1. Social welfare

In Finland, social security consists of various services and benefits that safeguard livelihoods and well-being, and aims to ensure adequate livelihoods for Finnish citizens and permanent residents. Finnish social security is not linked to citizenship, but is eligible to all residents including asylum seekers, which in some countries are among the most economically vulnerable groups to energy poverty due to the embedded social inequalities (Leng 2017). Social security is financed by taxes and insurance contributions legislated by the Ministry of Social Affairs and Health, and is implemented by several organizations such as Kela (the social Insurance Institution in Finland), municipalities, unemployment funds, pension companies, and other insurance providers. In this section, the main services and benefits related to energy poverty alleviation are presented.

#### *3.1.1.* General housing allowance

Housing and social assistance to help cover housing costs, including heating, is provided to eligible households by the Social Insurance Institution (Kela - Kansaneläkelaitos), a government agency that provides basic economic security for everyone living in Finland. The General Housing Allowance Act defines the maximum housing costs that can be granted in each payment according to the household characteristics including, for instance, the number of children and adults, and the location of the dwelling (Ministry of Social Affairs and Health 2014). Housing allowance is granted for permanent rental, owner-occupied, right-of-occupancy and co-ownership dwellings located in Finland. The main housing support granted are general housing allowance, pensioner's housing allowance, study allowance (only for students in special circumstances) and military allowance (only during military services). Property tax, rent of plots, loan security insurance or similar contributions are not accepted as housing expenses (Ministry of Social Affairs and Health 2014). Furthermore, the general housing allowance is available for all household typologies. Kela also provides energy companies with an electricity security deposit to help the most vulnerable pay for their energy costs.

#### *3.1.2.* Pension security

Pension security is composed of several allowances, depending on household characteristics. Table 2 below provides a summary of the different allowances for pensioners. The criteria of each allowance are defined by the Pension Housing Allowance Act (Ministry of Social Affairs and Health 2007).

**Table 2.** Available pension security allowances. Adapted from the Ministry of Social Affairs and Health (2007).

| Allowance | Definition |
|---|---|
| Employment pension | Granted to a person who has accrued an earnings-related pension in an employment relationship or as an entrepreneur. The amount of the earnings-related pension is determined by merit and there is no pension ceiling. |
| Retirement pension | Supports those people who do not receive an employment pension or whose earnings-related pension remains small. This depends on other benefits, the time lived in Finland, and household characteristics. |
| Guarantee pension | Provides Finnish residents a minimum pension of 837.59€ per month if the total amount before taxes is less than the minimum threshold set. The general requirement to receive this pension is that the applicant has lived in Finland for at least three years after the age of 16. |
| Disability pension | Provides security to individuals that are unable to work due to illness or injury. |
| Survivors' pension | Provides financial support to someone who either has lost their spouse/partner, or cares for under 18-year old children or an under 21-year old student who has lost their guardian. |

#### *3.1.3.* Housing renovation grant for the elderly and disabled people

The Housing Finance and Development Centre of Finland (ARA) provides subsidies for renovating dwellings that are in permanent residential use, and where at least one of the residents is over 65 years old or disabled (The Housing Finance and Development Centre of Finland (ARA) 2019). This subsidy is granted to an individual, however, the income and material wealth of all household members are taken into account; the income must not exceed the limits set out and the material wealth of the household must not be to such an extent that it could finance the renovation without a subsidy. Since the beginning of 2017, the subsidy does not cover the entire cost of the renovation, with the maximum amount of the renovation subsidy 50% of the approved renovation costs. Exceptionally, the amount of the grant may be up to 70% if the applicant is a veteran who has served in the front line or widowed due to war; is elderly or disabled; if they need to move out of the house because either the house or apartment does not meet the minimum accessibility requirements (i.e., physical barriers for mobility); or the social welfare and health care services that the person needs cannot be provided in such conditions. Additionally, since 2020, ARA has awarded grants for housing companies to improve the energy efficiency of apartment blocks (the applicant must always be a housing company). This grant covers up to 50% of the renovation project, or up to 4000-6000€ per apartment (The Housing Finance and Development Centre of Finland (ARA) 2021), and is able to assist the most vulnerable to improve their ability to heat their homes (i.e., heating system renovations, renewal of ventilation systems with heat recovery, or increasing additional thermal insulation levels for the upper sole, etc.).

#### *3.1.4.* Social credit

The purpose of social credit, which is regulated by law (Ministry of Social Affairs and Health 2003), is to prevent economic exclusion and over-indebtedness, as well as promoting the independence of people. Any person or family living or staying in Finland whose income is insufficient for essential day-to-day expenses can receive this benefit. The Ministry of Social Affairs and Health is responsible for the development and preparation of social credit legislation, and municipalities can decide for themselves whether and to what extent social credit is organized (Ministry of Social Affairs and Health). Social credit is provided to cover approximately 20% of the Finnish population, and is intended for low-income individuals who are considered to have sufficient solvency as defined by their municipality, but do not have the opportunity to obtain a reasonable loan. The main aim of social credit is to support the most vulnerable people with unexpected financial problems, for example rebalancing household finances, breaking the debt spiral, home purchases, rehabilitation, employment promotion, housing security and to solve situations of monetary crisis. Though social credit may vary from €200 to €10,000, most municipalities have set a credit ceiling of €5,000 with a maximum loan period of 5 years, and a favourable interest rate. In 2019, a total of €3.6 million in social loans was granted, and almost half of the amount was granted in Helsinki. Furthermore, two out of three recipients are wage earners (Department of Health and Welfare (THL) 2019).

#### *3.1.5.* State Guarantee Fund

The State of Finland owns Finnvera plc, which is a specialized financing company that helps people in a debt spiral and economically vulnerable situations (Ministry of Economic Affairs and Employment of Finland, Finnvera domestic financing). The State Guarantee Fund aims to ensure that Finnvera plc can provide credits and guarantee domestic activities (Ministry of Economic Affairs and Employment of Finland, State Guarantee Fund). It provides its clients with free advice on debt and financial matters, guarantees arrangement loans from banks and small loans, and aims to break the indebtedness spiral by and helping the customers to get their finances under control. The main customer typology is occupants of rented dwellings, with only a few individual applicants living in owner-occupied dwellings. The most common uses of small loans are the purchase of furniture and household appliances, the payment of a guarantee rent, removal costs and repairing cars.

#### *3.1.6.* Limitations of Social Welfare Approaches

Social benefits have been a primary means of reducing energy poverty in Finland aiming to help households afford minimum indoor temperatures and electricity supply, and may be seen as good practices to mitigate energy poverty and which other countries can learn from. However, due to the complexity of addressing energy poverty, and the multitude of factors which can result in energy poverty, low levels continue to persist among the most vulnerable - particularly those that are unaware of their eligibility for different benefits. Moreover, social policies are an ongoing expenditure, enabling low income households to help keep their homes warm, but may not address key underlying issues such as energy inefficient homes or inefficient heating systems.

### 3.2. Housing Energy Efficiency

The energy efficiency of a dwelling influences energy poverty the risk, with inefficient dwellings suffering from greater conductive heat loss through poorly insulated building fabric components and uncontrolled infiltration, while inefficient heating systems require greater amounts of energy to produce a given heat output. This has the effect of making dwellings ‘hard to heat’, where households in inefficient homes need to consume a greater amount of energy to maintain adequate indoor temperatures during the winter. Dwelling quality influences the risk to energy poverty vulnerability and is usually analysed through the complex relationship between the energy required by a household to meet their basic needs and the actual energy a household uses; the larger the gap between both values, the higher the risk of suffering energy poverty (Castaño-Rosa et al. 2018; Gouveia at al 2019).

Finland has one of the most energy efficient housing stocks in the EU in terms of space heating, due to housing policies and the age of the housing stock. Firstly, the Finnish housing stock is relatively young compared to the rest of Europe, with 75% of dwelling constructed after 1970 (Statistics Finland 2018). This coincided with the introduction of the first national building regulations for energy efficiency in building in 1976. The energy-efficiency requirements for new buildings became stricter in the 1980s, with most buildings required to achieve what is now classified as energy class D or above. The next major change took place in 2010, requiring new buildings to achieve energy class C or above (Ministry of Environment 2017). As of 2020, all new buildings are required to be nearly Zero Energy Buildings (nZEB). Older buildings undergoing renovation may also be required to meet energy efficiency requirements depending on the extent of the renovation.

Therefore, while energy requirements for heating remain high due to the cold winter climate, the high levels of energy efficiency help mitigate the consumption and subsequent costs for occupants. The relatively high energy-efficiency building stock is one of the reasons for low reported levels of winter energy poverty in Finland.

#### *3.2.1.* Limitations of increased energy efficiency

The increase in housing energy efficiency can have a number of unintended consequences (Shrubsole et al. 2014), including an increased risk of summertime overheating, reduced indoor air quality, and risks for moisture in buildings. Finland has historically faced significant health and economic burdens due to poor indoor air quality and damp in buildings (Lampi et al. 2020), and care needs to be taken during the construction and retrofit of buildings to a zero-energy standard does not aggravate moisture problems in buildings. While well-insulated buildings keep the heat in for longer in winter, in the absence of shading and other passive measures, there is a risk that heat gains from solar radiation are also retained in summer leading to building overheating risk.

### 3.3. District Heating

District heating is extensively used in Finland, where thermal energy from Combined heat and power (CHP) plants is recovered and used to heat homes. District heat networks are common in urban areas due to the widespread use of CHP, and is the most common form of heating in apartment buildings and housing cooperatives. In such cases, residents collectively organise and are billed for district heating, and costs are included as part of housing maintenance fees rather than being covered by individual households. This typically means that in rented properties, the cost of district heating is met by the landlord rather than the tenant.

District heat is very reliable, as continuous maintenance and heating service repair is provided to households connected to the network. Therefore, the costs of maintenance and repair do not fall directly on households, making them less likely to live in fuel poverty due to the expense of heating system repairs. The energy costs are low, and because they are typically paid collectively, households that are unable to meet the monthly maintenance costs will far in arrears to the housing company rather than the heating energy provider.

The high security of supply and relatively low costs of district heat are another significant reason why energy poverty is relatively low in Finland, and district heating is considered to be an effective alternative to old electrical heating systems, even heat pumps. District heating is presented as one of the main options to decarbonise the heating systems and support the energy transition from fossil fuels (European Commission, 2011).

#### *3.3.1.* Limitations of district heating

District heating is less viable in areas with low population densities, such as rural areas, due to the expense of expanding the network, while connections to single-family homes are expensive. The amount of heating in dwellings can be adjusted using thermostats, but households with district heat have less control over their heating systems, while the relatively low cost of district heat means that there is little incentive to reduce energy consumption. In areas of Finland like Helsinki, a significant share of district heat is produced with coal-fired CHP combustion. There are several challenges that should be considered in the new generation of district heating to improve its efficiency and reduce its climate change impact, while providing a more affordable energy service (Paiho and Reda 2016; Paiho and Saastamoinen 2018). These challenges include: renewable energy sources share increases; enabling electricity, heating energy production; distributed and local production share increases; open the network for all energy suppliers; and the implementation of supportive technologies (Paiho and Reda 2016).

## 4. Future summertime energy poverty risk

The In temperate European countries, energy poverty has traditionally been defined as a cold weather problem, where low-income households might live in poor-quality buildings and who struggle to sufficiently heat their homes. However, in hot climates such as areas of the USA and Spain; energy poverty includes dimensions related to the ability to adequately cool their home during hot weather (Castaño-Rosa et al. 2020b). However, climate change-related increases in average summertime temperatures and the frequency of extreme summer weather conditions (such as heatwaves), have led to increased interest in social justice and environmental issues by local and national governments in Northern Europe. There is currently a recognition of the need for research into summertime heat exposure, and the need to adapt housing to mitigate risks, thus creating a policy window for change.

In Finland, the increase in average annual temperatures from the pre-industrial period is nearly twice the world average (Mikkonen et al. 2015), and heatwaves have become both more severe and frequent. The climate is projected to continue to warm, with heatwaves such as that in 2018 (which led to an estimated 380 heat-attributable deaths (National Institute for Health and Welfare 2019)) predicted to become more commonplace in the future (Fischer & Schär, 2010; Meehl & Tebaldi, 2004; Russo et al. 2015). Hence, the health and well-being impact of increasing summer temperatures due to climate change have led to summertime energy poverty being considered in parts of the world where it has not previously been an issue (Castaño-Rosa et al. 2020b; Castaño-Rosa et al. 2019a).

In the Nordic regions, buildings have traditionally been designed for cold winters rather than hot summers, and the ability to adequately cool homes in summer might already be an issue. For instance, in 2012, 76% to 93% of households were unable to keep their homes comfortably cool during summer in Finland and Sweden, respectively (European Commission 2018b). Furthermore, according to the latest national assessment on weather and climate risks in Finland (Tuomenvirta et al. 2018), hot weather and building overheating is one of the biggest climate change related risks that Finland - and the Nordic region - faces. An increase in health impacts associated with very hot periods due to the warming climate is predicted (Ministry of Agriculture and Forestry 2014), with indoor domestic health impacts of climate change expected to arise from indoor air problems related to moisture in buildings due to increased precipitation and lack of building ventilation; overheating; heatwaves; and depression related to lack of snow (Finnish Institute for Health and Welfare 2020). Based on studies in other EU countries, reasons for building overheating risk might include lack of solar shading, low thermal mass, insufficiently openable windows and/or lack of mechanical ventilation (Lomas et al. 2021).

While winter energy use may drop in Europe due to climate change, maintaining acceptable indoor temperatures in summer months is going to generate a growing cooling energy demand, potentially hampering attempts to reduce energy use (Simcock et al. 2020). Castaño-Rosa et al. (2021) analysed the effects of change in temperatures in the residential sector cooling demand for Finland, suggesting that up to a two-fold increase in the Cooling Degree Hours[2] (CDH) are expected by 2050. This means that to overcome high indoor temperatures and stay healthy at home, without passive solutions, households would need to use cooling systems. This is reflected by predictions that in the next 30 years, the Heating Energy Demand (HED) in Finland is expected to decrease by 3% and to increase by 6% for Cooling Energy Demand (CED) per decade (Jylhä et al. 2015). Velashjerdi Farahani et al. (2021) analysed the energy demand and overheating risk of residential buildings through dynamic simulations using two climate scenarios for southern Finland in 2050, highlighting that the risk of overheating is high in the current and projected future scenarios. Of the modelled solutions to mitigate the overheating risk, active cooling was the only solution able to prevent overheating in the studied living spaces. Instead of active cooling systems to reduce building overheating (which are rare in Finnish housing and come at an ongoing financial cost), a combination of different passive building design measures instead might reduce overheating risk (Sukanen 2020), however this was not investigated in Velashjerdi's (2021) study.

The use of mechanical cooling systems might lead to negative environmental, financial and social consequences for households, including an increased summer energy poverty risk. This is because such systems increase energy consumption and energy bills, with consequences for social and climate justice (Schünemann et al. 2020). Those who cannot afford to pay for active or passive cooling adaptations, will suffer mental and physical health problems associated with high indoor temperatures, in turn creating public health issues (Thomson et al. 2019). For example, households with low incomes might be more likely to:

- Live in housing predisposed to high temperatures (Lomas et al. 2021);

[2] How much, in degrees, and for how long, in hours, outdoor temperatures are above a cooling threshold, and, consequently, the indoor spaces need cooling.

- Be unable to afford to install either passive measures (such as solar shading, or different windows), or install and operate active systems such as air conditioners;
- Be less able to relocate to somewhere cooler due to the costs of travel or physical disabilities;
- Have more underlying health issues, which will exacerbate the effects of the heat, with heat stress-related health risk and other limitations on well-being as major concerns (Thomson et al. 2019).

At present, the lack of long-term action can lead to a 'triple jeopardy' of public health, where health disparities can be seen across socioeconomic groups. This triple jeopardy effect is due to more deprived groups having greater rates of underlying health issues due to, for example, chronic stress, and less opportunity to choose healthy behaviours. When exposed to a hazard such as cold and/or heat stress - often at greater levels than non-deprived groups - it can lead to an increase in health inequalities. This can, in turn, lead to loss of income or education, further creating a disproportionate circle of negative health and socio-economic impacts.

It is thus paramount to better understand the true extent of winter energy poverty and how a warmer climate will influence the risk of overheating. Building regulations for renovation and for the design of new buildings need to include passive cooling mitigation solutions which enable people to adapt to different indoor conditions. Finally, overheating mitigation solutions must be occupant-centred to allow occupants to adapt to different indoor thermal comfort conditions and, consequently, reduce overheating risk.

In Finland, the need to mitigate against increasing temperatures is now included in the building regulations and it is now mandatory to conduct an overheating analysis at the design stage in order to allocate effective cooling solutions to avoid summertime overheating risk. Similar to district heating, district cooling is rapidly gaining popularity as households have not to pay for the repair and maintenance costs of the cooling equipment, making this solution more affordable for vulnerable people too. Up to 25% increase of the district cooling market is expected by 2030, mainly to be implemented in new apartment blocks as the implementation costs are lower (Vainio et al. 2015). However, old buildings might also be connected to existing district heating grids (which will combine district cooling too) or a smaller local network that provides heating and cooling. Nevertheless, reducing overheating risk through more resilient building design adaptations is crucial to reduce the need for increased cooling energy use in summer for decades to come.

It is thus important to better understand how prevalent overheating is in the current climate and how climate change will influence the risk of overheating in Finnish homes and, consequently, the effectiveness of current social and housing policies and impacts on public health. Solutions and policies cannot be solely winter focused, but need to also support social justice, inclusive and human-centric design, anticipating changing weather conditions and mitigating summer overheating risk areas. Therefore, while the Finnish welfare model is relatively effective to respond to the Finnish situation with regards to energy poverty in winter, it should be extended to meet the increasing risk from summer overheating. However, at present the Finnish welfare model excludes the impacts of heat waves in summer season, future climate change scenarios, housing and energy costs rising due to an uneven urban and smart infrastructure development, and the lack of awareness of energy poverty situations among society and regulators (ASSIST2GETHER 2018).

## 5. Discussion

While a number of social, housing, and energy infrastructure policies have contributed to the current low rates of energy poverty in Finland, there are specific groups which have not been reached by these measures, meaning that there continue to be persistent low levels of winter energy poverty. In this section, three main aspects from the literature review above are discussed, including the limitations of current policies, the role of energy-efficiency of buildings in energy poverty mitigation in the long-term, and the difficulties of vulnerable people to keep their homes adequately cool in summer.

Energy poverty levels are relatively low in Finland in-part due to social security benefits, which support the most vulnerable households' ability to afford a minimum indoor temperature and electricity supply. Furthermore, being connected to the district heating grid guarantees that most vulnerable households are unlikely to be disconnected. However, there are well-being consequences associated with the increase in housing costs for those households who live in detached dwellings with low incomes and old oil- and electric-heating systems. In general, the public and third sectors provide a range of support measures for poverty among citizens, which are used to some extent by those at risk of energy poverty. Nevertheless, subsidies to help people cover their energy costs may be a solution that solves the symptom of the problem but not the cause of the problem, and it is an ongoing future cost too. For instance, one-off support measures, such as the payment of the heating costs to low-income single-family households through social assistance can become a permanent solution perpetuating the problem of energy poverty rather than solving the underlying causes.

Further, the lack of recognition and identification of the most vulnerable groups leads to services not being effectively deployed, and the most at-risk of energy poverty may be excluded. Another problem is that single-family residents at risk of energy poverty often have other renovation needs and costs in their homes and investing in the renovation of the heating system or other measures to improve the energy efficiency of their dwelling is not a priority, or affordable. In this respect, energy advice and funding should be more accessible to at-risk groups. The practical implementation of the recommendations would require closer cooperation between the various actors and across sectoral boundaries.

Finally, problems cannot be solved if there is no established measure which enables the identification or evaluation of the problem. Although some Finnish citizens have occasionally experienced energy poverty related issues, the concept of energy poverty is relatively unknown among the Finnish population, making it difficult to define actions (ASSIST2GETHER 2018). Training professionals, as well as households, to identify and address the problem could be a potential mitigation strategy, which would also support good behaviour practices in the society. In the end, a more consistent identification of energy poverty by using qualitative data and households' evidence would contribute to more effectively addressing the issue of energy poverty now and in the future (Castaño-Rosa 2021).

## 5.1. Energy efficiency: a long-term solution to address energy poverty in Finland

Dwelling energy-efficiency standards are not part of the social assistance criteria when applying to pay for heating costs. This means that a new policy which promotes a deeper energy-efficiency improvement of buildings and summer adaptations is needed to address root causes of energy poverty risks. In this respect, financial support to pay for the heating costs should be seen as a short-term solution while the energy efficiency and summer adaptation of the dwelling is undertaken, guaranteeing long-term benefits. To effectively mitigate the problem of energy poverty now and in the future, a reduction in household energy expenditure should be targeted rather than providing an ongoing payment of ever-increasing energy costs through social benefits.

Moreover, on the basis of the criteria currently set out for the ARA renovation grants, which is targeted at the elderly and disabled, these target groups might not receive this grant due to the household's wealth or deductibles, even though they are living with a low income that restricts their everyday lives and prevents sufficient heating of their living quarters. The issue worsens as housing and retrofit costs rise. For example, renovation of a home is expensive but reduces monthly energy bills, and the operating cost of heating energy produced with heat pumps is often lower than when using fossil fuels, but the initial upfront investment is high, and those high expenditures are not fully covered by the grant. The lack of funding elements is a barrier to resolving the issue.

Therefore, Finland has a major structural problem in that it offers an aid scheme that does not encourage the highest energy-efficiency standards, but rather different allowance types to cover energy costs, and small repairs, which do not address the underlying issues and causes. This means that the continuous energy price increase may cause the number of households who need help to cover their energy costs to increase, and as a consequence, the amount of funding allocated to support social schemes too. In this respect, allocating the additional amount of money spent on social benefits to offset heating costs to improve the energy efficiency of a dwelling could be a long-term strategy to effectively address the continuous increase of the social security scheme budget and thus, at least in whole or part, eliminate the need for external financial support.

Especially taking the changing climate into account, energy-efficiency renovations must be combined with summertime adaptation measures, so that one solution does not create unintended consequences in another season.

## 5.2. Lessons for summertime energy poverty

Current housing, energy and social policies have effectively contributed to mitigate energy poverty in winter, resulting in current low levels. However, the risk of suffering energy poverty in summer is only just increasing in awareness. Current highly insulated building stock may lead to overheating risk, energy bill increase (high cooling energy demand), unhealthy indoor environments, and, consequently, energy poverty in summer. In response to this increased risk of summertime energy poverty, there are opportunities to learn from the technical and social solutions that have helped to reduce wintertime energy poverty to low levels in Finland, as well as learn from their limitations.

Though cooling demand will remain lower than the heating demand, cooling energy demand is predicted to increase by 10-30% in 2050 in comparison with 2020 across the EU (European Commission 2020), jeopardising the attempt to decarbonise the building stock. To counter this, building regulations may be employed to reduce the risk of overheating - and energy consumption for cooling - in much the same way that they have helped reduce wintertime heating energy use. For overheating, this can include passive overheating measures such as shading, blinds and shutters, and sufficient purge ventilation for both new builds and retrofit dwellings.

Changes to energy systems can also help mitigate the risk from summertime energy poverty. District Heating has been seen to be an effective solution to mitigate energy poverty in winter, as unlike with single-heating systems (i.e., heat pumps) households do not have to cover the associated maintenance and heating service repair costs. District cooling is rapidly growing in Finland, which offers households the ability to connect to a district cooling network where available. Regulations requiring the use of combined district heating and cooling must be required in the design stage of new buildings. Policies aimed at encouraging housing cooperatives to connect to the network, for example when undertaking plumbing renovations, would help to ensure that residents are connected to a reliable and equitable source of cooling. Replacing electrical cooling with district cooling or geothermal cooling is the main strategy for action defined in the Finnish long-term renovation strategy 2020-2050 (European Commission 2020). However, this must go hand-in-hand with passive measures to reduce (and potentially eliminate) the need for active cooling to begin with, thereby also reducing the associated environmental and financial costs and energy poverty risk.

For households outside of district cooling networks, households are currently able to receive subsidies to switch from old oil- and electrical-heating systems to heat pumps, as these are more efficient and less polluting. Reversible heat pumps should become encouraged, as they will enable both heating and cooling. However, energy poverty in rural detached households may continue to be at higher levels, as wealthy households will be able to pay for the additional maintenance and service repair costs, but most vulnerable people will struggle. In this respect, building regulations must be reconsidered in the face of projected cooling energy demand increase. Improving the energy efficiency of buildings by installing new heating systems must go hand-in-hand with the implementation of passive measures.

As with grants for improving energy efficiency, financial support could be provided for households to install passive overheating mitigation measures and reversible heat pumps. However, the associated energy bill increase could increase the risk of being in energy poverty among most vulnerable households, and risk the $CO_2$ emission reduction goals. Therefore, both improved energy efficiency through passive measures with solar protection in summertime and access to better energy infrastructure provide long-term solutions to reduce energy poverty vulnerability (and also reduce the environmental impact), and are preferable to ongoing financial support through social policy mechanisms. Building regulations must include passive cooling solutions for new and retrofitting buildings, and financial support must promote the switch from old- and inefficient-heating systems to a more efficient and affordable one while integrating active and passive cooling measures. This would enable Finland to effectively address the root causes of both winter and summer energy poverty.

## 6. Conclusion

Energy poverty is a multidimensional issue in all European countries and the root of this issue differs from country to country, meaning each country should develop unique strategies and policies to address energy poverty. This chapter reviewed the situation of energy poverty in Finland, examining the mechanisms by which energy poverty has been reduced to current low levels. Furthermore, the future likely effectiveness of current measures that support people at risk of energy poverty now, was investigated.

In Finland, energy poverty actions are integrated in the country's general social policy through which it is guaranteed that all citizens have the right to basic needs. The fact that energy poverty has traditionally been addressed through social and housing security benefits is the main reason why Finland has relatively low levels of energy poverty in winter. In this respect, Finland's current social policies can be seen as good practices to mitigate energy poverty and which other countries might learn from. However, it was found that many vulnerable people (1.7 to 3% of its population, depending on source) are left behind, as existing social security benefits are not reaching all eligible individuals and, consequently, they never get the chance to apply for support. This barrier may be overcome by developing specific measures and strategies to better understand who is most at risk of suffering from energy poverty and determining the best way to support them. This could include, for example, training professionals to identify and address the problem of energy poverty as part of their own work. This needs to be done in collaboration with energy companies, social institutions, municipalities and organizations. Furthermore, households should also be included in the training plan in order to enable peer support and create good behaviour practices among the community.

A second issue may be that the Finnish social security model assists and provides services to support residents who have encountered poverty and monetary problems, including social benefits to help cover housing costs expenditure. However, this does not provide a permanent solution to eradicate energy poverty, but is rather a short-term solution which makes vulnerable groups dependent on government support. As a long-term measure to prevent energy poverty, the income support allocated to help households cover the heating costs of electricity or oil heating over a period of one year could be used for the renovation of the dwelling or the heating system by installing reversible heat pumps for instance. Requiring the use of district cooling in both new and renovated existing buildings might be another potential solution to reduce households' energy costs, as they do not have to pay the repair and maintenance costs of their own system. Furthermore, the remaining renovation fund from ARA allocated for elderly and disabled people could also be used for energy renovations across a wider target group and to include higher standards and summertime dwelling adaptations. This would not only increase the energy efficiency of dwellings but it would also reduce the need to continuously pay subsidies long into the future.

Healthy environment and citizen well-being are both high on the political agenda, but they are rarely discussed together. Improving the energy efficiency and summer time overheating adaptation of dwellings will not only help global warming mitigation, but enable the most vulnerable people to reduce their heating costs and, consequently, be a more efficient deployment of social benefits. In this respect, there is the need for close multidisciplinary cooperation among experts and actors in different fields in order to know and identify the different 'faces' of the phenomenon. Currently, the social security system provides financial and other monetary support through the public and third sectors, but they fail to effectively target the energy poor, and no mechanism exists to cover summertime overheating vulnerability. Thus, a broader and earlier identification of the problem might help reduce and prevent energy poverty and the associated health issues. Increasing the energy efficiency and use of renewable energy in houses with oil and electric heating will also have a strong impact on housing $CO_2$ emissions.

Finally, summertime overheating has been identified as a significant social issue now, and especially in a future changing climate. Hence current housing and social policies need to be extended to account for summertime overheating risk and potential summer time energy poverty. The Finnish building regulation obligates planners and designers to analyse summertime issues at the planning and design stage in order to mitigate overheating risks. District cooling, which may be seen as an effective solution to reduce households' energy costs just like district heating, is rapidly gaining popularity in this respect. However, further research and data is needed to collect evidence and data which help policymakers develop effective policies, and housing companies implement effective passive cooling solutions such as solar shading, new window design, cross ventilation, use of thermal mass, etc., to mitigate dwelling overheating. Passive measures help prevent a summertime energy consumption increase, and, consequently, mitigate summertime energy poverty.

In conclusion, energy poverty is not a new phenomenon in Finland, but rather a marginal societal issue currently affecting a small proportion of Finns but which may become worse in the future due to the changing climate. It has traditionally been addressed through social and housing policies, however, society and climate are continuously changing and energy and social policies must therefore be examined together bringing knowledge from both the public and private sector in order to define a new level of expertise with a strong social, economic and ecological perspective.

**Funding**
This research was part-funded by Tampere University and the Academy of Finland for RESCUE Real Estate and Sustainable Crisis management in Urban Environments (number 339711).

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