BEYOND 2020 NOVEMBER 2 - 4 WORLD SUSTAINABLE BUILT ENVIRONMENT ONLINE CONFERENCE

Rethinking the built environment: climate change mitigation and adaptation in a Nordic climate

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Introduction

Energy poverty (EP), or Fuel poverty (FP) are both concepts that can be used interchangeably [1] and represent Energy Vulnerability (EV), which is defined as the inability of *an individual to obtain the energy services needed materially and socially at home* [2]. EP is a problem that cuts across multiple United Nations Sustainable Development Goals related to poverty, equality, and sustainability, making it a pressing issue for all European Union (EU) member states closely aligned to these goals. However, only England, Slovakia, Ireland, Scotland, Cyprus, France, recently followed by Spain, have an official definition of EP. The European Commission (EC) does not support a common EP definition for all EU member states due to the socio-economic disparities across EU countries. Regrettably, EP rates vary amongst each country depending on which indicator is used, leading to inaccuracies, especially when these indicators are used by themselves [3]. The issue is further complicated by the fact that EP has traditionally been assumed to be a problem of countries with severe winters and low-income households living in poor quality buildings, but the health and well-being impact of increasing summer temperatures due to climate change has led to summertime EP being considered [4]. Yet, current measures and policies to address EP fail to take in consideration these new factors and, consequently, fail to properly assess EP in its totality. The lack of reliable and accurate EP measures has led EP to be underestimated as a social problem across the EU.

This paper reviews the situation of EP in Finland, where EP is not assessed effectively despite the fact it is a current problem (in summer), and that it is expected to increase in prevalence due to climate change.

Nordic countries: understanding energy poverty in summertime

EP rates vary drastically amongst each European country depending on which indicator has been used for the analysis. For example, in 2012, in Bulgaria, Lithuania and Greece, 51.1%, 37.2% and 26.5% of households were unable to keep their homes adequately warm respectively, while this was only 1.4% and 1.5% of households in Finland and Sweden (primary indicator according to the EPOV) [5]. Yet in summer, 75.9% to 92.8% of households were unable to keep comfortably cool in Finland and Sweden respectively, while this was 47.6%, 64.1% and 75.6% of households in Bulgaria, Greece and Lithuania (secondary indicator according to the EPOV) [5]. This comparative analysis shows that EP is a multiple-factor issue that cannot be assessed by using current indicators across all European countries, require special attention depending on the studied country, and it raises the question whether current policies and measures to address EP have given enough protection to citizens.

EP is not a static issue, but one that changes along a year. In 2013, the Finnish Ministry of Environment examined the importance of EP in Finland resulting in a small proportion of households that are energy poor in Finland. However, the Nordic welfare model does not reflect the Finish situation very well with regards to EP, because it overlooks summer season and future climate change scenarios.

EP has been hardly studied in Finland mainly because of its near absence in winter, leading to a lack of research data, and too EP being hidden as a phenomenon in Finland. It was highlighted that the main factors which cause EP in the Finnish context, and which need further research, are:

- Ventilation and cooling issues: Finland saw the prevalence of uncomfortable indoor cooling increase between 2007 to 2012 (20.3% and 27.8%, respectively) [6]. Furthermore, according to the National Institute for Health and Welfare (THL), over 380 premature deaths were resulted of the summer heatwave in 2018.
- Energy price: it has been rising since the early 2000s and there are currently price-raising factors in the energy market, such as global growth in energy demand that show the need for the use of renewable energy [7].
- Living in large energy inefficient dwellings: buildings built before 1970 have a poor or very poor energy-efficiency characteristics where low-income households cannot afford the energy-efficiency retrofit of dwellings, affecting occupants' health and, consequently, the national healthcare system [8].
- Living outside urban areas: it means that the cost of heating and fuel transport are proportionally higher due to district heating network characteristics and the lack of feasible public transport [9].
- Multiple disabled households: they have higher healthcare expenditure indicating that this is not only a matter of poverty, and it leads to hidden energy services issues [3].
- Low-income households: young people (students), the elderly and unemployed are the most vulnerable groups to experience difficulties to afford their energy services [8].

Future Predicted Climate

Figure 1 shows the impact of climate change on cooling energy demand increases across Finland: the Southwest areas of Finland will be the most affected (increase of 300 to 400 % by 2100), representing those areas that are most vulnerable to climate change and, as expected, likely increased summer energy poverty. As such, policy-makers should pay special attention when designing new city and building policies and regulations, given that current building stock characteristics and urban composition are likely to increase the risk of people to certain vulnerabilities.

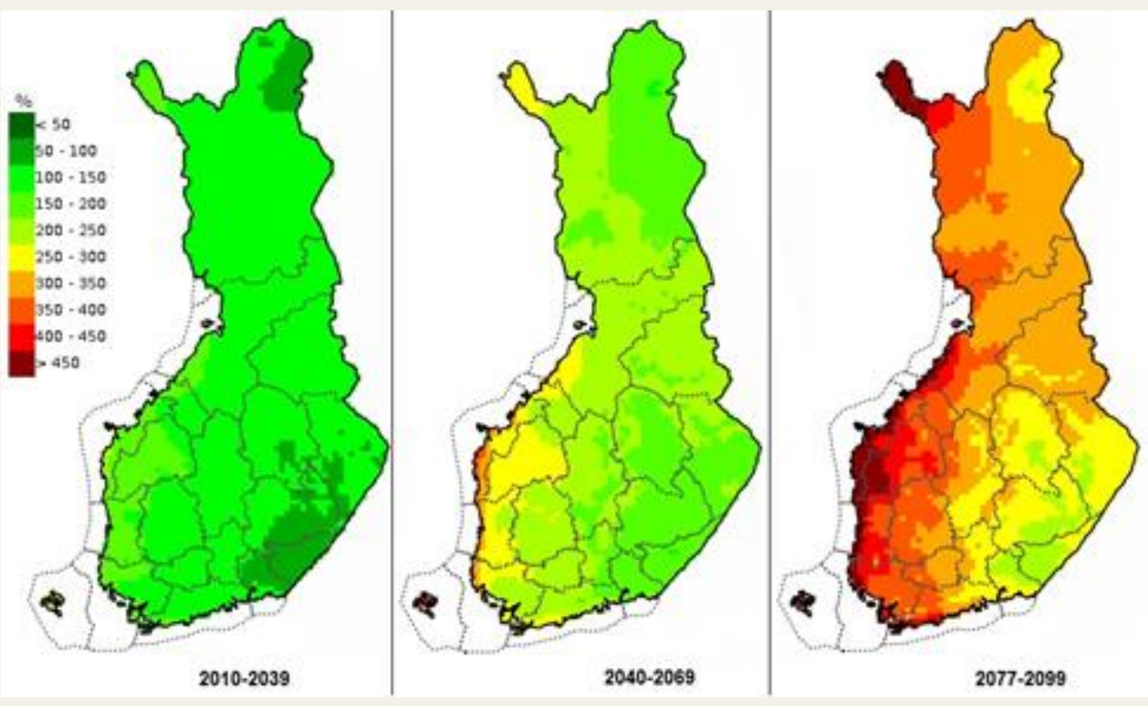

Figure 1: Climate change impact on cooling energy demand in Finland [10].

While cooling energy consumption in Finland is proportional to the indoor and outdoor temperature difference, however its usefulness for the Nordic region remains untested. Especially the low cooling threshold of 18ºC to estimate how cooling energy demand might increase due to climate change has several limitations, especially for its use in Finnish home environments. Moreover, CDD disregards variables influencing actual overheating risk such as building orientation, building ventilation potential, the absence or presence of solar shading, building fabric efficiency, occupant behaviour and adaptive thermal comfort capacity etc. In addition to the need for Nordic specific building overheating risk thresholds and summer EP risk criteria (see Figure 2), other considerations that increase both risks in summer and in a future changing climate in the Nordic region include:

- Low solar angle and long light days that lead to longer and deeper penetration in buildings and warmer air temperatures, and consequently, exacerbate overheating. This needs to be reflected in overheating and EP risks now and in the future.
- Current building design in the Nordic region also contributes to building overheating risk: e.g. windows are designed to effectively work during winter (e.g. maximizing solar radiation, few openings), however, there is a lack of summer solar shading and lack of opening systems to allow summer ventilation. This avoids a reduction of indoor temperatures and, as a result, leads to increased discomfort (or higher energy consumption for active cooling)

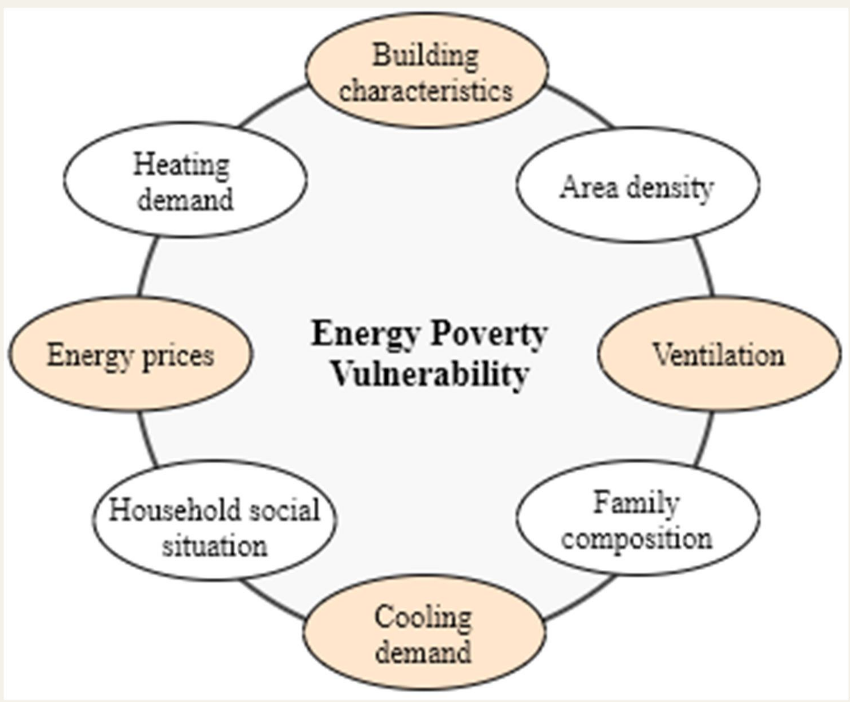

Figure 2: New theorical approach to understand vulnerability factors to EP in Finland (authors' own).

The issue of increased summer-time overheating and EP vulnerability is not just a matter of increased energy consumption or CO2 emissions, but a public health issue. For example, the most vulnerable people spend most of their time at home, living with high indoor temperatures (caused by building overheating) and poor indoor air quality (due to inadequate ventilation systems), leading to different physical and mental health issues, such as heat stroke, fatigue, decrease of the ability to concentrate and social exclusion (people feel ashamed to invite others at their home). In the worst case-scenario mortality rates are increased (elderly, children disabled people or pregnant in particular).

In Finland, the symptoms of energy poverty are mainly dealt with through various financial-support mechanisms, such as social loans, sickness insurance, transfers for the poorest households, etc. However, such mechanisms do not tackle the actual causes of EP nor its future impacts (e.g. increase of energy prices and cooling energy demand, impact on health and well-being).

Policy implications

- Regarding policy implications in terms of how to design built environment according to future climate change and EP issues, this paper highlights that the current Finnish building stock is ill-adapted to future climate change situations, and that ventilation and solar shading are key elements for consideration.
- The potential situation of high indoor temperatures (building overheating) and poor air quality and its associated public health consequences, highlights the need for research in overheating risk thresholds and EP risk specifically related to the Finnish and Nordic context.
- As CDDs, cooling energy demand is expected to increase by 6% per decade, which means an increase of electricity energy consumption. In this respect, electricity price may increase the risk of most vulnerable people.
- Special attention should be paid when designing new city and building policies and regulations, given that current building stock characteristics and urban composition are likely to increase the risk of people to certain vulnerabilities.
- This work will enable us to appropriately consider built environment adaptations as a solution to mitigating climate change impacts and vulnerability to EP, minimising public health impacts in the region now and in the future.

Conclusions

- EP is a multidimensional issue in all European countries and the root of this issue differs from country to country, so that each country should develop new strategies and policies to address EP.
- In Finland, there is no definition and/or plan to understand EP vulnerability because it has not been recognized as a problem in winter, according to current EP indicators. However, summer EP is identified as a significant issue now, and in a future changing climate.
- This paper argues for a new more holistic and Finland-specific approach to better understand EP vulnerability in the Finnish context (see Figure 2). Although most EP factors may similar to other countries, building characteristics, ventilation systems, cooling energy demand, and energy prices are the main factors that increase the risk of summer EP in Finland, especially when regarding climate change impacts.

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