Double Energy Vulnerability in the Urban and Peri-Urban Areas of Stavanger – Addressing Equity and Vulnerability in Low Carbon Energy Transitions

Master Thesis by

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THESIS ABSTRACT

Europe is experiencing critical energy crisis, and Norway is no exception. The surge in electricity prices in Stavanger has made low-income households unable to obtain the heat, electricity, and other essential energy services they need to survive. Further complicating matters, households in Rogaland face challenges accessing efficient and affordable transportation, resulting in disadvantages, and exacerbating inequalities among low-income and vulnerable residents. For this reason, the thesis aims to analyse the double energy vulnerability in the urban and peri-urban areas of Stavanger with the focus on addressing equity and vulnerability in the ongoing low-carbon energy transition.

The thesis builds on Sareen et al. (2022) paper on the Double Energy Vulnerability (DEV) in Stavanger's urban transport transition and examines the domestic and transport energy poverty in both the urban and peri-urban areas of Stavanger through the lens of the three core-tenet framework of energy justice – distribution, recognition, and procedural justice. It answers the questions of; **(1) what characterises the energy-poor households in the urban and peri-urban areas of relatively affluent cities; (2) how do the factors of double energy vulnerability (DEV) exacerbate inequality, and (3) how can policies target double energy vulnerability to reduce inequality while ensuring fairness?**

The thesis employs multiple qualitative methods. A semi-structured interview format, document analysis of scholarships and grey literature, a self-administered paper-based (expenditure) questionnaire, an online (perception-based) survey targeting specific social media interest groups, as well as primary data from the Norwegian Energy Poverty project were employed and analysed. Households at risk of double energy vulnerability were identified based on the 10% indicator and their lived-in experiences or subjective views.

The thesis found that double energy vulnerability is gradually emerging in Stavanger and that the geographic location of households determined their vulnerability to transport energy poverty. With low income and higher energy prices serving as the factors of double energy vulnerability exacerbating inequality, further findings revealed that low-income residents of Bryne were not recognized as having specific transportation needs, making them vulnerable to all forms of transport-related disadvantages (for example, forced car ownership, transportation affordability, transport accessibility, and car-related economic stress). As a specific recommendation, the thesis called for a detailed examination of energy poverty issues in

municipalities and regions across Norway as well as how subsidies trickle down to those living on low incomes.

Keywords: Energy poverty, domestic energy poverty, vulnerability, transport energy poverty, urban, peri-urban, double energy vulnerability, recognition, distributive, procedural, energy justice, energy affordability, energy accessibility, inequality, exclusion

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LIST OF ABBREVIATIONS

R&D – Research and Development

EU – European Union

EU SILC – European Union Statistics on Income and Living Conditions

UN – United Nations

SDG – Sustainable Development Goal

VAT – Value Added Tax

NOK – Norwegian Krone

KWh – Kilowatt hour

DEV – Double Energy Vulnerability

NGO – Non-governmental organizations

DEP – Domestic Energy Poverty

TEP – Transport Energy Poverty

FCO – Forced Car Ownership

No-EPOV – Norwegian Energy Poverty

NSD – Norwegian Centre for Research Data

LIHC – Low-Income High Cost

OECD – Organisation for Economic Co-operation and Development

SMSD – Severe Material and Social Deprivation

GHG – Greenhouse Gas

EP – Energy Poverty

HH - Household

COVID – Coronavirus disease

CO_2 – Carbon Dioxide

NAV – Norwegian Labour and Welfare Administration

EV – Electric Vehicle

SSB – Statistisk Sentralbyrå (Statistics Norway)

TRSE – Transport Related Social Exclusion

CES – Car-related Economic Stress

SES – Socio-economic Status

CHAPTER 1 – Introduction

1.1. Prevailing Double Energy Vulnerability Conundrum in Europe

Europe is facing critical energy crisis, and Norway is no exception. According to Boardman (2010, p.21) and Simcock et al. (2021, p.1), energy and transport poverty are accepted politically as an existing problem, attributable to severe forms of deprivation and have assumed immense political priority and critical attention from within and beyond academia. Within the European Union, countries like Austria (Brunner et al., 2012), the United Kingdom (UK) (Middlemis et al., 2019), Hungary (Herrero & Urge-Vorsatz, 2013), New Zealand (Howden-Chapman et al., 2012), and Japan (Okushima, 2017) have carried out extensive research on Energy Poverty on account of the happenstance of increasing fuel prices with decreasing household purchasing power (Lowans et al., 2021, p.1).

Lowans et al. (2021) have define the concept (domestic) energy poverty to mean the "condition in which households or small businesses are unable to purchase or afford the needed supply of heat, electricity, or other essential energy services necessary for their survival" (Lowans et al., 2021b, p. 1). A household is in energy poverty when it is deprived of (lacks access to or is not able to afford) domestic energy needs such as cooling, heating, lighting, and hot water, or the required technologies to keep a home at a sufficient temperature or cook hot meals (Martiskainen et al., 2021, p. 4).

Another form of deprivation similar to domestic energy poverty is transport energy poverty. While the former is explained as the inability to attain socially and materially necessitated levels of domestic energy services, the latter is defined concerning transport services – that is, 'the inability to attain socially and materially necessitated levels of transport services' (Martiskainen et al., 2021., p. 4). An individual is transport poor when he or she cannot afford or access essential transport services necessary for everyday functioning. In events where the two conditions simultaneously impact households, a Double Energy Vulnerability (DEV) has occurred.

Despite the extensive work done on both phenomena, particularly on energy poverty (EP), analysis of the two has often been conducted to identify separate patterns of vulnerability (Mattioli et al., 2017, p. 114; Simcock et al., 2021, p. 2). This arises because energy researchers sees "energy demand" as something that occurs inside the home (or the office), while the

consumption of motor fuel, for instance, falls under separate "transport studies" tradition (Martiskainen et al., 2021, p. 4). In parallel, energy and transport governance have routinely come about through distinct policy areas, jurisdiction, budgets, and R&D projects, with limited capacity to design and implement overarching policies across different departments (Martiskainen et al., 2021, p. 4). But recent developments suggest the need for convergence (Mattioli et al., 2018, p. 114), and there is a call to increasingly study the intersection of domestic and transport energy poverty (double energy vulnerability) because of its ability to heighten inequality, worsen health, and wellbeing, and place vulnerable groups at greater risk of poverty (Thomson et al., 2017).

Taken together, double energy vulnerability is the simultaneous impact of domestic and transport energy poverty on the poor and vulnerable groups (acting as an acute form of energy injustices). The consequences of both phenomena are dire (Thomson et al., 2017). For instance, the EU Survey on Income and Living Conditions report (EU SILC) guesstimates that as of 2012, approximately 54 million European citizens (10.8% of the EU population) were not able to keep their home at a sufficient temperature (Pye et al., 2015, p. V) while up to 125 million people across the EU experienced the consequence of energy poverty in their daily lives (Lowans et al., 2021, p. 1). Most tragically, energy poverty leads to an excess of winter deaths, ending the lives of people who receive insufficient heat. An analysis of UK winter deaths calculated 167,690 excess deaths from 2011 to 2017 (Guertler & Smith, 2018), of which 50,310 were due to cold housing conditions. Similarly, in Vermont, in the United States, TellerElsberg et al. (2016) have reported that energy poverty results in more deaths each year than automobile accidents. As a result, Karpinska and Smiech argue that energy poverty is a transitory condition that is less likely to be escaped by the poor.

In Europe, energy poverty happens not only due to socio-economic roots. It can also be socio-material because of poor-quality, energy-inefficient buildings (Wågsaether et al., 2022. p.2). Thus, energy poverty leads to poorly heated houses, with a range of negative health impacts, including respiratory and circulatory disease in adults, premature heart attacks, asthma in children, pregnancy complications, thousands of excess winter deaths, and increased risk of mental health illness and social isolation among the elderly (Pérez-Peña et al., 2021, p. 2). Thomson et al. (2017) in their comparative study of energy poverty on 32 European countries have identified a strong relationship between thermal discomfort and the exacerbation of existing conditions such as arthritis and rheumatism. The UK, for that reason, is particularly committed to addressing energy poverty and its associated repercussions including its various

forms of inequality and injustices while global efforts to eliminate energy poverty are notable in governmental efforts in China, Vietnam, Nigeria, South Africa, Chile, Brazil, Bangladesh, Senegal and Kenya (Aklin, 2018; Sareen and Nordholm, 2021, p. 2) as well as the United Nations Sustainable Development Goal (SDG) 7, namely universal access to affordable and clean energy (UN, 2018).

Depending on the definition used and the country considered, some studies indicate that transport energy poverty (TEP) affects between 10 and 90% of all households (Lucas et al., 2016a, p. 353). For example, in England, more than 1.5 million people are affected by this issue (Sustrans, 2012). Additionally, the report from the General Consumer Council of Northern Ireland (2001) highlights the inequity associated with and caused by transport energy poverty. These include, for instance, restricted access to employment, increased likelihood of exposure to air pollution, and increased difficulties faced by the disabled. According to the UK social exclusion unit, social exclusion makes it difficult to find certain services accessible (work, education, health care, etc.), and transport disadvantages can exacerbate social exclusion substantially, with road traffic's negative externalities disproportionately affecting the already exclusionary (Social Exclusion Unit, 2003). As a result, subjective well-being is also negatively impacted by this inequity (Awaworyi Churchill & Smyth, 2019).

Norway, which is an oil producing nation with a generous welfare system is not immune to this phenomenon. The rising energy prices is taking a toll on the finances of most low-income households. This has resulted in protests and the formation of pressure groups to draw the attention of policymakers to the plight of vulnerable people. For example, some citizens in Stavanger and several cities in Norway marched on January 20th, 2022, to demand action on the rising energy prices. Also, a social media pressure group has been formed. This Facebook group has over 600, 000 members consisting of Norwegian citizens and other nationals with diverse backgrounds. Their objective is to demand cheaper electricity (‘we who demand cheaper electricity’). Protest as a result of disproportionate increases in energy and transport prices, therefore, urgently calls for robust geographical analysis and demonstrates a need for alternative forms of pricing design and related policy implementation that can ensure fairness. This next section details the incidence and ramifications of energy poverty in Norway.

1.2. Energy Poverty: A Critical Condition in Norway

The January 20th, 2022 (Thursday) demonstration at Stavanger Sentrum projected the most pressing frets of citizens regarding the drastic increases in electricity prices. Aside from Stavanger, public protests against high electricity prices took place in Oslo, Kristiansand, Bergen, Arendal, and Harstad. Electricity has never been expensive as some days in the fall, and to curb the situation, wood dealers have run out, and students shower in the gym. Outside the Norwegian parliament were people with posters with the slogan "yes to political control over power", and their demands included predictable and long-term power prices for industry and agriculture, as well as a maximum price system for electricity for households[1].

Making the situation critical, Tor Reier Lilleholt, head of electricity analysis at Volue Insight, reinstated that the prices of electricity could get worse beyond the months of January and February. Regardless of the government supports scheme, Capar (2021) further states that the new electricity prices will make winter in Norway extremely expensive. Even though the state will cover over half of the bill, over 70 øre, the electricity still costs 1 krone and 50 øre per kilowatt-hour, including VAT. Supposing a household uses 27 000 kilowatt-hr a year and consumes 3,280 kilowatt-hrs in December, adding the four winter months of 2021, its electricity bill will be almost NOK 13,000, assuming the December 2021 prices remained unchanged. Although an average Norwegian household uses less electricity than what is cited as an example, since many small apartments are included in the average, only a few use 16 000-kilowatt hour a year and even with that, such a household will incur an extra price of around NOK 7,500 [2].

What is more, Statkraft's CEO Christian Rynning-Tønnesen told the newspaper Finansavisen that high electricity prices in Norway could last until spring 2022. This have placed a heavy load on households struggling to cater for their domestic and transport energy needs. It is always the case that households struggling to cater to their domestic energy needs correspondingly struggle to meet their transport needs. In extreme circumstances, households reduce and even forgo other essential needs such as savings, leisure, shopping, food, and

[1] NTB (2021). Protest against high electricity prices held in several Norwegian cities. Norway Today. Accessed 20 January 2022. Available at: PHOTO: Protests against high electricity prices held in several Norwegian cities - Norway Today

[2] Norwegian Broadcasting (NRK). 2021. Despite electricity subsidies, winter in Norway will be extremely expensive this year. Norway today. Accessed 27 December 2021. Available at: Despite electricity subsidies, winter in Norway will be extremely expensive this year - Norway Today

transport in substitute for their domestic energy needs. In this situation, Walker, and Day (2012) call it "the heat or eat situation," where households must choose between paying their energy bills or paying for food.

1.3. Energy Poverty: The Norwegian Government Intervention

The spike in the electricity prices have compelled the Norwegian government to subside the electricity bills of households to lessen the effects on households' income. An amount of 6.1 billion Norwegian Krone ($682.3 million) have been allocated to cover 55% of the portion of power bill prices above 0.70 krone per kilowatt hr (KWh). Additional money has been allocated to households that need it the most and a subsidy scheme is set aside for greenhouse operators[3]. The high electricity prices also affect students, and the government has provided 3,000 kroner support schemes for students who needs it the most[4].

Notwithstanding these interventions from the government, households still complain about their inability to meet their domestic and transport energy needs. The worse aspect is that some households do not receive government support while those that receive it complains that the prices are still high. It is prudent, therefore, to address equity and vulnerability in the ongoing low-carbon transitions, as this gets to the core of ensuring affordable and adequate energy access as a human right (Sareen & Nordholm, 2021, p. 2). It has been found, however, that low-carbon energy transitions may exacerbate existing socio-economic inequalities and even in places where infrastructure is abundant, such as some European and Scandinavian countries, energy poverty persists because of entrenched inequalities (Wågsæther et al., 2022, p. 2). Accordingly, this thesis will look into the injustices surrounding the energy system by analysing the procedures (for determining and contesting distribution), recognition (of different groups' needs and rights), and distribution (of goods and services among groups). This is important to ensure the greater well-being of the vulnerable, as Gillard et al. (2017, p. 54) have

[3] Reuters (2021). Norway parliament agrees increased electricity subsidy schemes. Accessed 17 December 2021. Available at: Norway parliament agrees increased electricity subsidy scheme | Reuters

[4] The Norwegian government wants to provide 3, 000kroner in electricity support to students. Norway Today, Accessed 8 December 2021. Available at: The Norwegian government wants to provide 3,000 kroner in electricity support to students - Norway Today

emphasized that more significant consideration of recognition and procedural issues helps solve the fundamental distributional inequalities that typically define energy poverty.

Norway is a rich, income-equal and energy abundant country (Bredvold, 2020), with hydropower supplying the majority of its electricity and wind power contributing a small but significant portion (Sareen et al., 2022, p. 3). However, the country is currently experiencing a relatively dry and depleted hydropower reserve pushing up electricity tariffs (Sareen et al., 2022, p. 2). The onus now lies on low-income and vulnerable households to match up with the current energy situation and this raises concerns about aggravated inequality, biases, and social exclusion. The high-income earners and the privileged are able to enjoy the benefits of low-carbon energy transitions as smart energy prosumers who can combine electric cars, photovoltaic panels, and smart electricity devices to automate an optimal relationship between energy usage and dynamic tariffs while the 'flexibility poor' faces the consequences of energy exclusion (Sareen et al., 2022, p. 2).

Figure 1- Protest against high electricity prices held in several Norwegian cities

Figure 1- Protest against high electricity prices held in several Norwegian cities

Protesters against high electricity prices outside the Norwegian parliament Photo: Javad Parsa / NTB

Source: Norway Today, 2022

1.4. Previous Research

This has led researchers to look into some key factors and reasons behind such energy poverty. Sareen (2020) has studied the scalar biases in the rollout of smart electric meters in Norway where supply-side actors in Norway control energy flexibility whereas households are burdened with responsibilities. Bredvold (2020) has studied Domestic Energy Poverty (DEP) in urban areas in Oslo and has argued that the lack of financial independence, social capital in the form of family, social and material dimensions to housing and energy consumption as well as normative expectations of energy use affects how energy poverty is experienced by households (Bredvold, 2020, p. IV).

Fjellså and Skjølsvold (2021) have also studied the 'locked-in' flexibility practices and electricity use among students. They have concluded that political stimulus for low-carbon transitions usually debars students and other vulnerable groups in society, thus instituting and fortifying 'flexibility poverty' (Fjellså et al., 2021).

Sareen et al., (2022) have particularly studied the double energy vulnerability in the Norwegian low-carbon urban transport transitions. With a focus on urban Stavanger, they have concluded that the car-centric infrastructural development and limited access to public transport in the areas of Østre Bydel produces preferential mobility opportunities for those with car access than for those limited by walking, bicycling and public transport (Sareen et al., 2022, p. 16).

However, energy poverty has received less attention in Norway and is understudied. Less scholarly attention is being paid to the peri-urban and rural areas susceptible to transport energy poverty due to long-distance commuting. Martiskainen et al. (2021, p. 6) argue that regardless of how efficient households' houses are, the car-dependent peri-urban locations, may still have to rely on energy-hungry and expensive private transport to obtain vital services due to poor access to public transport.

It is of this view that I study the double energy vulnerability in the urban and peri-urban areas of Stavanger, with the aim of addressing equity and vulnerability in the ongoing low-carbon energy transitions. Specifically, I address the procedural, distributive and recognition justice effects from the ongoing low-carbon energy transitions that exacerbates double energy vulnerability and aims to fill the gap of studying energy poverty in peri-urban Stavanger, which has received less scholarly attention. The purpose is to bring greater awareness of human needs and actions and understanding and recognizing the geographical disparities in energy poverty

helps to solve energy injustices (Bouzarovski & Simcock, 2017). This thesis is also to extend the work of Sareen et al., (2022) on the double energy vulnerability conducted in the urban areas of Stavanger. The research questions presented next.

1.5. RESEARCH QUESTIONS

Following the presented context above, I seek to answer these questions:

(a). What characterizes energy-poor households in the urban and peri-urban areas of a relatively affluent city?

(b). How do the factors of double energy vulnerability (DEV) exacerbate inequality?

(c). How can policies target double energy vulnerability to reduce inequality while ensuring fairness?

As iterated earlier, the aim and purpose of the thesis, are to address equity and vulnerability in the ongoing low-carbon renewable energy transitions through the lens of procedural, distributive, and recognition justice concerns. And so, the reason for selecting these three research questions are;

To identify who the vulnerable groups to DEV are, what special trait sets them apart in both study locations and how are they being impacted by the situation. Geographically identifying the differences, similarities and lived-in experiences or vulnerabilities of energy-poor households, is a first step in addressing their energy challenges, as energy justice concepts evaluate where injustices emerge, (b) which affected sections of society are ignored and (c) which processes exist for their remediation in order to (i) reveal, and (ii) reduce such injustices (Jenkins et al., 2016, p. 175). Thus, energy justice is employed based on the understanding that, for injustices is to be addressed, one must (1) identify the concerns – distribution, (b) identify who it affects – recognition, followed by the procedures or strategies for remediation. As a result, the three-tenet framework of energy justice -recognition, distributive, and procedural justice, will be the theoretical framework that will be applied to the study.

Furthermore, equity and vulnerability cannot be addressed without knowing the root cause or the factors that aggravate such inequalities. And so, the second research question is to know the factors of double energy vulnerability that heighten inequalities in both study areas. After knowing the factors, suggested policies to target DEV to reduce the inequalities and ensure fairness amongst Norwegian societies will be discussed. Followed next is the overview and structure of the thesis.

1.6. OVERVIEW AND STRUCTURE OF THE THESIS

The thesis proceeds as follows: Chapter (1) has given an introduction and presented both domestic and transport energy poverty problem in the context of Stavanger and Norway.

Chapter two (2) will review literatures on both domestic and transport energy poverty. It will begin by defining key terminologies, and then conceptualize both Domestic Energy Poverty (DEP) and Transport Energy Poverty (TEP).

Chapter three (3) will discuss the analytical framework used applied to the study. It begins by discussing the concept of energy justice and followed by the three core-tenet framework – recognition, distribution, and procedural justice.

Chapter four (4) will systematically describe how the study was carried out, the methods of data collection and analysis.

Chapter five (5) gives a contextual background of Norway as well as the two study areas

Chapter six (6) presents the results from the data collection.

Chapter seven (7) discusses findings and answers the research question, revealing how households are distinct from both locations and the people and places at greater risk of double energy vulnerability as well as the related injustices in terms of procedural, distribution, and recognition.

Chapter eight (8) presents the discussion

Chapter nine (9) concludes by giving implications for future research, arguing for the need to explore the interconnection between domestic energy poverty and transport energy poverty in various regions and municipalities in Norway, particularly during these decarbonisation periods and where electricity and transport bills are high.

2. Chapter 2 - Theoretical Literature Review

2.1. Defining Key Concepts: Poverty, Domestic Energy Poverty, Transport Energy Poverty and Vulnerability

Energy Poverty (EP) is a global issue plaguing both developed, developing, and underdeveloped countries alike. It has been defined in various ways and through various terminologies including 'fuel poverty', 'energy vulnerability' and 'energy insecurity' (Simcock et al., 2021, p. 2). As stated in Bouzarovski and Petrova (2015, p.3), I treat these various definitions and terms as referring to fundamentally the same phenomenon: "an incapacity to attain a socially and materially necessitated levels of domestic energy services". Considering the global north and specifically Norway, it is comprehensible that energy poverty is a result of factors such as low incomes, low-quality and inefficient housing, high energy costs, and/or increased energy demands (Simcock et al., 2021, p. 2).

On the other hand, *transport energy poverty*, encompass a broad range of aspects such as 'transport affordability' (i.e., limited access to transport modes), 'accessibility poverty' (i.e., the difficulty of reaching key services and opportunities) and 'exposure to transport externalities' (e.g., road traffic casualties and air pollution) (Lucas et al., 2016). Affordability, mobility, and accessibility are all explored in this paper, and are put together into one working definition: "the inability to attain a socially and materially required levels of transportation services" (whether due to affordability, mobility, or accessibility difficulties). It can also be understood as not having access to or living far away from public transport, forcing people to rely on expensive private cars and/or creating potential mobility challenges (Simcock et al., 2021, p. 2). This limits people's ability to effectively perform functions. That is, lacking access to or not being able to afford essential transport services, restricts one's ability to travel for fundamental needs, such as employment, education, health care or leisure (Martiskainen et al., 2021, p. 4). This negatively affects low-income households especially those situated in auto-mobile-oriented areas while directly impacting on their health and wellbeing (Simcock et al., 2021, p. 2).

Finally, *Vulnerability* has been defined by Leal Filho et al., (2018, p.1141) as the "physical, social, economic, environmental, and institutional structures and processes that determine a system or individuals' susceptibility, coping and adaptation capacities regarding the way that it reacts to dangers". It reveals the susceptibility of a population to respond to a hazard and is

shaped by existing circumstances, which is often considered independent of the hazard (Jagarnath et al., 2020, p. 811).

In energy poverty studies, vulnerability can be defined in terms of (i) (Risk of) *Exposure:* the likelihood or rate at which an individual, household or community will experience energy poverty; (ii) *Sensitivity:* the degree to which those exposed to energy poverty will be impacted or will lead to loss of wellbeing and (iii) *Adaptive capacity*: the degree to which those exposed and affected by energy poverty will plan, respond and recover (Simcock et al., 2021, p. 3). Followed next is the concept of domestic energy poverty.

2.2. Domestic Energy Poverty (DEP)

After a considerable period of relative neglect and non-recognition of energy poverty in the EU, the phenomena has gradually emerged as a central policy (Bouzarovski et al., 2021, p. 1) becoming a political priority since the approval of the Clean Energy for all European Package (CEP) (Rodriguez-Alvarez et al., 2021, p.1). Across Europe, energy poverty is predominant and even though the concept increasingly corresponds to the EU legal framework (Directive (EU), 2018; Regulation EU 2018/1999) and has attracted greater attention amongst researchers, the gravity of the problem exacerbating inequality and injustice are still not widely acknowledged.

Policies and scholarships in many European countries uses the term ‘energy poverty’ to encompass questions of access, infrastructure, and health in addition to the more established issues of affordability and efficiency, while questions of security, equity, justice, and socio-technical transitions are jointly entering the vocabularies of energy and fuel poverty researchers across the world (Bouzarovski & Petrova, 2015, p. 33). The subject of energy poverty outside the UK has received relatively little attention, and Sareen et al. (2020) and Karpinska, & Smiech, (2021) posit that discourses on energy poverty often emphasize its metrics. From the standpoint of policymaking, reducing the time spent on energy poverty and helping households immediately transition to non-poverty states are imperative (Karpinska, & Smiech, 2021).

Boardman (1991) first defined energy poverty as the “inability to afford adequate warmth at home”. This is described as the problem of energy deprivation and has been employed to capture problems of inadequate access and affordability to energy in both developed and developing countries, necessitating a host of economic, infrastructural, social equity,

education, and health concerns (Bouzarovski, & Petrova, S. 2015). Low-income levels, high energy prices and low levels of energy efficiency (particularly in buildings) have been identified in mainstream energy poverty research as the three main drivers of the lack of sufficient warmth in homes (Boardman, 2010; Hills, 2011; Mattioli & Marsden, 2018, p. 115). These factors coupled with common proxy indicators such as energy affordability (based on income, energy prices and energy consumption), energy use patterns (based on energy consumption and type of heating system and share of central heating) as well as housing patterns (tenure system and housing characteristics) determines the level of households' vulnerability or at risk to energy poverty (Pye, S., et al., 2015. P. 10).

According to Sovacool and Dworkin (2015), affordability is not just lowering energy prices so that people can afford warm homes and well-lit dwelling spaces, but also that energy bills do not overly burden consumers. Affordability thus encompasses stable prices (minimal volatility) as well as equitable prices that do not require lower-income households to expend disproportionally larger shares of their income on essential services. Implicit in this criterion is the idea that highly available energy fuels and services is meaningless unless households and other consumers can afford to access and utilize them (Sovacool and Dworkin, 2015, p. 439).

Day et al., (2016), on the other hand, provides a similar definition of energy poverty as a situation of inability to realize the essential capabilities, as a direct or indirect result of insufficient access to affordable, reliable, and safe energy surfaces, as well as considering the alternative means of realizing these capabilities in a reasonable manner. Defined from perspective of capabilities, they emphasizes on the comprehensive multidimensional nature of energy poverty in contrast to limiting energy poverty to some monetary metrics, such as the quantity of energy consumed, or expenditure incurred on energy resources. The capabilities approach to EP draws attention to its multidimensional impacts on wellbeing and human flourishing and a variety of factors such as economic pressure, health conditions, education, security, income, labour productivity, and social inclusion are adversely affected by EP (Cali & Cakir, 2021). Nevertheless, in order to illustrate a holistic, systematic perspective on justice implications, the thesis will adhere to the justice perspectives of Rawls and Fraser (1995) - (re)distribution of benefits, recognition, and procedural - in order to provide a holistic and systematic viewpoint. Followed next is Transport Energy Poverty (TEP).

2.3. Transport Energy Poverty (TEP)

Transport energy poverty is a more nascent term (Sareen et al., 2022), and not sufficiently studied within academic, policy or infrastructure design (Lucas et al., 2016a, p. 354). Lucas et al. (2016) attributes this to the "inadequacy, fragmentation, inconsistency and tokenistic treatment of the issue as well as the more nebulous nature of mobility as a 'merit good' and its less obvious causal chain between a lack of transport and any knock-on negative social consequence". It is becoming even more difficult to define because unlike domestic energy poverty, transport energy poverty lives with individual compared to an entire household, in the sense that, one member of a household may experience it, whereas another member of the same household may not and it is particularly antithetical around gender differences (Lucas et al., 2016a, p. 354).

Again, the highly social, temporal, and geographic context-specific nature of transport energy poverty is such that it is to a great extent connected with the secondary benefit of providing accessibility to goods, services, and activities, making it arduous to bring out a single definitive indicator (Lucas et al., 2016b). As a result, Lucas and Markovich calls for a 'lexicon of definitions to ensure greater degree of clarity and consistency within and between academic and policy literature (Lucas and Markovich, 2011, p. 233; Lucas et al., 2016a, p. 354).

Fundamentally, the concept has been employed in two different ways by academic literatures. A general understanding of the concept is used to refer to all kinds of inequalities associated with both transport and access; hence, 'poverty of transport' and it is used in tandem with other notions such as 'transport-related social exclusion', 'transport disadvantage', 'transport/mobility poverty', 'accessibility poverty' etc (Mattioli et al., 2017, p. 116). Another understanding relates to 'transport poverty', commonly defined as affordability of transport cost, which is used in relation to other notions such as 'transport affordability', 'forced car ownership' and 'car related economic stress' (Mattioli et al., 2017, p. 116).

The thesis will focus on 'transport energy poverty' as the much broader term relating to all kinds of inequalities related with both transport and access, whereas specific considerations will be given to the latter; encompassing issues of transport affordability, forced car ownership and car related economic stress.

The enforced lack of mobility services essential for societal participation, resulting from inaccessibility, and or unaffordability, or unavailability of transport is termed as transport

energy poverty (Lowans et al., 2021b, p. 2). Simply put, transport energy poverty refers to the inability to attain socially or materially necessitated levels of transport services (Martiskainen et al., 2021, p. 4).

The narrower definition of transport energy poverty has compelled Lucas et al (2001) to provide a much broader definition. This encompasses not only the inability to afford or access essential transport services, but the consequential inequalities that comes with it (including accessibility poverty, mobility poverty and other social disadvantages and inequalities). Hence, transport energy poverty is as a result of the compounded effect of transport disadvantage (i.e., not having access to a car, poor public transport options, etc) and other forms of potential social disadvantages (unemployment or low income, disability, or poor health) (Allen & Farber, 2019, p. 215) leading to reduced activity participation, increased generalized cost of reaching destinations, social isolation, and exclusion. Lucas goes on to state that an individual or household is transport poor if,

" in order to satisfy their daily basic activity needs, at least one of the following conditions apply; 1) there is no option available that is suited to the individual's physical condition and capabilities; 2) the existing transport options do not reach destinations where the individual can fulfil his/her daily activity needs, in order to maintain a reasonable quality of life; 3) the necessary weekly amount spent on transport leaves the household with a residual income below the official poverty line; 4) the individual needs to spend an excessive amount of time travelling, leading to time poverty or social exclusion; 5) the prevailing travel conditions are unsafe or unhealthy for the individual" (Lowans et al., 2021b; Lucas et al., 2016)

The core function of an urban transport system is to provide people the opportunity to participate in everyday activities, social interactions, and access to destinations essential for their well-being (Allen & Farber, 2019, p. 215). Transport, therefore, is a derived demand, in the sense that a certain amount is required to access essential services and opportunities as well as to partake in social activities and networks (Mattioli et al., 2017, p. 117). Notably, shorter commuting times, increased employment rates and greater levels of activity participation are associated with greater accessibility and affordability of transport. Hence, transport and access problems, is a contributory factor to a wide range of poor life outcomes, including unemployment, reduced participation in education and training, poor diets, reduced health services usage and exclusion from several social activities and networks (Mattioli et al., 2017, p117).

According to Allen and Farber (2019) one important indicator for assessing the performance and social outcomes of a city's transport network is access to employment opportunities (Allen & Farber, 2019, p. 215). Employment is essential to reducing social exclusion as it provides the financial capacity to support other aspects of life. Difficulties in finding employment can be compounded if local transit services are ineffective in providing access to destinations in a reasonable amount of time (Allen & Farber, 2019). Generally, transport, amongst other things, is a key factor for explaining the observed and related social inequalities (Mattioli et al., 2017, p. 117) and addressing equity in transport system will mean providing equal opportunity (in terms of access destinations and affordability of transport alternatives) while at the same time reducing the gap between the highest and lowest levels of accessibility and affordability. The next section 2.4 discusses the social disadvantages and inequalities related to transport energy poverty.

2.4. Transport Disadvantage, Social Exclusion and Equity in Transportation

In the context of social exclusion, there are significant economic and social costs associated with reclaiming the contributions of individuals and groups that cannot access critical opportunities in society such as education, employment, and health care (Luz & Portugal, 2022, p. 1). As Allen and Farber (2019), asserts, urban transport systems are designed to connect people with daily activities, allow them to interact with others, and let them get where they need to travel for their well-being, yet they can also contribute to societal injustice.

The concept of social exclusion is vast and complex, extending far beyond the economic and material aspects of living. According to Burchardt et al., (1999) an individual is socially excluded if (a) he or she is geographically resident in a society but (b) for reasons beyond his or her control he or she cannot participate in the normal activities of citizens in that society and (c) he or she would like to so participate (Burchardt et al., 1999, p. 229). The choice to participate in societal activities are not voluntarily. Therefore, social exclusion is focused on unequal access to participation in society and its consequences are lack of participation, with income, low education, and limited political power serving only as causes or risk factors.

Social exclusion and transportation nexus has been widely studied and in describing the connection between both phenomena, several concepts have been used. There is no consensus on what term is most used, and terms such as 'transport/mobility poverty', 'accessibility

poverty', 'transport disadvantage', and 'affordability poverty' all describe transport-related social exclusion.

Transport affordability is described as a situation when a household is forced to consume more travel costs than it can reasonably afford, especially costs relating to ‘motor car ownership and usage’ (Lucas et al., 2016a, p. 335). Defined in close association with Forced Car Ownership (FCO), transport affordability is the situation where low-income households must spend a substantial share of their income on running a vehicle due to a lack of public transport and high public transport fares.

Poverty based on accessibility considers how easy it is for people to reach their basic daily activities within a reasonable time and cost. Accessibility poverty thus refers to ‘a situation where an individual’s level of accessibility is insufficient to provide access to key opportunities in a society, such as healthcare, employment, education or social network’ (Luz & Portugal, 2022, p. 5). The difficulty of accessing activities may be due to transportation problems, but it may also be related to individual characteristics and land use patterns (for example, when a person has a high level of potential mobility, but lives in a distant region with few activities).

Mobility poverty transcends a lack of resources for transport options to an absence of motorized mobility. It is a systematic lack of motorised transport that creates difficulties in moving around, which is often (but not always) related to a lack of services and infrastructure.

For an equitable transport system, Allen, and Farber (2019) argue that two forms of equity dimensions must be taken into consideration. One which looks at horizontal equity - addresses the distribution of resources, like transit provision, equally amongst the overall population, whereas vertical equity addresses the distribution of resources with special reference towards specific groups, often those who are more vulnerable to social or economic exclusion (Allen & Farber, 2019, p. 215). For the purpose of addressing equity amongst the most vulnerable in Stavanger, the thesis adopts vertical equity and advocates for justice for ethnic minorities, recent immigrants, asylum seekers, refugees, single-parent families, the aged, students and young people, those who are unemployed, those in low-wage or precarious employment, women, households with children, as well as those with disabilities considered in scholarships as vulnerable to double energy vulnerability (Allen & Farber, 2019, p. 215; Martiskainen et al., 2021, p. 6; Simcock et al., 2021, p. 5).

It has been acknowledged by urban planners in Bergen that these vulnerable groups suffer from transport-related disadvantages. A pyramid that represents the vulnerabilities of various users

and ranks them according to their priority is shown in figure 3. According to Bergen mobility planners, the pyramid suggests a hierarchy of traffic users, with soft users at the top and hard users at the bottom. In recent years, however, the pyramid has flipped, with "hard" users such as car drivers given priority (Wågsaether et al., 2022, p. 7). Accordingly, this shows how vulnerable and 'soft' users are treated during transport, thus indicating that such inequalities need to be addressed. The next section finally unpacks the three core tenets framework of energy justice in relation to domestic energy poverty.

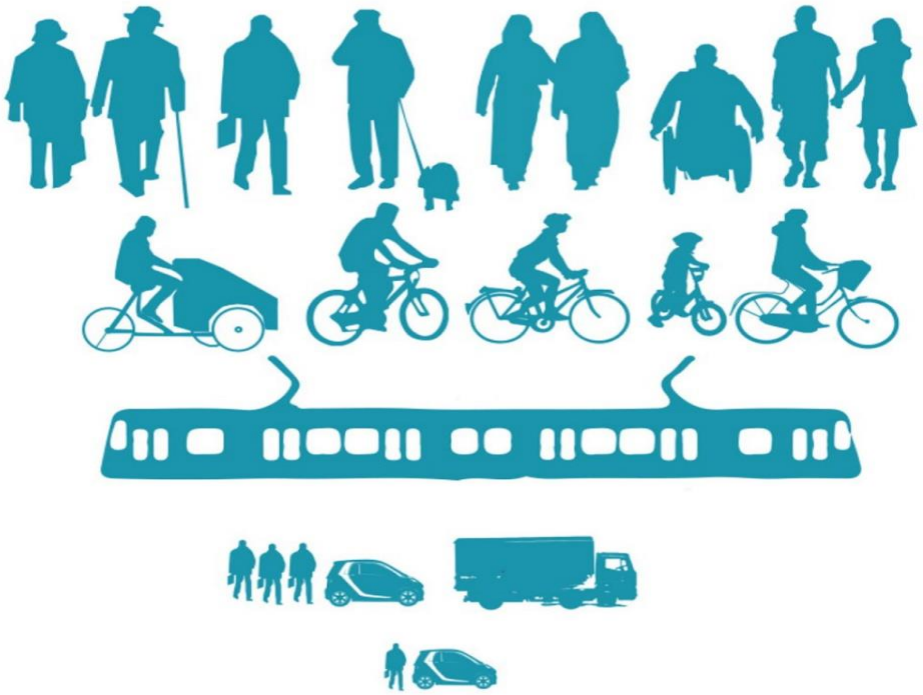


Figure 2 - The Bergen Transport Pyramid (Bergen Municipality, 2016, p. 36; Wågsaether et al., 2022, p. 7).

2.5. Unpacking The Three Tenets Framework of Energy Justice in Relation to (Domestic) Energy Poverty and Transport Energy Poverty

2.5.1. Energy Poverty as a Problem of Recognition Justice

Failure to attribute some groups of people equal respect and equal rights as others leads to social injustices. Seen in this way, recognition justice has been categorized into two; justice as non-recognition – a situation in which the need or circumstances of certain groups are not identified or ignored; and justice as misrecognition and disrespect – a situation in which groups

of people are maligned or stigmatized in public discourse and cultural representations (Jenkins et al., 2016, p. 177; Bouzarovski and Simcock, 2017, p. 644; Fraser, 1995).

In relation to energy poverty, the degree to which non-recognition becomes an issue varies among nations. The UK in particular, have a relatively long history of fuel poverty activism, and the issue has formally been recognized in national policy and discourses since the early 2000s (Bouzarovski and Simcock, 2017, p. 644). Comparatively, some European and Scandinavian states have historically limited awareness of energy poverty as a problem.

In regard to misrecognition and disrespect, underconsumption of energy or lack of access to energy services that most people consider to be normal can be a source of stigma ascribed to the 'spoiled identity' of someone who is poor or incapable (Hards, 2013). As described by Bouzarovski and Simcock (2017), the stigma associated with poverty and under-consumption often thrives in societies with greater economic inequalities and where it is implied that the poor are themselves responsible for their circumstances. (Walker et al., 2013a; Bouzarovski and Simcock, 2017, p. 644).

2.5.2. Energy Poverty as a Problem of Distributive Justice

Distributional justice acknowledges both the physical unequal allocation of environmental benefits and ills and the uneven distribution of their associated responsibilities (Jenkins et al., 2016, p. 176). It also deals with how social benefits and disadvantages are allocated across society (Sovacool). Relating to the fair distribution of benefits and disadvantages, social justice theorist John Rawls (1971) provides a perspective of what is to be distributed and the principles through which a just distribution is to be achieved. He states that “primary goods (such as rights and liberties, power and opportunities, income, and wealth) should be distributed in a manner a hypothetical person would choose if, at that time, they were ignorant of their own status and thus of their competitive advantage or disadvantage, in that society (Rawls, 1971, p. 62; Walker and Day, 2012, p. 70). He further argues that inequality in the distribution of a primary good may be acceptable, on the condition that it benefits those who were least advantaged in general.

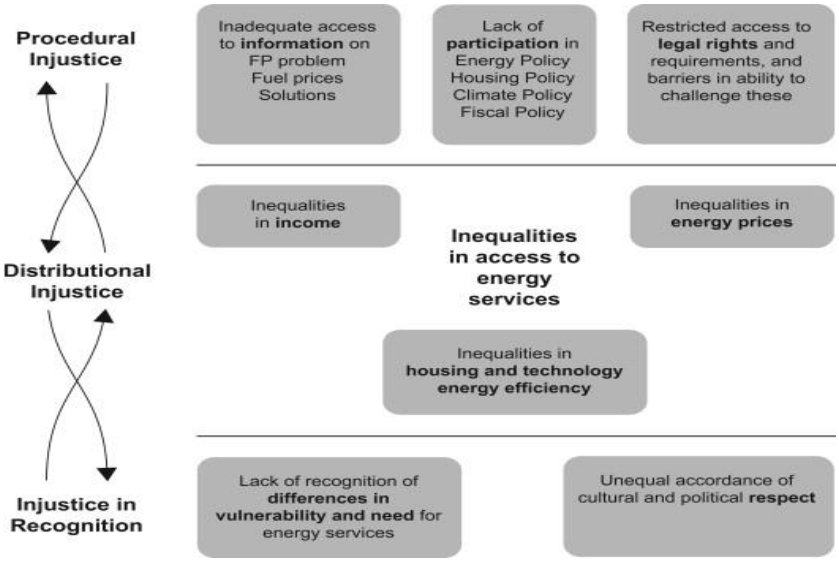


Figure 3- Three forms of injustice and their component parts in fuel poverty (Walker & Day, 2012, p. 74)

The problem of energy poverty is one of many different forms of distributional injustice that results from a combination of income, energy price, and home conditions inequalities. Researchers working on energy poverty have found that there is an uneven distribution of burdens when it comes to affordability and access to energy services and unequal distribution of benefits when analysing energy poverty research. While income or wealth shortage is unquestionably fundamental to fuel poverty, it does not fully explain the prevalence and patterning of the problem - in this sense fuel poverty is unique from general poverty. There is also the price of energy, which clearly determines the relative affordability of energy and, consequently, warmth for people with different income levels. Third, is the energy efficiency of housing, heating, and other technologies. As Boardman (2010) makes clear, poorer, and more vulnerable households tend to live in substandard quality housing and have the least resources or opportunities to improve its efficiency and heating. These interacting inequalities (**summarised in figure 3 above)** make it impossible for households in energy poverty to adequately heat their homes. Additionally, they are unable to pay their fuel bills or must spend a great deal of their income on energy costs.

The issue of income inequality has been a concern of successive governments' fiscal and social policies to varying degrees. There have been specific energy poverty programs that have provided direct monetary assistance to those with low incomes to facilitate their ability to pay their energy bills and these are largely specifically targeted and have a limited distribution capacity. Campaigners have also focused their attention on energy prices after successive fuel,

energy tax and price increases by energy suppliers that were out of line with market trends. Companies profiting at low-income consumers' expense has been seen as a violation of basic notions of fairness while activists have repeatedly called attention to the unequal distribution of energy prices in the UK, highlighting the fundamental unfairness of those on the lowest incomes paying the most (Walker & Day, 2012, p. 71). Through social housing, the distribution of quality housing has been made more equitable in terms of energy efficiency.

2.5.3. Energy Poverty as a Problem of Procedural Justice

The third way of understanding justice is through procedural or participatory justice. In contrast to distributional justice, procedural justice focuses on processes, including those that produce or sustain unequal outcomes. It is also linked to recognition justice, in the sense that, lack of cultural respect and lack of involvement and influence in decision-making closely interconnect (Walker & Day, 2012, p. 72). Thus, procedural justice is characterized by four key elements; 1) access to information; 2) access to and meaningful participation in decision-making; 3) lack of bias on the part of decision-makers and 4) access to legal processes for achieving redress (Sovacool & Dworkin, 2015, p. 437).

In terms of access to information, being able to know the scale of the problem of fuel poverty, its occurrence and patterning is fundamental to being able to redress it, and to enabling advocacy and campaigning groups to call policy bodies to account. Having ready access to information on energy prices and ways to be more efficient in energy use is also important in informing the responses of vulnerable consumers and those supporting them (Walker & Day, 2012, p. 72).

In order to ensure meaningful participation in decision-making, those affected by fuel poverty must be properly represented in a variety of relevant decision-making processes, including energy policy and strategy, energy pricing and market regulation, housing policy, energy efficiency, etc.

Access to legal processes is key for challenging the decision-making and actions of both public bodies and private energy companies that have responsibility for vulnerable consumers. The establishment of laws and regulations that protect the interests of the fuel poor is a prerequisite but allowing low-income people and those with vulnerable circumstances to enforce such laws and regulations is equally significant. The next chapter presents the analytical framework.

3. Chapter 3 – Analytical Framework: Three core-tenet framework of Energy Justice

3.1. Conceptualizing Energy Justice

Energy justice has emerged as a new crosscutting social science research agenda which seeks to apply justice principles to energy policy, energy production and systems, energy consumption, energy activism, energy security and climate change (Jenkins et al., 2016, p. 174). The concept emerged from environmental justice movements and the started gaining greater attention in early 2013 (McCauley and Heffron, 2017)

Before defining energy justice, the concept justice means different things to different people and while it has been defined by various scholars, institutions, and beliefs, its definition (or what it is) is less important than what it actually does (Sovacool and Dworkin, 2015, p. 436). According to Sovacool and Dworkin (2015) promoting and ensuring justice is salient, as it links individual wishes to the value of a larger body, and thus, to the implicit or explicit coercive pressures of society as a whole. Since being dealt justly makes people feel healthy, virtuous, sane, and 'right', justice helps to promote mental health and psychological wellbeing. Also, justice helps to resolve conflict in ways that exceed mere individual preferences and, thus, reduce the demeaning impact otherwise felt by those whose wishes are rejected. Lastly, it enables us to make better choices, even in the absence of disputes, by distinguishing between more or less "just" outcomes expected from our decisions (Sovacool & Jenkins, 2015, p. 437).

I employ the modern conception of justice that strives to promote fairness and a just social structure, and analyse injustices from the normative and evaluative perspective, (**as shown in table 1**) where I will first examine the injustices and then suggest solutions for their resolution.

Table 1- The evaluative and normative contributions of energy justice

Tenets	**Evaluative**	**Normative**
Distributional	Where are the injustices?	How should we solve them?
Recognition	Who is ignored?	How should we recognise?
Procedural	Is there fair process?	Which new process?

Table 1: The evaluative and normative contributions of energy justice

Source: **Jenkins et al., 2016, p. 175.**

Energy justice according to Sovacool & Dworkin (2015, p. 436) refers to the global energy system that fairly disseminates both the benefits and cost of energy services, and one that has representative and impartial energy decision-making. It tries to apply principles and concepts from social justice to the global energy system in its broadest sense (Sovacool et al., 2017, p. 677). Its conceptual framework therefore involves the burdens, or how the hazard, costs and externalities of the energy system are disseminated throughout society; benefits or how access to modern energy systems and services is distributed throughout society; procedures or ensuring that energy decision-making respects due process and representation; and recognition, that the marginalized or vulnerable have special considerations (Jenkins et al., 2016a; Sovacool et al., 2017, p. 677).

Sovacool and Dworkin (2017) puts it that energy justice serves as a conceptual tool for philosophers and ethicists that better integrates usually distinctive and procedural justice concerns. As an analytical tool, it assists energy researchers who are striving to understand how values get built into energy systems or to resolve common energy problems. It also serves as a decision-making tool to assist energy planners and consumers in making informed energy choices (Sovacool & Dworkin, 2017, p. 142).

I seek to understand how values get built into energy systems to solve energy poverty problems and in my analysis of energy poverty, I define justice as distributive, procedural, and recognition. The three tenet framework of energy justice follows next.

3.2. The Three-Tenet Framework of Energy Justice

Scholars have described energy justice in several conceptual frameworks of definitions. As presented in **figure 4**, the concept is defined to include the three core-tenets frameworks of energy justice (also known as a triumvirate of tenets) - distribution, recognition and procedural (Heffron & McCauley, 2017; Jenkins et al., 2016), cosmopolitan and restorative justice(Heffron & McCauley, 2017; Sovacool & Dworkin, 2015) as well as the eight-core principles of practice to energy justice: availability, affordability, due process, transparency

and accountability, sustainability, intra-generational equity, inter-generational equity, and responsibility (Sovacool & Dworkin, 2015).

Lee & Byrne, 2019, p. 2, acknowledge that energy justice has gained increasing popularity in energy social science and its conceptual and analytical framework is widely used to analyze social conditions and processes. Nevertheless, the concept has not been directly applied to studies of double energy vulnerability. In so doing, my thesis seeks to carry out a theoretical integration by situating the analysis and discussion to the three core-tenets framework of energy justice. I apply the three-core tenet framework of energy justice to DEV studies to (i) shed light on distributional unfairness and (ii) reduce such inequality concerning a person's ability to access and consume energy. I do this by first examining (a) which affected sections of society are ignored - recognition, (b) where injustices emerge - distribution, (c) which processes exist for their remediation in order to (i) reveal, and (ii) reduce such injustice - procedural (Jenkins et al., 2016, p. 175).

The thesis, therefore, will focus mainly on recognition justice, distributional justice (which complements availability, intragenerational equity and affordability) and procedural justice (which complements due process and good governance) as a principle for the practice of energy justice in the double energy vulnerability of households in Stavanger.

When looking at the energy justice conceptual framework, one has to narrowly begin with the three core tenets of energy justice to see if they are present in a particular case before broadening their scope to see where the issue fits within the energy system (Heffron & McCauley, 2017, p. 660). For this reason, cosmopolitan justice which seeks a globalized or worldwide perspective to recognize the equal worth of all human beings and restorative justice which seeks justice or repairs the harm done to people (and/or society or nature) after an incident has happened (Heffron & McCauley, 2017, p. 660; Nordholm & Sareen, 2021, p. 5; Sovacool & Dworkin, 2015, p. 440) will not be explored further in this thesis, considering the scope of the study – the urban and peri-urban areas of Stavanger as the locus of empirical analysis, the thesis aim and purpose, its timelines as well as the timeliness of the ongoing energy crisis currently impacting the subjective wellbeing, health, functions, capabilities and finances of Stavanger households. A brief review of the three tenets applied to energy followed next.

3.2.1. Recognition Justice

According to Jenkins et al. (2016), justice as recognition goes beyond mere tolerance and argues for fair representation, freedom from physical threat, and absolute and equal political rights. The authors also stress the need to critically acknowledge the various types of vulnerabilities and specific needs related to energy services among social groups (particularly marginalized communities). Cultural and political dominance, insults, degradation, devaluation, stigmatization, and denigration are all forms of recognition injustices (Bouzarovski & Simcock, 2017, p. 642; Jenkins et al., 2016, p. 177). Fraser (1997) and Schlosberg (2007) also conceive recognition justice to include patterns of non-recognition (invisibility of people and their needs) as well as disrespect through stereotyping and disparaging language (Jenkins et al., n.d., p. 5). Part of recognition injustice further includes misrecognition – that is a distortion of people's view that may appear demeaning or contemptible (Schlosberg, 2003, p. 82) and therefore calls to acknowledge the different and varied perspectives of various ethnic, racial and gender differences (Jenkins et al., n.d., p. 5).

3.2.2. Distributive Justice

Energy poverty is one type of distributional injustice which results from the combination of inequalities in income, energy prices and housing conditions (Lee & Byrne, 2019, p. 2). Distributional justice acknowledges both the physical allocation of environmental benefits and ills (social goods and evils) as well as the uneven distribution of their related responsibilities, particularly the exposure to risk (Jenkins et al., 2016, p. 176; Wågsaether et al., 2022, p. 5). It seeks to understand what a just distribution of economic resources between geographic regions might encompass and further examines where "questions about the desirability of technologies (the location of wind resources) in principle becomes entangled within issues that relate to specific localities" (Bouzarovski & Simcock, 2017, p. 642; Jenkins et al., 2016, p. 176). It does consider not only the location of infrastructures but also access, availability and affordability of energy services (Jenkins et al., 2016, p. 176). From the standpoint of consumption and the core principles of affordability, availability and intragenerational equity, energy poverty research has revealed the uneven spread of burdens with regard to affordability and access to energy services, as well as an unequal distribution of benefits. Section 3.2.1 briefly explains this point.

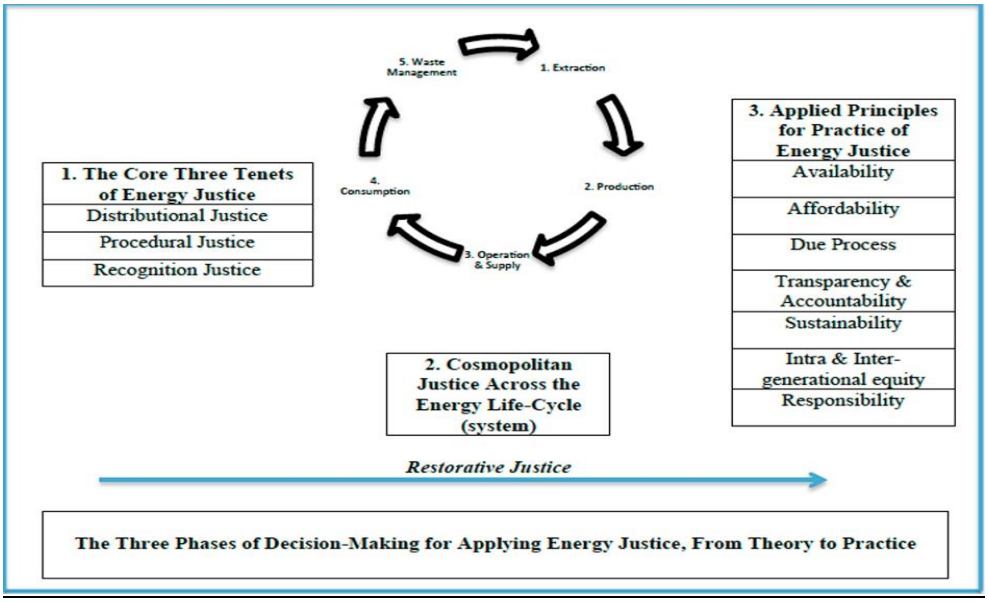


Figure 4- The Energy Justice Conceptual Framework (Heffron & McCauley, 2017, p. 670)

3.2.1. *Availability,* "People deserve sufficient energy resources of high quality" (Sovacool and Dworkin, 2015, p. 440)

The most fundamental element in the principles of energy justice, according to Sovacool and Dworkin (2015, p. 439), is availability. Availability involves the "ability of an economy, market, or system to guarantee sufficient energy resources when needed". Tied strictly to Distributive justice (Distributional justice is in the distribution of economic goods among the members of the society (Pellegrini-Masini et al., 2022, p. 3), availability argues for people to have sufficient access to energy resources of high quality. This cuts across concerns related to security in supply, sufficiency, and reliability to cover a range of different dimensions. It incorporates the physical endowment of a particular country or region and the technological solutions that the region utilizes to produce, transport, conserve, store, or distribute energy (Sovacool & Dworkin, 2015, p. 439). It also includes the amount of investment needed to keep the system functioning, essentially having a robust and diversified energy value chain, as well as promoting infrastructure that can withstand accidental and intentional disruption (Sovacool & Dworkin, 2015, p. 439).

3.2.2. *Intragenerational equity, "**All people have a right to fairly access energy services**"*

Intragenerational equity argues for the right of people to have access to energy services fairly. Embedded in modern theories of distributive justice, intragenerational equity deals purposefully with three aspects of distribution; 1) what goods, such as wealth, power, respect, food, or clothing, are to be distributed; 2) between what entities are they to be distributed; 3) what is the proper mode of distribution-based on need, based on property rights, or something else? (Sovacool and Dworkin, 2015, p. 439).

3.2.3. *Affordability,* "All people, including the poor, should pay no more than 10 percent of their income for energy services" (Sovacool and Dworkin, 2015, p. 440)

The UN Sustainable Development Goal 7 promotes affordable and clean energy, and lacking access to energy supplies, and transformation systems obstructs human and economic development (SDG 7). Affordability practically becomes equal to availability when energy prices rise, and households are unable to afford heat or electricity, lacking access to reliable energy services altogether. Sovacool (2015, p. 439) affirms that the affordability of energy services is not just reducing the prices so that people can afford warm homes or well-lit dwelling spaces but also energy bills that do not overly burden consumers. Affordability embraces stable (minimal volatility) and fair prices that do not demand energy-poor households to expend a more significant portion of their income on essential services. Hence, the concept of highly available and abundant energy services is illogical unless households and other consumers can afford to access and use them. Procedural justice follows next.

3.3. Procedural Justice

Procedural justice is concerned with how decisions are made to achieve social goals or who is involved and has authority in decision-making processes (Sovacool & Dworkin, 2015, p. 437). Thus, it goes beyond mere inclusion and advocates for equitable procedures that engage all stakeholders unbiasedly (Jenkins et al., n.d., pp. 4–5, 2016, p. 178). In principle, procedural justice states that all groups should be able to partake in decision-making effectively and that their decisions should be duly acknowledged and critically considered. As a consequence, four essential elements characterize procedural justice; (1) access to information; (2) access to and meaningful participation in decision-making; (3) lack of bias on the part of decision-makers; and (4) access to legal processes for achieving redress (Sovacool & Dworkin, 2015, p. 437).

Accordingly, this is tied to due process and good governance, which postulates that countries must respect due process and human rights in the production and use of energy, in addition to enabling people to access high-quality energy and environmental information, as well as fair, transparent, and accountable forms of energy decision-making (Sovacool & Dworkin, 2015, p. 440). Followed next (section 3.3.1) briefly describes the process and good governance of procedural justice as core principles for the practice of energy justice.

3.3.1. Due Process, "Countries should respect due process and human rights in their production and use of energy" (Sovacool and Dworkin, 2015, p. 440).

Due process in decision-making aims to ensure that the potential for stakeholder participation in the energy policy process at least roughly matches the importance (in aggregate and to each person affected) of the matter at stake and the irrevocability of any decisions that may be reached (Sovacool & Dworkin, 2015, p. 439). According to Jenkins et al. (2016), due process goes beyond simple inclusion and considers local knowledge mobilization, which seeks the engagement of the affected populace. Due process further entails effective recourse through judicial and administrative remedies and forms of redress (Sovacool & Dworkin, 2015, p. 439). To be precise, it suggests that residents must be involved in deciding about projects as well as processes that may affect them; they must be duly informed, and this must be fair; social and environmental impact assessments must involve their consultation and approval, and neutral arbitration should be available to handle grievances (Sovacool & Dworkin, 2015, p. 439). This notion, in EP studies, is linked chiefly to low-income and energy-poor households, the marginalized, and minority groups. According to Jenkins et al. (2016), early intervention is vital to an effective consultation process. Thus, the engagement of local communities is imperative regarding procedural justice aspects (Jenkins et al., 2016, p. 178). Incorporating the knowledge, discourses, and stories of affected residents in decisions significantly impact policies.

3.2.3. Good governance, "All people should have access to high quality information about energy and the environment and fair, transparent, and accountable forms of energy decision-making"

Finally, to reduce corruption and upgrade accountability, *good governance* ensures that all people have access to high-quality information about energy and the environment (Sovacool & Dworkin, 2015, p. 439). This means impartiality, full information disclosure by government and industry, and suitable and sympathetic engagement mechanisms (Jenkins et al., 2016, p. 178). Full information disclosure, accountability, and transparency, throughout a variety of sectors, are critical constituents of promoting "good governance" and centre on democratic and transparent decision-making processes and financial accounting, as well as effective measures to reduce corruption and publish information about energy revenues and policies (Sovacool & Dworkin, 2015, p. 439). Most often, many governments place public consultation at the heart of energy strategies, and environmental decision-making yet fails to disclose thorough information to the public. This either takes the form of both states induced or voluntary disclosure (Jenkins et al., 2016, p. 178). Nevertheless, Jenkins et al. (2016) and Sovacool and Dworkin (2015) have argued that adequate information disclosure, transparency, and accountability can be driving forces for more ethical and sustainable consumption practices as well as society's choice of energy production (Jenkins et al., 2016, p. 178). This further stimulates democracy, confidence, and trust and enhances social stability (Sovacool & Dworkin, 2015, p. 439).

In EP studies, information disclosure on household energy consumption patterns provides a mechanism for addressing procedural injustices (Jenkins et al., 2016, p. 178). Four information disclosure strategies have been identified by Delmas et al. (2013) as effective in reducing household energy use; (1) information on past energy use; (2) information on conservation strategies; (3) information on monetary savings; (4) information on peer consumption (Delmas et al., 2013, p. 730-731). Adequate information disclosure provides hints and tips to end users on reducing their energy consumption and providing their own usage feedback to authorities, reflection on past usage or, in some instances, patterns of their peers (Jenkins et al., 2016, p. 178). It further stimulates increasing sustainability practices and household inclusion in addressing distributive injustices. The following section (3.3) discusses the limitations of the theoretical framework.

3.3. Limitations of the theoretical framework

To conclude, even though the three-tenet framework of energy justice provides a conceptual backbone for identifying and analyzing problems with regard to common energy (including

energy poverty), Heffron & McCauley (2017) and Lee & Byrne (2019) have criticized the framework as incompetent in tackling the complex political and economic forces that regularly produces energy justice (Lee & Byrne, 2019, p. 2). To them, the framework only focuses on problems like enhanced accessibility and affordability and neglects the structural and ideological pillars of injustices. Moreover, according to Heffron & McCauley (2017), there are limited reflections on how the justices' concepts transfer into practice and are 'enforced' in practice despite their massive application and long history of use in academia (Heffron & McCauley, 2017, p. 660). Even with these shortcomings, nonetheless, Bouzarovski & Simcock (2017) agree that recognition, distributive, and procedural justice concerns are usually the analytical boundary for energy justice discussions and serve as a suitable conceptual framework for investigating injustices arising from energy poverty (Bouzarovski & Simcock, 2017; Lee & Byrne, 2019, p. 3).

3.4. Chapter Summary

The chapter has provided a detailed description of the three-tenet framework of energy justice that will be applied to the analysis and discussion of the thesis. The following chapter (4) presents the methodological approaches to the study.

4. CHAPTER 4 - METHODOLOGICAL APPROACH AND METHODS

4.1. Introduction

Whether implicitly or explicitly, every type of empirical research has a research design and Yin (2018, p. 27) defines this as "a logical plan for getting from here to there, where *here* may be defined as the set of questions to be addressed, and *there* is some set of conclusions about these questions (Yin, 2018, p. 27). Following a clear methodological path should clearly reveal how a researcher complied to both formal and explicit procedures when doing his research and this implies gaining partial or total control through a series of decisions made before the research begins (Blaikie & Priest, 2019, p. 33). Systematically, a research design should incorporate a brief description of the logic or logics that have been selected, and a justification for the selection in terms of its appropriateness for the task of answering the research questions. This chapter gives a step-by-step methodological approaches and process in collecting and analysing data for the thesis.

The first sub-section 4.2 will analyse the logic of inquiry/research strategy (abductive and inductive logic of inquiry) suitable for this research thesis. This will be followed by (sub-section 4.3) the ontological and epistemological assumptions of inductive and abductive logic, justification for the selection of urban and peri-urban Stavanger as the geographic location for the study (Scope) 4.4, case study research 4.5, research design 4.6, data collection techniques 4.7, data analysis procedures 4.8 and the ethical considerations to the research

4.2. Logic of Inquiry – Abductive and Inductive Logic of Inquiry

The logic of inquiry corresponds to particular philosophical and theoretical traditions. It serves as a starting point and a set of steps to answer research questions (Blaikie & Priest, 2019, p. 91). Blaikie & Priest (2019, p. 91) have categorized the logics of inquiry into four different types: Inductive, Abductive, Retroductive and Deductive logic of inquiry. While deductive and retroductive logic are appropriate for answering 'why' questions and most suitable for carrying out explanatory studies, inductive and abductive logic best answers 'what' questions and are useful for explorative and descriptive studies.

I have employed Inductive and Abductive logic in answering my research questions of: (1) What characterizes energy-poor households in urban and peri-urban areas of relatively affluent cities, (2) How are the factors of double energy vulnerability exacerbating inequality, and (3) How can policies target double energy vulnerability to reduce inequality.

The justification for the selection of Inductive logic as the suitable logic of inquiry in this thesis is that the method aims to establish limited generalisations about the distribution of, and patterns of associations amongst, observed or measured characteristics of individual and social phenomenon (Blaikie & Priest, 2019, p. 92). Aside producing fundamental descriptions that refers to single individual or events, it is also suitable for making general descriptions in answering the research questions, questions about the characteristics of categories, groups, or collectives of people (Blaikie & Priest, 2019, p. 92).

The first research question - what characterizes energy-poor households in the urban and peri-urban areas of relatively affluent cities - required the identification and description of individual energy-poor households by choosing a set of characteristics that defined the households (characteristics like socio-economic and demographic). It was necessary to draw distinctions between these identified sets of individual characteristics in both areas and then summarize the most common characteristic in terms of the frequency with which they occurred or the qualities that became noticeable in a specific situation.

The identified energy-poor households were those that spent more than 10% of their income on electricity bills yet earned less than 300,000NOK gross annual income before tax. Although not universally applicable to some extent, Williams (2017, p. 11) argues that the goal of interpretivist research is not to discover universal laws rather make understanding of a particular situation. Employing inductive logic was essential for answering the research question and establishing patterns of associations and regularities at certain times and places were all that was required (Blaikie & Priest, 2019, p. 94).

A set of identifiable socio-economic and demographic characteristics such as employment status, social class, and gender (the unemployed, low-income households, households with children, single-parent households, students, and young people and the retired) were the defined concepts in determining who was vulnerable to both TEP and DEP (Blaikie & Priest, 2019, p. 93). This was further based on the researchers' background knowledge, from theory

and previous research. It was necessary, therefore, to use inductive logic to answer the research question, with the aim of establishing descriptions of characteristics and regularities.

I further employed abductive logic to the research process due to its ability to uncover new insights from the everyday interpretations, meanings, and languages of social actors (Blaikie & Priest, 2019, p. 101). This logic develops deeper understanding based on 'thick' descriptions and social scientific concepts obtained from everyday concepts and interpretations of social actors.

The aim and purpose of this research is to understand the entrenched inequalities and vulnerabilities in the ongoing low-carbon energy transitions. One way of understanding these disparities were to first access and describe social actors lived in experiences of, and vulnerability both DEP and TEP through their meanings and interpretations, the motives, and intentions they provided of their own action and the actions of others. This required thorough understanding of the life experiences of affected DEP and TEP households. With this, categories and concepts are gleaned from the interpretations, forming the keystone with which the problem is properly understood. This approach is always necessary when exploring the largely tacit, mutual knowledge and symbolic meanings of social actors' actions (Blaikie & Priest, 2019, p. 99).

According to Blaikie & Priest (2019, p. 99), abductive logic involves theory development from social actors' meanings and accounts of their everyday actions. It should be made clear that the study does not intend to formulate or test theory as Blaikie and Priest (2019, p. 99) puts it, however, adopting this approach was necessary for "theory matching" through interpreting or recontextualizing individual phenomena within the contextual framework of ideas (Dubois and Gadde, 2002, Kovács & Spens, 2005, p. 138,.Danermark et al., 2002. p. 115). The thesis sought to achieve this by mapping and matching the theoretical framework of the three-tenet framework of energy justice and the empirical data through the semi-structured interviews, document analysis, secondary data and the observations of social actors' actions and activities.

The logic of inquiry further corroborates with depth realist, idealist, constructionism, and conventionalism of the ontological and epistemological assumptions of inductive and abductive logic (Blaikie & Priest, 2019, p. 101-104). The next section discusses in detail the ontological and epistemological assumptions of the chosen logics of inquiry.

4.3. Ontological and Epistemological assumptions of Abductive and Inductive logic

Every social science examination entail metatheoretical (i.e., ontological, and epistemological assumptions) (Danermark et al., 2002., p. 150) and the fundamental conception of ontology and epistemology explains the nature of social reality (ontology) and in which way knowledge of social reality can be acquired (epistemology) (Blaikie and Priest, 2019, p. 102). According to Blaikie and Priest (2019) ontological assumptions argues on the existence of social phenomena, the conditions with which it exist and how they are interconnected. Epistemological assumption, on the other hand, lay claims to knowledge foundations, how knowledge is made possible and the criteria for determining when knowledge is adequate and legitimate (Blaikie & Priest, 2019, p. 102).

The aim and purpose of the thesis conforms to depth realist, idealist, empiricism, rationalism, constructionism, and conventionalism of the ontological and epistemological assumptions of inductive and abductive logic. The key underlining assumptions of depth realist and idealist supposes that social reality is perceived as social episodes produced by the shared interpretations and cognitive resources of social actors (Harre) through their daily activities, whereas constructionism, empiricism, rationalism, and conventionalism lay claims of knowledge production as unmediated scrutiny that comes from the structures of human thoughts (Blaikie & Priest, 2019). In practice, the thesis relies on a subjective, as opposed to an objective constructive outlook that postulates that individuals slowly build their own understanding of the world through experience and maturation (Willis, 2007, p. 96). Its classical and contemporary philosophical paradigms, therefore, represent that of interpretivism, classical and contemporary hermeneutics/ phenomenology, interpretivism, ethnomethodology, structuration theory and feminism (Danermark et al., 2002, p. 163, Blaikie & Priest, 2019, p. 111).

4.4. The Urban and Peri-Urban Case Selection and Scope

The justification for selecting both the urban and peri-urban areas of Stavanger were based on practical and theoretical reasons. Practically, I live in Madla, closer to the city centre and to Storhaug (Østre Bydel) and was possible to collect data as such. Bryne, which represents the

peri-urban is accessible via a train from Stavanger city centre. So, I was influenced by the accessibility and location of both places.

Theoretically, by restricting the scope of my study to the urban and peri-urban areas of Stavanger, I am able to define spatial and demographic demarcations and, overall, the geographical setting for my study. For example, Simonsen & Skjulhaug, 2019, p. 189, discuss how central urban areas offer short transaction distances and private services, shopping, and amenities. Although these aspects are evident in Østre Bydel, it also has a high socio-economic and socio-material vulnerability (Sareen et al., 2022, p. 5). Bryne's peri-urban location, on the otherhand, does not necessarily translate into poor living conditions, however, it does influence practical participation in society (due to long distance commuting). Peri-urban areas are often socially fragmented, unevenly populated, and disconnected from local facilities and services (Simonsen & Skjulhaug, 2019, p. 185). The distances between peri-urban areas and urban centres are generally longer and more fragmented than between urban areas and well-established neighbourhoods. The next section discusses the adoption of qualitative case study research.

4.5. Multiple (Comparative) Qualitative Case Study Research

The thesis research approach identifies with an explorative multiple case study research, with urban peri-urban Stavanger as its unit of analysis (Sovacool et al., 2018, p. 30; Bryman, 2016, p. 61). The purpose of conducting explorative research is to examine a phenomenon thoroughly. Neuman explains explorative research as research with the "aim to examine a less explored or understood phenomena and develop preliminary ideas about it and move towards refined questions" (Neuman, 2014, p. 38). Exploring the phenomenon as a case allowed for an in-depth understanding and helped link ideas in understanding the groundwork of the analysis. Explorative research addresses 'what' and 'how' questions (Neuman, 2014; Yin, 2003) and this thesis framing of the 'how' research question is '*how are the factors of double energy poverty exacerbating inequality*?'.

Case study research entails a detailed assessment of particular subjects or phenomena (e.g., individuals, firms, cities, policies, adjustment to a new technology) and related contextual conditions, often using multiple sources of evidence (e.g., documents, interviews, direct observations etc) (Sovacool et al., 2018, p. 30). According to Robert Yin, a case study is "an

empirical method that investigates a contemporary phenomenon (the case) in depth and within its real-world context, especially when the boundaries between phenomena and context may not be clearly evident" (Yin, 2018, p. 15).

The research identifies with a case study (as a method of selection- a choice of what to be studied and not a methodological choice) and my reason for studying two contrasting cases using more or less identical method is to understand the real-world case (which is double energy vulnerability) and assume that such understanding is likely to involve important contextual conditions pertinent to the case (Bryman, 2016, p. 64; Yin, 2018, p. 15). The context of the case study reveals the urban and peri-urban locations, accenting how low-income households may uniquely experience DEV in Stavanger. Followed next is the research design.

4.6. Research Design

In this thesis, I have applied a qualitative research method, considering the ontological interpretative/phenomenological assumptions which premises on the belief that, "the real world and the incidence and phenomena that happens in it, are created by subjective thoughts, actions and interactions of social actors who lives in it" (Brotherton, 2008, p. 36). Employing qualitative method of analysis was suitable in answering the research questions. This was made possible by accessing in-depth the perspective of households, interpretations of individual experiences, and meaning identification to those experiences held (Sovacool et al., 2018, p. 28).

4.6.1. Qualitative Research Approach

Data for the thesis was collected using semi-structured interviews implemented with individuals (or households), data from the Norwegian Energy Poverty project (serving as a primary data for the urban areas), surveys methods (both expenditure-based and perception-based survey) and document reviews from municipal sources.

The semi-structured interview consisted of pre-set open-ended questions which took into consideration the three-tenet framework of energy justice and emphasized more of procedural justice concerns with additional questions probing from the discussion. Data from the

Norwegian Energy Poverty project (a small-scale qualitative expenditure survey) involving a fieldwork from late August to early September 2021 was employed and analysed as data for the urban area, while expenditure-based and perception-based surveys focused on the peri-urban area, hence allowing for a comparison of the two places.

Finally, the methods were complemented with desk-based analysis of municipal sources such as reports, websites, and news media. The method was useful in identifying phenomena among which connections were established (Blaikie & Priest, 2019, p. 203). These triangulating methods assisted in bringing out essential elements and greater insights to the problem at hand, restraining the heavily criticizing use of qualitative method as lacking widely accepted standard of rigor, interview biases and social desirability biases (Sovacool et al., 2018, p. 29). The interviews and surveys provided access to peoples lived in experiences, motivations, beliefs, understandings, and meanings while analysing documents provided insight into information, frames and storylines presented by different actors, as well as the social interactions among them (Sovacool et al., 2018, p. 29).

Owing to accessibility and lived-in experiences relevant to the research questions, I adopted convenience and purposive sampling procedures respectively in collecting data from respondents. With the purposive sampling, individuals above 18 years of age (including males and females) were only considered as eligible to participate in the study, below (17 years and below) which persons were not considered. The reason for this is that individuals from 18 years and above were capable of taking full responsibility of themselves (in terms of renting an apartment, paying bills, buying cars, paying for transport fares etc) and becoming self-dependent. This age represents maturity and experience and explains the age limit of the sample size. Data from the convenience sampling, on the other hand, was collected from special social media interest groups (Stavanger expats) consisting of both Norwegians and other foreign nationals' resident in Norway.

In all, 45 data responses were received from the urban area, 15 responses from the peri-urban (expenditure-based small-scale survey), 8 separate interviews (4 from the urban and 4 from the peri-urban), 21 perception-based responses from targeted social media interest groups and document analysis of municipal sources. Even though conducting a comparative study with 45 data responses from the urban areas as against 15 responses from the peri-urban areas seems small and somewhat questionable, Sovacool et al. contends that qualitative researchers argue that "less is more" in terms of the sample size, since depth is more important than breadth.

Qualitative studies that compare samples from different cases, regions or settings regularly produces more useful results (Sovacool et al., 2018, p. 29). This is not to dispute the fact that larger samples are not useful. Larger samples hold more value, especially if it increases the breadth of perspectives, and has a strong internal and external validity (Sovacool et al., 2018, p. 29). Followed next is the data collection procedures.

4.7. Data collection

This section provides a step-by-step procedure in collecting the data. There were eight semi-structured interviews, a document analysis of scholarships and grey literature, a self-administered (expenditure paper-based survey) questionnaires, and an online survey (Perception-based survey) targeting specific social media interest groups. Additionally, existing empirical data and materials from the Norwegian Energy Poverty (No-EPOV) project were employed and analysed on the part of urban areas. The self-administered questionnaires and semi-structured interviews mainly focused on collecting data from Bryne, allowing for a comparison of the two places. A desk-based study of municipal sources further complemented this. Finally, before the methods and procedures were implemented, a final assessment and approval were obtained from the Norwegian Centre for Research Data (NSD).

4.7.1. The Norwegian Energy Poverty (No-Epov) Project

Data collected within the Norwegian Energy POVerty (NO-EPOV) project which commenced from August to December 2021 by a five-person team, was used as part of the data for the thesis. The research studied the Double Energy Vulnerability in the context of Norwegian cities and focused on urban areas in Stavanger (Østre Bydel). Using small-scale qualitative expenditure-based survey, the data reported on individual and household's lived-in experiences and vulnerability to both domestic and transport energy poverty. Questionnaires for the project were designed in line with the understanding from scholarships on the topic as well as existing works on energy poverty and practices in urban Norwegian contexts, personalizing it to the context of Stavanger and Østre Bydel. The questionnaire was designed based on individual understanding and internal reflection of the topic and tried out amongst team member to ensure it captured the details the study needed for the analysis before it was sent out on the field.

The field work took place from late August to early September, giving the researchers exactly three weeks, according to the timeframe given for the study. Specified areas within Østre Bydel for data collection included Stavanger sentrum, Badedammen, Bergeland, Nylund, Lervig, Emmaus and Varden. A map of the study area was included to help respondents locate exactly where they lived. This helped in ensuring that households strictly lived in the targeted locations for the study.

Team members approached respondents outdoors at various locations within Østre Bydel at different times of the day. In all, 45 responses were received, and data were collected on both weekdays and weekends. However, weekends were most suitable, and a lot of responses were recorded due to the ten-minute timeframe of the questionnaire. The numbers on the map refer to the codes assigned to each respondent (example: interviewer two coded their respondents starting with 200, while interviewer three coded starting from 300). As evident, the study achieved considerable breadth in the spatial distribution of Østre Bydel residents.

4.7.2. The Online survey (Stavanger Expats group) – Perception-based questionnaire

The online survey (perception-based questions) targeted specific social media groups like the Stavanger expats (see section 2.4). The Stavanger expat group is a Facebook group located in Stavanger and open to all foreigners (and also Norwegians) moving to and living in Stavanger, Norway. This includes diverse kinds of people from different backgrounds, race, religion, ethnicity, country, etc.

The questionnaire was first sent to the group administrators and moderators for thorough scrutiny before it was approved for access by the entire group. This was done with the purpose of not breaching the rules and regulations of the group and also to ensure the questions did not go against group members identity. Being it race, religion, ethic group, colour, sexual orientation etc. Questions were designed to capture the perception of individuals or households lived in experiences of DEV. It featured 21 questions on a google form, divided into two main categories: Household economy and energy use and Household transport use. Because the group included Norwegians and immigrants, the questionnaire was written in both English and Norwegian, making it easier for everyone to participate, willingly and based on their preference.

To prevent biases in recruiting or inviting individuals to respond to the questions, the form (or questionnaire) was placed generally in the group, allowing everyone access and the equal opportunity to participate, voluntarily. This also prevented the invasion of privacy. It was placed in the group on the 12th of February through to 12 March and received 21 detailed responses. In addition, highlights from previous comments made on a post by an expat regarding the increases in electricity prices were captured and presented below in the empirical analysis. This was based on a recently received 13.000-krone electricity bill of a household in contrast to a 3.500-krone electricity bill received the same year, sparking a lot of comments, detailed lived-in experiences and injustices meted out to low-income households and lowly temporary residents.

4.7.3. The Paper-based survey (Expenditure-based questions)

Another expenditure-based questionnaire was designed for inhabitants of Bryne. It adopted the same method of data collection from Østre Bydel. Changes, however, had to be made on the specific questions relating to geographical location of inhabitants. The purpose of this questionnaire, similar to Østre Bydel, was to capture the energy and transport expenses vital in measuring the amount of cost household incurs. To ensure the questionnaire suited the intended purpose, it was first tested on team members of the No-EPOV project who, based on their prior experience, made corrections, and contributed suggestions to the questionnaire, before sending it out to the field.

Data collection at Bryne commenced from 17th February to 10th March (three weeks). Contrary to Østre Bydel, the questionnaire was mostly answered during weekdays (in the afternoons and evenings) than on weekends. People were approached randomly for response, but care was taken to ensure that they were above 18. This was done by asking them first of their age before data is collected. A map of Bryne was added to the questionnaire to help respondents locate approximately where they lived. A random door-to-door survey was also carried out on weekends (Saturdays and Sundays). These are days people usually worked less and spend time with their families at home.

4.7.4. Semi Structured Interviews

Semi-structured interview involves "prepared questioning guided by identified themes in a consistent and systematic manner interposed with probes designed to elicit more elaborate responses" (Qu & Dumay, 2011, p. 246). Punch argues that "the interview is one of the main data collection tools in qualitative research as it provides enough grounds for accessing people's perceptions, meanings, definitions of situations and construction of reality" (Punch, 1998, p. 174).

Although the expenditure and perception-based responses captured the incidences of DEV experienced amongst households, a semi-structured interview was conducted to further collect in detail, the experience of households regarding the recent increases in energy prices. The interview questions were specifically designed to capture general procedural and distributive injustices as well as other forms of injustices at the household level. In total, eight (8) individuals were interviewed (4 males and females each) and equally represented both the urban and peri-urban areas.

The interviews were conducted from 3rd March 2022 to 30th March 2022 and respondents living in both Østre Bydel and Bryne were recruited randomly via Facebook. A general invitation was sent to the Stavanger expat group seeking for respondents to be interviewed on the topic. Aside this, private messages were sent to individuals randomly and asked to participate in the interview discussion. Dates were listed and respondents were made to choose the dates that suited them for the interview. The researcher and those who voluntarily agreed to be interviewed set a venue and date, depending on their availability to meet.

The interview took the form of a semi-structured one, allowing for a scheduled and unscheduled probe for clarification and elaboration (Holstein and Gubrium 1995, p. 39; Qu & Dumay, 2011, p. 247) and before each interview started, an information letter which captured in detail the purpose of the study was handed out to them and were made to agree and sign a letter of consent. By agreeing to be interviewed, respondents were made aware of recording of responses and encouraged them to be anonymous as possible. Below is Table 2 and 3, highlighting the interview dates and times, status, and sex/gender of each respondent. Respondents' identities were represented with code numbers, strictly going according to the planned assessment of NSD.

To ensure equal representation, 2 males and 2 females in each study areas were interviewed. Within this were students, unemployed households, immigrants, part-time workers, and a full-time worker. One female from Bryne did not reveal her economic status due to personal reasons. The interview format presented next.

Table 2 - Interview Sessions of respondents from Østre Bydel

INTERVIEW DATES & TIMES	SEX/GENDER	STATUS	RESPONDENTS' IDENTITY
03/03/2022 (13:05 – 13:35)	Female	Student	Ø1
05/03/2022 (11:15 a.m. – 12:03noon)	Male	Unemployed	Ø2
10/03/2022 (14:20-14:57)	Male	Immigrant and part-time worker	Ø3
15/03/2022 (10:7-10:21a.m.)	Female	Full-time worker	Ø4

Table 3 - Interview Sessions of respondents from Bryne

INTERVIEW DATES & TIMES	SEX/GENDER	STATUS	RESPONDENTS' IDENTITY
4/03/2022 (09:06-09:27)	Male	Student	B1
22/03/2022 (10:00-10:25)	Male	Unemployed	B2
23/03/2022 (15:15-15:57)	Female	Student and part-time worker	B3
30/03/2022 (13:15-13:57)	Female	No answer	B4

4.7.5. The Interview Format

Before the interviews, several protocols were observed between the researcher and the respondents.

First of all, appreciation was showed to the respondents through, vote of thanks, for their time and willingness to participate in the interview process. Secondly, the researcher introduced himself, the theme, problem, research issue, scope, aim and purpose of the study to the respondents, giving them foreknowledge and understanding of the topic as well as how timely and significant the study was and their need for involvement as such. Also, because the research had gone through careful assessment by the Norwegian centre for Research Data | NSD, respondents were made aware of the fact that the research was solely for academic purpose and that their confidentiality, anonymity, and personal data protection rights were strictly under check and would not be compromised on. Again, respondents were made aware of how their data would be analysed and reported and that their data was going to be deleted or discarded after the study is completed. With this, the researcher sought for permission to record the interview discussion and take notes to ensure quality and clarity of the responses given.

Finally, an information letter from the NSD portal was handed out to respondents to carefully read and sign as a form of consent. This included detailed information from the start of the research through to the end, including information on data protection rights and the rights of respondents to withdraw from the study or request for their data not to be used for the research. The researcher ended the interview by thanking the respondents.

The next section 5.4 will discuss the procedures for analysing the data, followed by the validity and reliability of the research, the ethical considerations, and challenges or limitations of the study.

4.8. Data analysis procedures

Different approaches exist for analysing qualitative data. This include interpretive approaches, social anthropological approaches, and collaborative approaches (Miles & Huberman, 1994). This thesis uses interpretative approach that treats social actions and human activities as texts. For the analysis, interviews were transcribed into written texts and key themes were reconstructed from the text through a thematic analysis of households' lived-in experiences and vulnerabilities, in particular, when they have emerged as relevant, similarities and differences with respect to households' vulnerabilities to DEP and TEP.

4.8.1. Identifying the thematic framework

The study adopted a thematic framework as a means of categorizing and structuring the data collected during the study. Before using the thematic framework to categorize the data, recorded interviews were played severally for the purpose of data familiarization and was transcribed (written down) manually into a textbook. The data was then classified and organized according to key concepts, themes, and as emerging categories (Ritchie et al., 2003). The theoretical analytical background in Chapter 3 (The three core-tenet framework of energy justice) provided a basis for capturing the main themes and concepts, leading to a theme-based analysis of the data. Thus, the thesis deduced the key concepts and themes from the theoretical analytical framework and matched them with the primary data collected from the interviews and the subjective reports

4.8.2. The Framework Approach to Thematic Analysis

In identifying recurring ideas and topics in the data, a framework to the thematic analysis of the qualitative data was used. The framework helped in searching for themes and categories in the data and followed Ryan and Bernard (2003) recommendation when searching for themes in a data. This included (1) repetition – establishing patterns within the data relevant to the research question and focus, (2) similarities, and differences – exploring how interviewees discuss a topic in different ways, categories – local expressions used in an unfamiliar way and (3) the use of metaphors – the way in which participants represent their thoughts in terms of metaphors or analogies (example, people described their vulnerability to DEP as like 'the Heat of Eat' situation) . The table below (table 4) depicts the framework adopted for the thematic analysis.

Table 4 The Framework Approach to Thematic Analysis

DOUBLE ENERGY VULNERABILITY									
Domestic Energy Poverty (DEP)					**Transport energy Poverty (TEP)**				
	Health	Energy afford.	Heat or eat	Subj. wellbeing	FCO	CES	TRE	Trans. Afford.	Trans. access

Interviewee 1								‘Public transport fares are expensive’	
Interviewee 2									
Interviewee 3			‘Struggle to choose between paying electricity bills and eating enough						
Interviewee 4	‘Burn more woollen clothes indoors.								‘Difficulty in accessing certain destinations’

Table 4. Framework approach to thematic analysis based on Ryan and Bernard (2003). Table adjustments have been made by the author.

4.9. Ethical Considerations

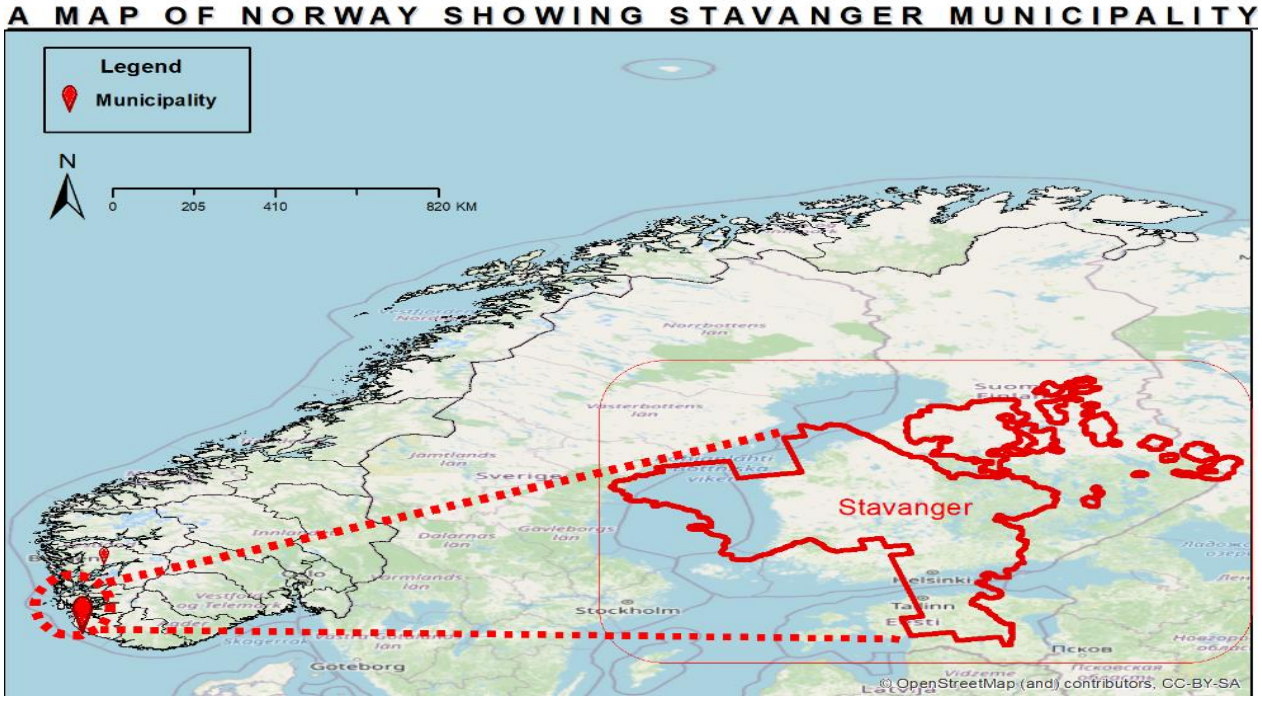
Finally, ethics in social research is particularly crucial, due to its human involvement and the possibility of producing harmful as well as beneficial results. Blaikie and Priest (2019) contend that social researchers must weigh the benefits of their research against potential harm, whether it is physical, psychological, social, political, economic, or legal. Even research that is not directly involving humans must take ethical considerations into account, especially when analysing data sources (Blaikie & Priest, 2019, p. 51). In this manner and as mentioned earlier, the researcher has obtained an ethical clearance from the Ethics Committee and the research has been thoroughly evaluated by the Norwegian Centre for Research Data. Lastly, as part of the interview process, the researcher sought the consent of all interviewees and assured them that their personal information would be kept confidential, anonymous, and protected in everyway. The next chapter presents a contextual background of the cases.

Chapter 5 – Contextual Background & Historical Overview Of Østre Bydel (Storhaug) and Bryne

5.1. Norway and Energy Poverty – A Historical Overview

Despite its prevalence, energy poverty remains a largely unexplored phenomenon in Norway. Hutton and his colleagues conducted a more thorough study of energy poverty in Norway and the United Kingdom in 1988 and found that Norway was less susceptible to energy poverty than the United Kingdom (Hutton, 1998, p.1). In addition, Norway has historically had one of the lowest energy prices among the EU nations (Bredvold, 2020, p. iv), justifying the reason for the lack of attention given to energy poverty studies.

In recent times, however, the phenomena has become much more prominent over the past few decades, as well as briefly before the election season (September 2021) and during some long winters that were dry and cold. Before this Hutton, et al., (1988) argued that housing was a major challenge in Norway in the nineties, proving that energy poverty appears to have become much more prominent over the past few decades.



Map 1 - A map of Norway showing Stavanger (South Norway) – Site area

Source: Drawn by author using ArcMap and image editing software Figma

5.2. The case of Stavanger

The South-west coastal city of Stavanger is Norway's third largest region with about 485 797 inhabitants (Statistics Norway, 2022). The city is historically known for its use of natural resources (hydroelectric power, wind, sun, and bioenergy) as well as its building-related industries, and for the past half century, it has also been the state capital's petroleum industry, resulting in the city and its neighbouring towns being some of the wealthiest in Scandinavia.

Despite Stavanger's relative prosperity, the municipality has one of the highest levels of income inequality in Norway (Sareen et al., 2022, p. 4; Tuv, 2019). This local wealth disparity raises interesting questions about what it means to be poor in a wealthy city, a setting that is particularly suited to study DEV since it entails the study of disparities among local populations.

Urban (Østre Bydel – Storhaug)

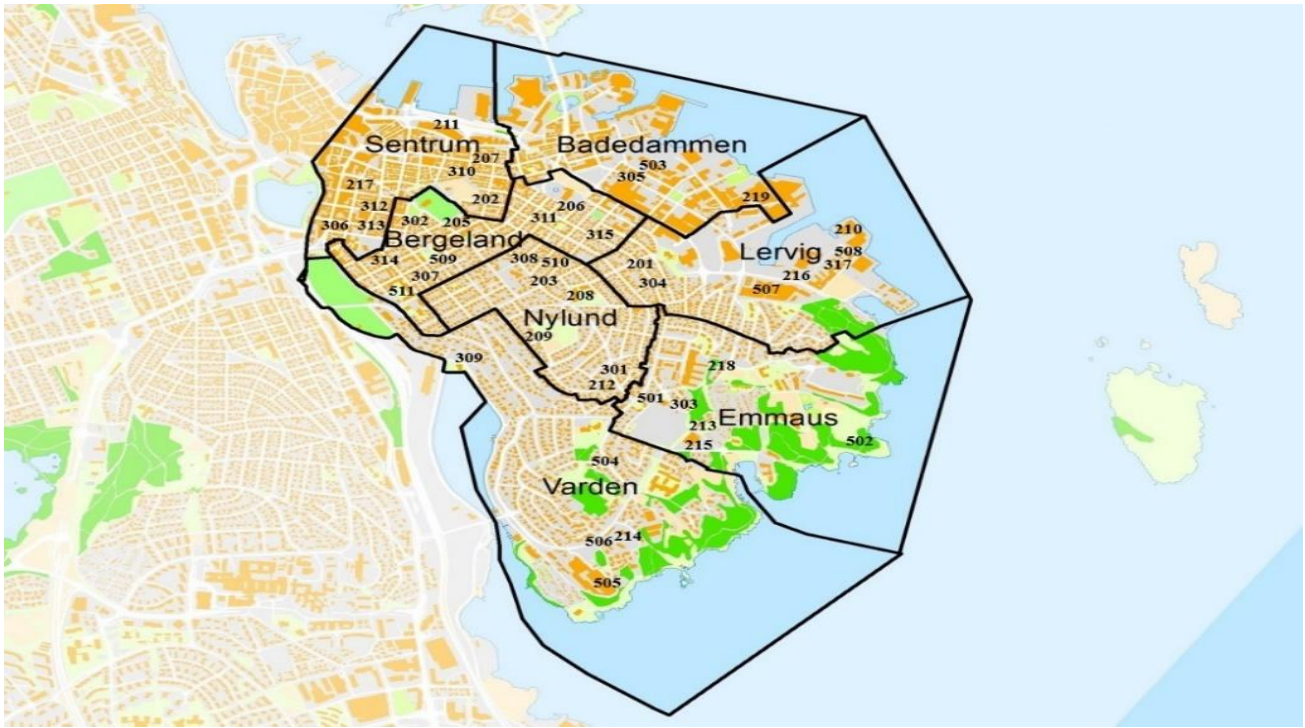
Map 2 - A map of Stavanger showing Østre Bydel and Bryne

Source: Image captured from Google Earth

Peri-Urban (Bryne)

5.3. The Case of Østre Bydel

Østre Bydel, the fourth most populous city on the southwest coast of Norway and a suburb neighbourhood directly east of the city centre in Stavanger (in the county of Rogaland), historically has been the industrial backyard of Stavanger but has undergone redevelopment recently. It stretches to include Storhaug, a municipality of about 17 597 people and among the sub-areas of the municipality are Johannes, Nylund, Varden, Bergeland, Emmaus, Lervig and Sentrum (Stavanger Municipality, 2022). The high seat of the Norwegian petroleum industry has made the city and its adjacent municipalities among the most affluent in Norway in terms of median income per household, with SSB (2022) reporting an average monthly earning of households of about 50 790 KR. The number of people working in Stavanger are 74, 730 and the most popular job opportunities through Pedersgata leading to Stavanger east are restaurants, shopping centres and hotel jobs. Residents who commute to work from Stavanger to another municipality are 28 018, and residents who commute to work in Stavanger municipality are 35 719 (SSB, 2022). 61 668 households privately own cars, and a larger number of residents rely on all forms of public transport.



Map 3 - A map of Østre Bydel featuring the geographic coordinates of respondents. No-EPOV Project.

Source: Sareen et al. (2022, p. 6)

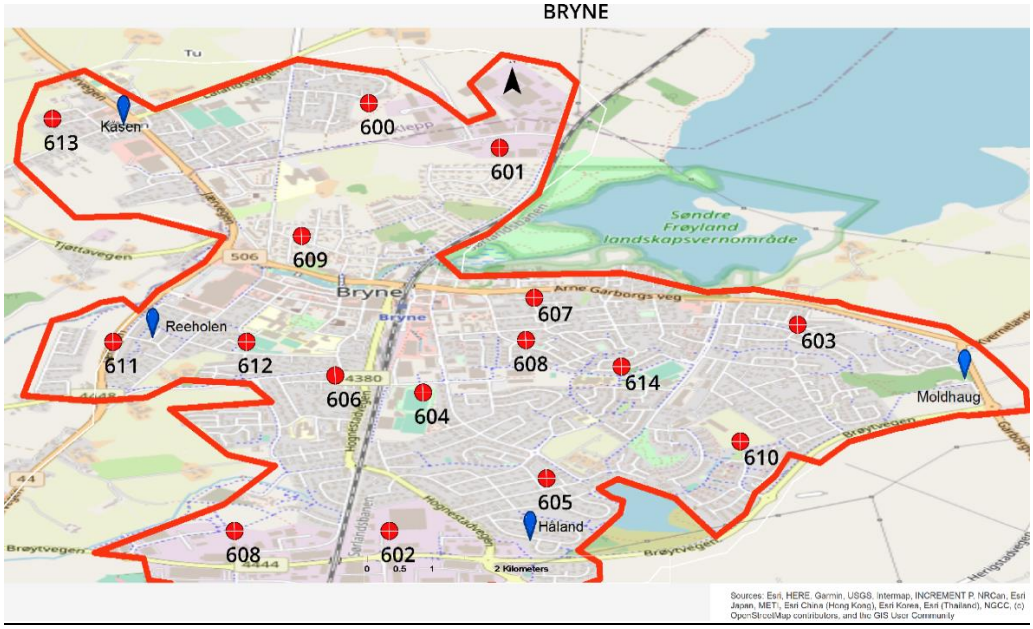
Again, Østre Bydel has the lowest median income and rate of education, the highest rate of increase in child population and highest incidence of child poverty and unemployment rate in Stavanger (Stavanger Municipality, 2019). According to the 2016 Stavanger Living Conditions Report when the oil crisis was at its peak, unemployment was highest in areas close to the city centres (especially Storhaug) and the proportion of children in low-income families in Stavanger were mostly found in places like Badedamen, Sentrum, Kvaleberg and other downtown and areas closer to the city centre. The relocation pattern meant that more families with children chose to live in the areas close to the city centre while the survey reported a stronger overrepresentation of young adults.

5.4. The Case of Bryne

The administrative centre of the municipality of Time, Bryne, is a small town located (on the Southern shores of the lake Frøylandsvatnet, about 25 minutes south of the city of Stavanger by train) in the municipality of Time, in Rogaland's County. It has a population of 12 465 (SSB, 2022), and with its road and rail connections, the town is known as a famous commuter town in the region of Stavanger. About 10,297 people work in Time municipality, with the main employment opportunities being restaurants jobs, shopping, and hotels jobs. Accordingly, 91, 931residents living in Bryne privately own cars while most people rely on public transport for commuting (especially the Stavanger-Egersund train).

The history of Bryne suggests that Bryne originated from Thime Station, which is now Time Station. When Jaerbanen square last open in 1887, it was made of a small cluster. The most prominent buildings were a bedehus as well as the station building (Stangeland, 2021). Bryne, in recent times, has developed rapidly and the town is now considered as number one among the stations between Stavanger, Sandnes and Egersund. The city finally changed from Time to Bryne about100 years ago (Stangeland, 2021).

The next chapter (6) introduces the structure to the analysis and analyses the data collected from households in both study areas.



Map 4 - A map of Bryne showing the geographic coordinates of respondents

Source: Drawn by author using ArcMap and image editing software Figma

6. Chapter 6 - Applying the analytical framework

In order to avoid fragmentation and ensure detailed analysis structure, it is important to explain how the analysis will be conducted. I first identified and analysed households who are vulnerable to both domestic and transport energy poverty in both areas based on the 10% indicator and subjective responses of households (the 10% indicator and subjective view explained in section 6.2). From there, I analysed energy poverty as a problem of distributive justice and finally examined households' desired recommendations for a better energy and transport system.

The analysis is structured as follows; The first theme (1) will analyse issues of recognition. This is done by identifying or recognizing households at risk of DEP in both areas. Followed next will identify and analyse households at risk of TEP in both areas.

Theme three (2) will analyse energy poverty as a problem of distributive justice. This is done by conducting analysis on energy poor households and their awareness and receipt of subsidies and other benefits.

The last theme (3) will analysis the identified sought-after policy recommendations of households. Issues regarding procedural concerns will be moved to the discussion section.

6.2. Setting of Thresholds/Indicators – Perception-based Indicator and the 10% Indicator

In setting the threshold for the identification of household vulnerability to DEP and TEP, three EP indicators will be considered. First, is the perception (subjective based) indicator, which reports on households' lived-in experiences and variables to TEP and DEP, providing an intuitive self-assessment and subjective responses to DEV experiences of households in Stavanger.

Secondly, I employ 10% indicator which recognises households who spend over 10% of their income on energy and transport cost, as vulnerable to DEV (Robinson & Mattioli, 2020, p. 72).

Lastly, the income and wealth statistics of households in Norway (updated 1 March 2022) shows the household with the lowest annual income after tax per annum to be 287,000 NOK. Based in the statistics, I determine the threshold for energy poverty as <300,000 NOK. Below

300,000 NOK combined with the 10% indicator, a household will be defined as energy poor (SSB, 2022).

THEME 1

6.3. A COMPARATIVE ANALYSIS OF DOUBLE ENERGY VULNERABILITY IN STAVANGER'S ØSTRE BYDEL AND BRYNE

6.3.1. Incidences of Domestic Energy Poverty in Østre Bydel

Even though low-income households who spends more than 10% of their income on energy (electricity) bills are deemed vulnerable to domestic energy poverty, the risk of poverty and social exclusion, according to Eurostat (2021) is defined not only on household's income level, and because deprivation is multidimensional, analysing only income poverty becomes deficient (Castaño-Rosa & Okushima, 2021, p. 558). In so doing, I evaluate energy poverty to encompass working status, joblessness, and a range of other socio-economic and socio-material characteristics (Eurostat, 2021).

Our dataset of 45 respondents from Østre Bydel has captured not only the gross annual income per capita and estimated percentage electricity bill of households, but also the number of households living in a house/home, number of adults, gender of respondents, employment status, housing status, house size in square meters, whether households follow electricity price fluctuations, tries to reduce electricity usage, and heat the entire home. All these variables assisted in determining households' vulnerability to domestic energy poverty.

Furthermore, poverty assessment comprises of firstly, identification – who is poor – that is by defining certain given standards (in this case the threshold) that might assist in identifying and differentiating 'the poor' from 'those that are not poor' (Castaño-Rosa & Okushima, 2021) and secondly 'aggregation'- how the poor characteristics of different people combine into an aggregate measure (Castaño-Rosa & Okushima, 2021, p. 558).

In the first place, the analysis has categorized households 'considered energy poor' according to their income and socio-demographic vulnerabilities, and in aggregate, it has shown the commonalities and differences among them. This is to answer the first research question of 'What characterizes energy-poor households in the urban and peri-urban areas of a relatively affluent city?

Table 5 - Recognition of DEP amongst households in Østre Bydel

No.	No. in HH	No. of Adults	Age range	Gender	Employment Status	Housing status	House size (sqm)	Gross annual income / capita, k NOK	Estimated el. in bill %age	Follow tariff flux	Tries to reduce el. use	Heats entire home
201	1	1	46-55	M	Unemployed	Rented	<40	<300	10%	Yes	Yes	Yes
206	2	2	56-65	M&F	M is a Student, F is unemployed	Rented	40-70	<300	10%	Yes	Yes	Yes
208	2	2	66+	M	Retired	Self-owned	>110	300	10%	No	No	No
307	1	1	56-65	F	Unemployed	Rented	40-70	<300	6-10%	No	Yes	No
312	2	2	18-25	F	Part-time job and student	Rented	40-70	<300	6-10%	Yes	Yes	Yes
501	1	1	56-65	F	Unemployed	Social housing	40-70	No answer	>10%	Yes	Yes	No

6 out of 45 households have been identified as domestic energy poor in Østre Bydel, representing 13.33% of the aggregate

The dataset from Østre Bydel (Urban Stavanger) (**Table 5**) revealed 6 out of 45 identified households as domestic energy poor, constituting 13.33 per cent of the aggregate dataset of 45 respondents. With their ages ranging from 18 to 66+, the major socio-demographic characteristics of these identified energy poor households are their employment statuses, with 4 people being unemployed, 2 as students, a part-time worker, and a retired person.

This is not surprising. Martiskainen et al., (2021, p. 6) have set out a list of vulnerable groups at risk of domestic energy poverty and this includes the retired or older people, students and younger people, people on lower incomes, the unemployed, and people with higher expenses. In the UK, on the other hand, low-income families along with older people – are officially recognised as being the most vulnerable (Gillard et al., 2017, p. 53).

Out of these 6 identified energy poor households, 4 earns less than 300 000 NOK gross annual income before tax, one earns 300 000NOK while one decided not to give an estimate of her income. In so doing, I determined her vulnerability to DEP based on the fact that she spends more than 10% of her income on energy bills (Robinson & Mattioli, 2020, p. 72). 2 out of the remaining 5 spends approximately 6-10%, while 3 reports exactly 10% of their estimated electricity bill. The justification for their socio-demographic vulnerabilities followed next.

6.3.2. Socio-Demographic Vulnerabilities of HH in Østre Bydel

Unemployed Persons

Amongst the identified energy poor households were unemployed persons (that is respondent 201, 307 and 501). Generally, the unemployed are assumed to be vulnerable groups both financially and in terms of health and socially (Stavanger living conditions report, 2018). These unemployed groups are vulnerable to EP partly due to the fact that they are faced with fewer economic resources to cater for their domestic energy needs and therefore, face direct problems of affordability. Although they reported having lower incomes, their vulnerability to EP is further exacerbated by additional material deprivations (Eurostat, 2021).

Respondent 201 reported that he lowers his thermostat to 19 degrees because of the current expensive energy bills. This signifies that he receives inadequate heat, defined as material deprivation and economic strains by Eurostat (2020). Aside being faced with low income, unemployed people generally spend more time at home due to their joblessness and may need to consume a greater amount of energy particularly heating as well as greater usage of appliances which may increase their energy cost (Simcock et al., 2021, p. 5).

Students

Students were also identified as domestic energy poor among the datasets (respondent 206 and 312). In energy poverty scholarships, students, amongst other groups, are identified as having low income and are also likely to spend more hours in their apartments or hostels, increasing their energy usage and cost. Although most students reported that their energy bills are included in their rent while some received support (in the form of a loan – Lanekassen) from the Norwegian government to study, they still complained that the cost of their rent after COVID 19, has increased appreciably and therefore, pays extra income for their accommodation fees. Again, prices of some basic necessities, particularly food and clothing have increased, as a result, they spend more money on their basic needs as well. The argument here is that those who do not receive any government support or are self-dependent, suffer from the consequence of energy price increases.

Retired

Unique to household number 208 is that he is retired, earns 300 000NOK gross annual income per capita, owns his house of greater than 110 in size (sqm), does not try to cut down on his energy cost, neither does he follow electricity price fluctuations. When asked why he does that, he reported that "*I burn wood for heat more often and because I will still pay the bill even if it is expensive or not, there is no need to follow the price fluctuations*".

The physiological being of retired people and the aged, demands that they will need more heat to survive, particularly during the winter periods, and therefore, will have to commit themselves to energy and its associated cost. Already, it has been reported in scholarships that energy poverty results in "excess winter mortalities" and TellerElsberg et al., (2016) have reported that each year more death happens as a result of energy poverty than automobile accidents in the U.S cold state of Vermont, particularly to the aged and people with peculiar health conditions.

The elderly and infirm, by nature of their age, require a higher-than-average room temperature (Walker and Day, 2012, p. 72). This retired person will need more energy compared to a younger adult and coupled with the fact that he (respondent 208) lives in the house with his wife (reported that he lives with his wife who is also retired), more energy will be needed.

Even though they burn wood for heat, this should not encourage low-income households to largely access and consume energy resources like the fossil fuels (wood) with the idea of keeping themselves warm. According to Sadath and Acharya addressing energy poverty without paying adequate attention to the use of energy efficiency, reversely causes environmental degradation and a threat to sustainable development, and this method has an adverse consequence on people's health (Sadath & Acharya, 2017). The only option to solve this issue is to transition to higher standards of energy efficiency technologies, which is a hard-to-reach option for households on low-income.

Part-Time Workers

As a part-time worker and earning less than 300 000NOK, respondent 312 is vulnerable to domestic energy poverty as she spends 6-10% of her income on electricity bills. Additionally, she lives with another adult in her household and heats the whole house. She does that because her accommodation bill includes heating and other energy expenses all put altogether.

Part-time workers may have unstable income or unprotected jobs to sufficiently cater for their domestic energy needs. Even if their income and jobs are sufficiently secured, the possibility of being laid off during difficult times is much higher compared to a full-time employee. This makes her vulnerable to EP. The number of adults in a household also determines how much energy each household consumes and how much they spend on domestic energy. The more adults there are, the more energy they consume and the more their incomes they spend on energy.

Single-Parent Households and Households with Children

Shown in the table (**table 5**) are single-parent households and household with children (respondent 201, 206, 307 and 501). Martiskainen et al., (2021) affirms that single-parent households and even households with children are likely to be at greater risk of double energy vulnerability partly due to single-parents' over-representation in low-income groups and their likelihood to be inhabiting poorer-quality housing with fewer transport options. Households with children, on the other hand, relatively experience high energy and transport cost owing to, for instance, increased space heating or space cooling, greater appliance usage and a high frequency of journeys to transport children, which often induces car ownership (Martiskainen et al., 2021, p. 5). The reflects the situation of respondent 206 who reported two persons (including their son) living in their households. Detailed subjective responses from the identified households are discussed in the next section.

6.3.3. Lived-In Experiences and Vulnerability to Energy Poverty in Østre Bydel

According to Eurostat (2021), households are materially deprived and vulnerable to (energy) poverty when they are faced with enforced inability to partake in one or more of the following activities: pay unexpected expenses, afford a one-week annual holiday away from home, a meal involving meat, chicken or fish every second day, the adequate heating of a dwelling, durable goods like a washing machine, car, being confronted with payment arrears (mortgage or rent, utility bills, hire purchase instalment or other loan payment, etc.) (Eurostat, 2021). The subjective accounts of low-income Stavanger households in Østre Bydel reveals the level of their vulnerability or deprivation (Eurostat, 2021) and clearly uncovers the difficulties some of them faces when trying to cope with the current energy crisis. Their lived in has been sub-categorised into health-related problems, restrictions on capabilities and subjective wellbeing, "the heat or eat situation", energy accountability and gender-related vulnerability to EP.

6.3.3.1. Health-Related Consequences from Energy Poverty

A look at the dataset from Østre Bydel (**table 5**) shows that most households answered 'yes' to the question "tries to reduce electricity use". These are clear indication that their home is under-served by energy services. Despite the fact that some households intentionally limit their electricity use in other ways than to reduce their energy costs, especially respondent 208 who reported that "*I go out with my dog often, so the door is opened a lot and there is no use in heating the house all the time"* and respondent 307 "*I cut down on my electricity usage to prevent fire outbreak and the kommune gives me money and not want to burden them"*, respectively, most respondents reported the opposite – that they can save money and reduce expenses (respondent 201, 206, 312 and 501).

It is indeed economically rational on the part of the households to reduce cost; however, it is at the same time hindering them from having the normal indoor temperature necessary for good health. Subjective responses from households confirms this point.

"Because of the high cost of electricity, I burn more wood in the fireplace – which is not good for our planet, health, and the indoor temperature in my house"

"My house generates more carbon due to the use of wood heating and I know we are not the only one, most household does that". It is not good for our health, but we have no option, the bill is bloodily much bigger"- **Ø3**

Several households worldwide depend on polluting solid fuels such as wood, dung and coal for heating and cooking and in instances where open or poorly ventilated stoves are used indoors, large quantities of harmful pollutants are released, serving as agents of several diseases such as stroke, lung cancer and chronic obstructive pulmonary diseases (Bouzarovski et al., 2018, p. 5). These materials produce larger amount of CO_2 and further leads to environmental pollution (Pérez-Peña et al., 2021, p. 2).

Again, Graham (2007, P. Xi) further contends that "inequalities in people's health are intimately and inextricably connected to inequalities in their material and social circumstances". Energy poor (low-income, retired, students, unemployed, etc) households are likely to be living in poorer quality, less efficient housing, unlikely to go to the gym, go for vacations, attend health seminars within and abroad, participate in social activities (due to their limited finances) and undertake energy efficiency improvements in their home, due to their inability to afford the upfront cost or to be deemed 'credit worthy' for loans that could fund such measure (Simcock et al., 2021, p. 5). Such situation affects their overall well-being, life satisfaction and upbringing.

Again, the housing status and the size of housing plays a vital role in the identification of households at risk of energy poverty. The housing size determines the quantity of energy needed to heat or cool the house at every specific season. In cases where households own larger houses, they may need to use greater energy to heat or cool the house, leading to higher energy consumption and cost. This is the case of respondent 208, who is retired, owns a house of more than 110 sqm, and does not receive NAV subsidy (this will be covered in detail in **theme 2**- EP as a problem of distributive justice).

Among the six persons identified energy poor households (see **Table 5**), four are renting their homes (aside from bills for energy and transportation, these low-income families would still have to pay for the cost of living in these rented homes) and one is living in social housing. Social/ municipal housing is given out to people who cannot find a place to live due to poor finances, health, or social problems. Every three years, households occupying municipal housing apply to renew the lease if they still need municipal housing and can apply for housing

benefits from the Housing Bank to cover part of their rent (Stavanger Kommune, 2022). This shows how vulnerable they are to domestic energy poverty.

6.3.3.2. Under-consumption of Key energy services

Another categorisation of socio-material deprivation to EP is the under-consumption of key energy services. According to research on energy poverty scholarships, those living in energy poverty are often forced to ration and limit their energy consumption in order to avoid racking up high energy bills. Consequently, they 'under-consume' key energy services, with harmful consequences for their health and wellbeing (Liddell and Morris, 2010; O'Sullivan, 2019).

This is in line with the subjective responses of households who reported that they have drastically reduced and shifted their consumption patterns and are also unable to carry out certain functions as they used. According to reports from a household, *"Because of the high energy prices, we have tried to reduce energy consumption and shifted patterns. We have drastically reduced expenditure on stuffs like food, clothing, and heat and have to constantly check the apps to see when it's cheaper times to use our things, like washing machines, charging our electric cars (which the government also encouraged us at buying, and now we are being charged extra for this too"! –* **Ø4**

It is indeed true that most households are impacted by the energy prices. However, it is equally important to mention that some households pointed out the fact that Stavanger winter season has been very clement and has taken a considerable amount of impact from the price increases. However, the fact remains that the impacts are still felt by low-income households. From the interview session, one household reported that "*I'll add that Stavanger has a very mild winter climate most years (barely gets below freezing), and even with this year's high energy prices we've been lucky so far with pretty warm weather most of the winter. We're personally lucky to be able to not worry much about energy costs, but if we were having to use a lot of energy to stay warm, then we will be heavily impacted. And of course, lower income people are more strongly affected" –* **Ø1**

These reports are indicative that households are being materially deprived from energy poverty. Further subjective account proves this point.

6.3.3.3. "The Heat or Eat Situation"

There are also situations where household choose between paying for adequate heat or using their income for food. This is quite synonymous to the under-consumption of key services. This situation is referred to by Walker and Day (2012) as the "heat or eat situation", where households are forced to make a choice between paying for energy bills or paying for food bills, where income is limited. One household reported that

"Currently I am struggling in making the choice of paying for heat or eating enough, and I now eat out less because of the enormous expenses on my electricity usage. I can't express this to my friends and even family, as I consider it as a shame. I hope things gets better!"- **Ø2**

In the midst of such challenges, it becomes difficult for households to forgo heating, especially during peak winter months. They either reduce the amount of food they consume in place of paying for heating or the reverse. In households with children, this is critical. While parents make sure that they provide their children with enough heat, they also sacrifice their own nutritional needs, food, and health for the sake of making sure they provide their children with enough food and nutrition. The challenge that comes with this is also unique in its own way.

6.3.3.4. Energy Accountability

As procedural justice advocates for good governance and full information disclosure on households' energy consumption patterns (see section 3.3), only a few households hold themselves accountable for being higher energy consumers and as a result deserve to pay a higher energy cost.

It was asked in the Stavanger Expats group, "Do you consider your household a higher energy consumer?". 20 (95%) out of 21 households responded to the question and out of the retorts, only 35% of the 20 (95%) acknowledged that they are higher energy consumers whilst 65% answered "No", meaning they consume less energy at home.

Psychological research has suggested that one of the most powerful predictors of the intention to take energy problems seriously, or to change energy related lifecycles or decisions, is who the respondent blames for energy problems (Sovacool & Dworkin, 2015, p. 436). 'If people believe their own consumption is wasteful and accept personal responsibility, they are likely to change their attitudes and actions. But if they are able to blame companies, politicians,

foreign countries, and other consumers, they will do nothing' (Sovacool & Dworkin, 2015, p. 436). Likewise, forcing or putting pressure on households to adjust their consumption away from their current routine runs the risk of leaving people unable to consume sufficient levels of energy services at the particular time when they are required (Calver & Simcock, 2021, p.6). This could practically imply, for instance, that households are not able to use space heating or cooling systems when they are most 'needed' (Calver & Simcock, 2021, p. 6). Who people see as responsible for energy problems, and what they perceive as just or unjust, can shape investment decisions, personal behaviour, and even trust (or lack of trust) in both information about energy and the institutions regulating or supplying it (Sovacool & Dworkin, 2015, p.436).

6.3.3.5. Gender-Related Inequality to Energy Poverty in Østre Bydel

Lastly, inequalities cannot be discussed without issues of gender and employment status. The rationale for including these variables in the table (table 5) is to know the disparities and other gender-related inequalities double energy vulnerability comes with. It is sad to know that with all these vulnerabilities and severe material deprivations, females have been mostly impacted by domestic energy poverty in Østre Bydel than males, constituting four (including respondent 206, reporting together as one household) of the identified energy poor households than men constituting just three (see table 5). It also realized that 3 of the females are unemployed compared to 2 unemployed men.

The most critical and impacted domestic energy poor household was a female (respondent 501), who spends >10% of her income on electricity bill, does not heat her entire home, thus lacking sufficient heat, is in social housing and unemployed. Females, also due to their reproductive roles, may spend more time in the home than men, causing their energy needs to increase. As to whether she receives government support will be discussed in theme 2 of the analysis of energy poverty as a problem of distributive justice. [5] The next section analysis DEP situation in Bryne.

[5] It should be noted that these material deprivations and economic strains does not necessarily characterize Storhaug as a bad residential area. Some of these vulnerable areas and especially areas closer to the city centres, on the other hand, are very popular areas for

moving in due to short-distance commuting, frequent entertainments, and leisure activities necessary for increasing the well beings of residents. Most particularly the "15 minutes smart city idea" where everything is within 15 minutes of walking distance, makes the area a favourable place to live. However, gentrification, density, and urbanisation, coupled with the establishment of service-oriented business in the area have made it relatively high to live in, often displacing current and poor inhabitants in the process.

6.4. DOMESTIC ENERGY POVERTY ANALYSIS OF BRYNE

Table 6 - Recognition of DEP amongst households in Bryne

No.	No. in HH	No. of Adults	Age range	Gender	Employment Status	Housing status	House size (sqm)	Gross annual income / capita, k NOK	Estimated el. in bill %age	Follow tariff flux	Tries to reduce el. use	Heats entire home
600	1	1	18-25	M	Student	Rented	Under 40	<300	> 10%	Yes	Yes	Yes
602	3	3	18-25	F	Student & Part time job	Rented	70-110	<300	6-10%	Yes	Yes	No
605	2	2	26-35	M	Part time	Rented	40-70	<300	10%	Yes	Yes	No
606	**2**	**2**	**26-35**	**F**	**Other**	**Social housing**	**40-70**	**300**	**>10%**	**Yes**	**Yes**	**No**
607	1	1	26-35	F	Unemployed	Rented	40-70	300	10%	Yes	Yes	No
608	**3**	**2**	**36-45**	**F**	**Unemployed**	**Social housing**	**40-70**	**No answer**	**10%**	**Yes**	**Yes**	**No**
609	**1**	**1**	**18-25**	**M**	**Student & Part time**	**Rented**	**Under 40**	**<300**	**6-10%**	**No**	**No**	**Yes**

7 out of 15 households have been identified as domestic energy poor in Bryyne, representing 46.67%% of the aggregate

The situation in Bryne in terms of domestic energy poverty (socio-material deprivation and lived-in experiences to DEP) is not so different from that of households living in Østre Bydel. What sets them apart is the record high number of vulnerable households (46.67%) identified as energy poor. In fact, households in Bryne faces a double effect from the ongoing energy price increases making them more vulnerable to both domestic and transport energy poverty. According to Martiskainen et al., living in geographically isolated areas increases the risk of both energy and transport energy poverty, primarily due to the need to travel longer distances to access key services and a reliance on expensive domestic energy and motor fuels (Martiskainen et al., 2021. P.5).

Originally, households in DEV are overrepresented in peri-urban areas (Robinson & Mattioli, 2020, p. 3) and researchers have found that households can suffer from both domestic energy poverty and transport energy poverty simultaneously, and that the two problems may intersect in mutually reinforcing ways (Simcock et al., 2021, p. 2), the case of Bryne.

The data set of 15 respondents from Bryne, identified 7 (constituting **46.67%** of the aggregate dataset) out of 15 Bryne households as domestic energy poor. This was based on their reported income (which is less than 300,000 NOK), estimated electricity bills and other subjective

reports. Having their ages ranging from 18 to 45, these households were further identified based on their socio-demographic characteristics: that is their employment status and housing status.

Out of these seven identified DEP households, three are students (with two having double economic statuses; student and part-time workers), two unemployed persons, and a part-time worker (see table 6). Only one person did not reveal her economic status thus due to personal reasons. Even with this, five of these households reported that they are renting and two are in social housing.

Reporting on their estimated percentage of income that goes into their electricity bill, four out of the seven spends 6-10% and more than 10% on electricity bill each, while three spends exactly 10%. These households are identified as to domestic energy poverty because most of them spends 6-10% and more of their income on electricity bills while earns 300 000NOK or less as their gross annual income (before tax).

Based on the 10% indicator as explained in section 6.2, it is clearly evident that these households are domestic energy poor. Again, five of these seven respondents are renting and two are living in social housing. Social housing, as iterated earlier, are given out to people or households who cannot find a place to live due to poor financial, health or social problems while renting will mean that these households, aside paying for expensive energy bills, will need to pay for their rent as well, increasing their monthly or yearly expenses. Subjective responses follows next.

6.4.1. Socio-Demographic Vulnerabilities of HH in Bryne

Students

It is already indicated in the student analysis section of Østre Bydel (see section 6.3.2.) that students are likely to be identified as energy poor owing to their lowness in income coupled with the fact that they may spend greater amount of time in their hostels or apartments increasing their energy cost, especially in the winter periods. As indicated in the dataset (table 6), student respondents 600, 602 and 609 all reported an annual gross income (before tax) as less than 300, 000 NOK, yet spent between 6-10% or more than 10% of their income on electricity bills.

Respondent 600 and 609 reported that they heated their entire room while respondent 602 did not do that. They reasons they gave for heating their entire room is that (both 600 and 609) had their heating bills as part of their rent and so, once they pay their monthly rent, it comes with heating, and other necessities such as heating, internet, etc.

Respondent 602, when asked why he did not heat her entire home room in apartment, reported that she pays that separately and is mindful of the cost she will be incurring.

Unemployed Persons

Also identified in the dataset are two unemployed persons (respondent 670 and 608). Although, these categories of people are identified as vulnerable to DEP, a closer look suggests that unemployment is a strong driver of vulnerability to EP, due to low income. The unemployed persons identified in the Bryne dataset were females and are living in rented and social housing. Aside their lowness in income, unemployed persons generally spend a greater amount of time at home. They being females speaks of the fact that they may use a greater amount of energy at home especially, energy for heating, cooking, washing, etc, thus increasing their energy usage and cost.

Respondent 608 did not report her gross annual income yet spends 10% of her income on electricity bills. This provides much evidence to suggest that she spends a lot of money on her domestic needs. In some cases, these unemployed persons may need to necessitate the rationing of key energy services.

Part-Time Worker

Unstable household income and "precarious employment' have been identified as a factor that can increase household vulnerability to EP. Shown in table 6 above, respondent 602, 605 and 609 reported that they were part-time workers and earned 300 000NOK or less annual income yet spent between 6 – 10% of their income on electricity bills.

The reason for them being being vulnerable to EP, aside their income, can be their insecure work and income instability. These are key characteristics to part time or precarious employment. Citing the COVID 19 periods as example, many part-time and even full-time

workers lost their jobs while others had their number of working hours drastically reduced. It is more likely that such people can be laid off easily (esp. during a pandemic- covid). I argue that income restrictions and insecure jobs may make these part-time workers vulnerable to EP.

6.4.2.Lived-In Experiences and Vulnerability to Energy Poverty in Bryne

6.4.2.1. Restriction on Subjective Wellbeing and Lack of Savings

Financial dependency increases human subjective wellbeing and leads to human prosperity. When an individual is financially dependent, he or she is able to carry out activities to increase his or her subjective well-being. Churchill and Smyth defines subjective wellbeing as the judgement by an individual of his or her satisfaction with their life, feelings of happiness and sadness, as well as other negative and positive emotions (Awaworyi Churchill & Smyth, 2019, p. 40).

Energy poverty has been found to limit the subjective wellbeing of households, cease their happiness, and isolate them. Households faced with EP voiced out their concerns that the current energy situation has ripped them of their financial freedom and as a result, are not able engage it leisure and other social activities to make them happy as they want to. Even though what constitute happiness is not only about leisure activities, financial freedom also places a key role. Residents in Bryne reported that "*Because of the energy cost. I am not able to do nice activities with the family and kids*".

"*It has become more difficult to save for leisure activities and holiday travels*"

Research has found that one major reason for not undertaking in out-of-home activities or leisure is associated with the lack of financial resources and that the level of unmet need for out-of-home activities is higher among vulnerable groups who believe that they cannot afford leisure activities for financial reasons (Nordbakke & Schwanen, 2015, p. 1148). If energy prices are too high that households struggle to save for future needs and other unforeseen circumstances, it will be much more difficult to allocate resources for leisure activities.

Households further reported that "*The energy prices put extra burden on the loans and other insurances. I am left with very little for unforeseen days*"

"*The increase in energy prices is impacting my savings*"

Situations like these prevents low-income households from participating in social activities, thus isolating them essential activities necessary proper functioning. Subjective wellbeing is also linked with health and the next section presents the health-related consequences of EP.

6.4.3. Health-Related Consequences

Most often, EP leads to poor health and Thomson et al. (2017) in their studies on the relationship between EP, health, and wellbeing of 32 European countries found that at the intersection of EP and health, energy poor households suffered both physical and mental health issues (Thomson et al., 2017, p. 1). People with underlying health conditions, the aged, pregnant women and infants as a result mostly becomes vulnerable to the effects of low temperatures. According to the subjective responses of households….

"*My grandmother is very old and most often, she covers herself with a blanket. I always ask her to just increase the temperature in her room and not to worry about the energy cost. I promised to take care of that. She mostly disagrees and up to date, she covers herself with the blanket. I get disturbed when I see her doing that, but she would not stop. She gets sick sometimes as her room often becomes unpleasantly cold*" – **B4 (Woman)**

"*I do not have a full-time job and so I work part time jobs. The salary, I will say, is not so much good to live a comfortable life and so I will say I am unemployed to some extent, and also like to stay in the room more often. I realized for some time after a long period of staying home, that I started having seasonal depression. I know it is because I live indoors for so long with cold indoor temperature but other challenges especially finances and personal challenges have contributed to this. I just hope to find a well stable job but until then this condition is what I live in. I seek advice and support from friends and other relatives, and this is the hope I am feeding on for now*" – **B2 (Unemployed)**

6.4.4. Gender-Related Vulnerability to Energy Poverty in Bryne

It is also realized in Bryne data set (see Table 6) that women constituted the majority of identified energy poor households in Bryne. A closer reading of the dataset reveals that women constitute 4 out of 7 identified EP households, while men constitute 3. Further discovery is that two (2) out of the four (4) women are in social housing, while the other two are renting.

Respondent 608 who is in social housing has 3 persons living in her household with 2 being adults. She does not heat her entire home yet estimates that 10% of her income goes into electricity bill. This speaks of the lack of attention to gender effects and disparities in much of EP studies (Simcock et al., 2021, p. 7).

Research further points out that women who are primary earners in a household typically have lower incomes due to structural disadvantage in the labour market (Simcock et al., 2021, p. 7) and traditional gender roles or reproductive roles such as taking care of children, cooking, doing laundry, etc makes women consume more energy and incur more energy cost compared to men. EP severely impacts women compared to men in Rogaland and it is imperative, therefore, to pay critical attention to gender related inequalities associated with EP.

To conclude and answer the first research question ‘what characterises the energy-poor households in the urban and peri-urban areas of relatively affluent cities’, I sum up in table 8, the list of identified households vulnerable to DEP in both areas, based on their socio-economic characteristics and socio-material deprivations. It can be concluded from the EU SILC report on severe material deprivation and at risk of poverty, as well as the 10% indicator that some households in Stavanger are vulnerable to DEP and the main factor contributing to their vulnerability is low income and high energy prices (energy affordability).

The next section will analyse issues of TEP.

To conclude, recognition justice seeks to answer the question of ‘who is ignored’ and ‘how should we recognise?’. I sum up in table (8) the identified energy poor households and the geographic vulnerability of DEP in Stavanger.

Table 7 - Summary of identified households or different socio-demographic groups vulnerability factor to domestic energy poverty in Stavanger

IDENTIFIED SOCIAL GROUP	VULNERABILITY TO ENERGY POVERTY
Low income and low wage	• Insufficient money to cater for energy cost
Part time or precarious workers	• More likely to have unstable income or unprotected job to sufficiently cater for domestic energy needs • More likely to have low income
Unemployed	• More likely to have low income to cater for domestic energy needs • More likely to spend more time at home leading to greater energy needs and cost
Students and young people	• More likely to have low income • More likely to spend more time at the hostel or apartments resulting in greater use of energy and increased cost
Household with children	• Greater energy needs resulting in greater energy bills
Women	• More likely to spend much time at home to perform reproductive (gender) roles leading to greater use of energy and cost • More likely to have lower income compared to men
Single parent households	• More likely to have low income
Retired or older people	• More likely to have lower income • Greater need for energy especially heating in the winter due to their physiological factor resulting in increased energy costs

Table (10) Summary of Spatio-temporal or geographic vulnerability to DEP in Stavanger

LOCATION (AREA)	**VULNERABILITY TO ENERGY POVERTY**
Urban	• Greater vulnerability to DEP (especially those living in 'inner city') due to gentrification and electricity price increase.
Peri-Urban	• Experiences similar vulnerability of DEP as the urban areas

Table 8 - Summary of households' lived-in experiences and vulnerabilities to EP in Stavanger

LIVED-IN EXPERIENCES AND VULNERABILITIES/ DISPARITIES	**EP CONSEQUENCES ON HOUSEHOLDS**
Health Consequences	As a result of energy poverty in Stavanger, low-income households have insufficient heat (low indoor temperatures), and continuously burn wood for heating which in turns leads to dangerous emissions of gases like CO2, impeding on their health.
Under-consumption of key energy services	Most Stavanger households, as a result of EP, are often forced to ration and reduce their energy consumption in order to avoid racking up high energy bills. Most households are forced to under-consume essential energy services especially heat, in order to be able to pay for their electricity bills.
Energy accountability	Most low-income Stavanger households do not hold themselves accountable for high energy consumption
Gender divisions to EP	There are disparities in terms of the severity of impact to domestic energy poverty. Women are more affected by energy poverty compared to men

Subjective wellbeing restriction	The consequence from energy poverty in Stavanger is that it has prevented most low-income families in partaking in activities that will increase their wellbeing and happiness. Activities such as holidays and vacations with family, shopping etc.

6.5. Analysis Of the Incidences of Transport Energy Poverty In Østre Bydel

Figure 5 - Jæren Line (jærbanen) Stavanger – Bryne – Egersund Railway Line.[6]

Source: This picture was taken from Google (Accessed March 3, 2022).

Introduction – The Discontinuation of the May 7th, 2022, Bus Strike

Another form of deprivation similar to domestic energy poverty is transport energy poverty. In Stavanger, the situation regarding Transport Energy Poverty (TEP) is getting more severe. If not for state interventions and the forbearance of transport workers, transport services would have ceased on May 7, 2022. More than 2,362 bus and city tram drivers across the country and 16,000 employees in the public sector could have embarked on a bus strike. The impact on Oslo, Bergen and Stavanger could have been serious, as could kindergartens, schools, healthcare, car-dependent households, and a variety of other businesses. There is greater need to pay crucial attention to transport-related issues since they can negatively impact low-income families and car-dependent households.

[6] Stavanger-Bryne-Egersund Railway Line. Taken from google photos (accessed on 3 march 2022) - Jæren Line (Jæren Line) - Bing images

Table 10 compares household income and car ownership in Østre Bydel. Households' income levels are divided into four stages: less than 300,000 NOK, 300 – 600, 000 NOK, 600, 000 – 1 million NOK and more than 1 million NOK. The analysis of household income and car ownership is based on households' self-reported car affordability and income levels. The fact remains that low-income households, among other groups, will face a higher risk of experiencing TEP due to their limited income to be able to afford or possibly access a car.

6.5.1. Recognition of TEP amongst households in Østre Bydel

Table 9 - Household Income and Car ownership

Household Income	Fossil fuel Car	Hybrid Car	Electric car	No car
< 300 KNOK (6)	17% (1)	0% (0)	0% (0)	83% (5)
300 – 600 KNOK (15)	47% (7)	13% (2)	13% (2)	27% (4)
600 – 1,000 KNOK (11)	45% (5)	18% (2)	27% (3)	10% (1)
>1, 000KNOK (7)	57% (4)	14% (1)	29% (2)	0% (0)

Note: Six of 45 respondents chose not to answer the household income question

The dataset (**Table 10**) explains households' income and car ownership based on their ability to afford the different types of cars: fossil fuel cars, hybrid car, electric cars and in some cases unable to afford a car.

From the dataset of Østre Bydel (**see table 5**), 6 out of 45 households were identified as domestic energy poor and reported an annual income of less than 300,000NOK. From table (**10**) and out of these 6 identified energy poor households, 5 (83%) had no car or was not able to afford a private car and as such relied on public transport and other modes of transport while 1 household (17%) had a fossil fuel privately-owned car.

15 households reported an annual income ranging from 300 – 600K NOK, with 7 (constituting 47%) reporting in possession of fossil fuelled cars, 2 (13%) reporting hybrid cars, and another 2 (13%) reported in possession of an electric car. The remaining 4 (27%) had 'no car'.

The next income group are 11 households who earns 600 – 1,000K gross annual income. Out of these 11 households, 5 (45%) owns fossil fuelled cars, 2 (18%) owns hybrid cars, 3 (27%) owns electric cars while 1 household (do not have access to a car).

The last income group are those that earns more than 1 million NOK gross annual income. This group is made up of 7 households, 4 (57%) of which owns a fossil fuelled car, 1 (14%) owns a hybrid and 2 (29%) owns an electric car. Figure (4) depicts a graphical representation of (table 10) of low-income households and car ownership in Østre Bydel.

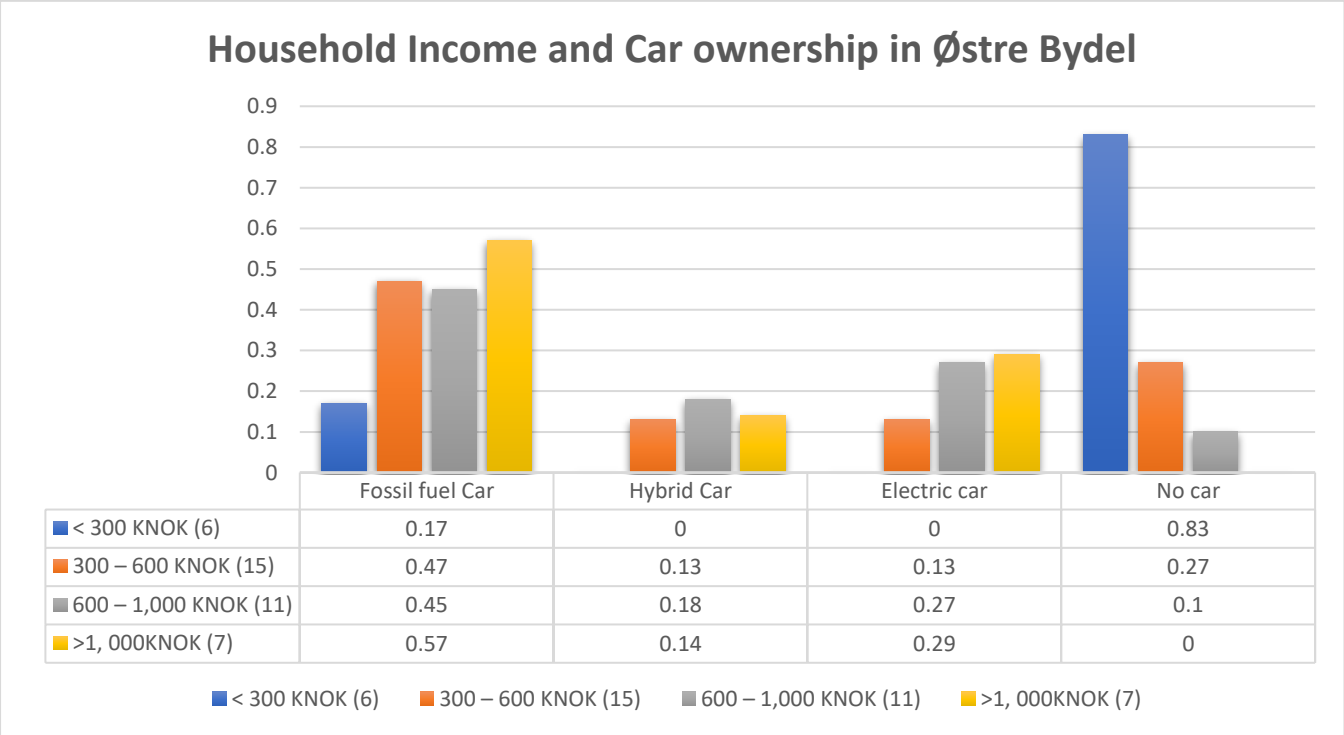


Figure 6- A graph representing household income and car in Østre Bydel

Judging from the graphical representation, it is very surprising and unexpected to know that regardless of the combination of taxation rules and incentives associated with the use of electric cars in Norway as well as the growing campaign on the need to transition from fossil fuel to renewable sources of energy, most households in Østre Bydel drives fossil fuel powered cars. This includes 17% of households that earns <300,000NOK, shockingly 47% of households

within the income range of 300-600KNOK, 45% of households in 600K-1,000KNOK and 57% of households earning >1,000KNOK.

One ambitious goal of the Norwegian government in reducing emissions from road transport is to make all new passenger cars and light vans by 2025 be zero emission. Also, the Climate and Environmental plan 2018 - 2030 adopted by Stavanger City Council seeks to achieve one important goal by 2030, which is to cut direct greenhouse gas (GHG) emissions in Stavanger by 80 per cent and to be fossil-free by 2040 (Stavanger municipality, 2018a, p. 4).

The focus area 2 of the Climate and Environmental Action Plan seeks to promote renewable fuel and technology in the transport sector of Stavanger and further states over 13 planned measures to ensure efficient and sufficient EV charging opportunities, including enough charging spaces and affordability of charging cost (Stavanger Municipality, 2018a, p. 10-13).

However, from the graphical representation, a considerable number of households owns fossil fuel cars compared to hybrid and electric cars and more shocking is the fact that households earning more income, thus from 600,000 NOK to 1 million NOK uses more fossil fuelled cars more than low-income households.

This can be attributed to the insufficient charging stations in urban Stavanger, discouraging households in purchasing electric and even hybrid cars. Coupled with expensive electricity cost, charging of electric vehicles are now more expensive, deterring households from purchasing and using electric cars. According to some fossil fuel car owners,

"I am not encouraged to use electric car. Already electricity is expensive to which my family and I are struggling to cope with and even when I buy an electric car, I will be faced with a problem of charging space. This is the reason why I will go for fossil fuel car; I have no option and there is nothing I can do about it"

"*What is the essence of purchasing electric car if charging it is expensive? This is not to say that EV regulations in Norway are not efficient, in fact I care for the environment a lot and as such I will encourage everyone, if possible, to go electric but pricing of energy should be made cheaper for all".*

The dataset and subjective responses reveal the increasing use of fossil fuel cars in the system. Already, Pérez-Peña et al. have found a strong link between transport energy poverty and environmental sustainability, arguing that the energy poor households and sometimes high-income earners are more likely to use fossil fuel cars with the possibility of emitting excessive

CO_2 which in the long run contributes to climate change and heat islands, greenhouse effect, heavy rainfall as well as affects the health conditions of the most marginalized (Pérez-Peña et al., 2021).

Also observed from the graphical representation is the overrepresentation of low-income households with 'no car'. This can partly be explained by lowness in income as well as walkability, safety, and density of activities in Østre Bydel and areas closer to the city centre (Lucas et al., 2018, p. 623).

Empirical studies suggest a strong association between distance travelled and accessibility of destinations and network designs (Lucas et al., 2018) and because distances between residences and activity destinations are shorter, and this makes more energy-efficient modes like walking, cycling and public transport more practicable, reducing car dependence (Mattioli et al., 2018, p. 118).

Here, the Kolumbus action plan and the Stavanger climate and environmental action plan on transport (particularly, reducing scope of transport and changing travel habits, measures for increasing cycling and walkability in the municipality as an organisation) are turning out to be successful in urban Stavanger (Stavanger Municipality, 2018a, p. 5-9; Strategi for Kolumbus, 2021.).

The most identified modes of transport of identified low-income households were walking, use of public e-bikes, scooters (including public e-scooters), public buses, hjem-jobb-hjem, E-skateboard, motorcycling and 'buddy driving'. When asked in the Stavanger expatriates' group 'how easy are you able to meet all your transport needs', most responded positively with comments such as

"*Easily, since I live in the city centre and can walk and cycle*"

"*Cycling supports most of our daily transport need and car-sharing is easily accessible for weekend getaways*"

The next section analyses issues of TEP in Bryne

6.5.2. Recognition of TEP Households in Bryne

6.5.2.1. Transport Energy Poverty in Bryne

Transport energy poverty in Bryne is also a major issue of concern and needs critical intervention. From the interviews and perception/ lived-in experiences of households, I categorise the reported transport disadvantages faced by households into transport affordability, transport accessibility, forced car ownership and car-related economic stresses. Prior to that, I examine household income and car ownership, as was done in Østre Bydel, to assess whether households are capable of afford or access a car necessary for reaching important destinations like work, school, etc. (Allen & Farber, 2019, p. 215). This is also to reveal households' usage of the type of car.

Table 10 - Household Income and Car Ownership

Household Income	**Fossil fuel Car**	**Hybrid Car**	**Electric car**	**No car**
< 300 KNOK (7)	29% (2)	0% (0)	0% (0)	71% (5)
300 – 600 KNOK (4)	75% (3)	25% (1)	0% (0)	0% (0)
600 – 1,000 KNOK (2)	50% (1)	0% (0)	50% (1)	0% (0)
>1, 000KNOK (1)	0% (0)	0% (0)	100% (1)	0% (0)

Note: one of 15 respondents chose not to respond to the household income question

Table (11) analyses the income level and car ownership of 14 respondents. Out of 7 households that earns less than 300 000NOK, 2 (29%) owns fossil fuel cars and the remaining 5 (71%) have no access or are unable to afford a privately-owned car.

4 households reported an income level ranging from 300 – 600 000NOK out of which 3 (75%) possesses fossil-fuel privately owned cars with 1 (25%) owning a hybrid car.

The next income level are 2 households who earns 600 – 1, 000 000NOK. With this household, each owns fossil fuel and electric cars, representing in percentage a 50-50. Only one household (100%) earn more than a million krone and owns an electric car.

Bryne dataset stirs up a conversation on households' reliance on public transport. From the graphical representation (**figure 7**) below, the dominant household with no access to a privately owned car are households earning less than 300 000NOK (constituting 71%). This is to say that most households rely on energy-efficient modes of transportation as well as on public transport. As this is no surprise, the use of fossil fuel cars in commuting is also highest amongst residents in Bryne.

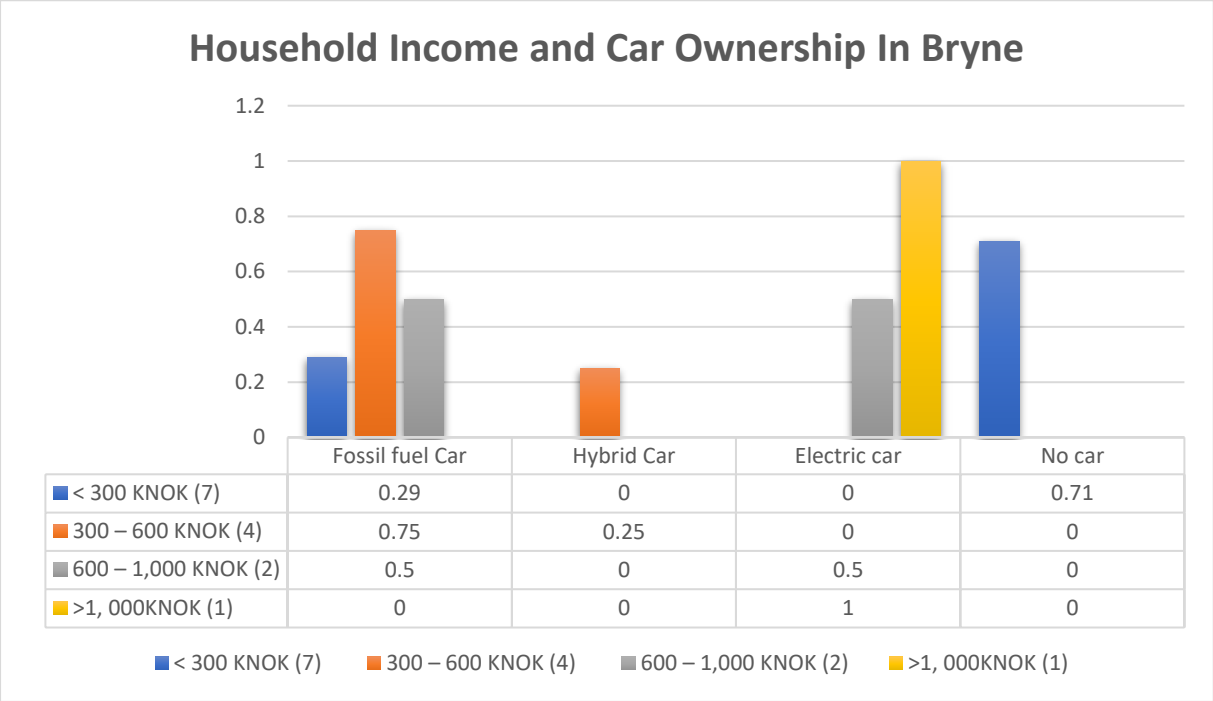


Figure 7- A graph representing household income and car in Bryne

I attribute this to a variety of factors. It is not only a matter of choice, but also a matter of low income, high costs associated with charging EV and hybrid vehicles, as well as high costs of electricity. Followed next is detailed account on the transport-related disadvantages and inequalities in Bryne.

6.5.3. TRANSPORT-RELATED DISADVANTAGES AND INEQUALITIES IN BRYNE

Despite the difference in income levels between energy-poor and energy-rich households in Østre Bydel and Bryne, Bryne's vulnerability to transport energy poverty takes a different turn (Bryne is more vulnerable to TEP compared to Østre Bydel). Aside from affordability and accessibility of transport, inhabitants in Bryne further faces issues of car-related economic stress, forced car ownership, and other car-related social disparities. This hinders their accessibility to vital services such as employment, school, healthcare, etc.

6.5.3.1. Issues of Transport Affordability

To begin with, transport affordability refers to the lack of individual resources to afford transport options. This is a situation where households finds transport services expensive and unaffordable. Households reported that *"Prices of bus/train fares are expensive. As a student at University of Stavanger, after my classes, I will either sit at the library or spend the whole day in a friend's house. I have classes sometimes in the mornings and afternoons. During those periods, I cannot go back home until I am done with all my classes else, I cannot join the afternoon classes when I go home. I get tired sometimes"* – **B3 (Student and Part-time worker)**

"*I wouldn't say I am able to meet all my transport needs. I do not have a car and I rely on public transport. Public transport could be so much organized and affordable*"

6.5.3.2. Issues of Transport Accessibility

Again, some inhabitants of Bryne raised concerns about the difficulty in reaching certain key services at a reasonable time and its impact on their quality of lives. This situation and the category of people facing it, according to Lucas et al. (2016) should be categorised as people facing transport accessibility poverty.

Accessibility poverty refers to the difficulty in reaching certain basic daily activities at a reasonable time, ease, and cost such as employment, education, healthcare services, shops and so on (Lucas et al., 2016a; SEU, 2003). It also manifests as an inability to reach certain

key places especially less automobile and transport challenging areas. Respondents were keen to this issue, and during the interview session, they reported that, "*I find problems sometimes going to work and other tourist places. There are no direct buses to some popular tourist destination areas, and it prevents my family from having a good time. Instead of visiting places like beaches, we will rather stay at home. Also, there is traffic commuting from Bryne to Stavanger with a car, and so I sometimes go to work late which affects my performance. I am bothered but I have no option. My kids are young and moving from my current place to stay or live at a different location won't help me. Again, houses in Stavanger are quite expensive to buy or rent than those in Bryne and so I prefer living in Bryne" –* **B4 (Woman)**

"I struggle with the train because sometimes it may stop suddenly for some issues. Then, I will be late. I prefer the bus, but there is no direct bus from Bryne to the university. So, I have only 2 options, the one is using the car and paying bomb ring and so on. Besides, driving a car in the morning from Bryne to the university may take a long time because of traffic, especially in the morning. the other option is to take the train and bus num 6 to the university" – **B1 (Student)**

"I cannot visit my friends and other relatives on weekends, especially Sundays. It is too much work for me. Train delays and keeps longer on the road. My expenses are too high that I can't purchase and maintain a car. I have a family to take care of and the only times I can go out to have fun with my kids is on Sundays but due to the constrains, we do that at home. I work from Monday to Saturday afternoon" – ***Stavanger expatriate living in Bryne***

Accessibility poverty is a key determinant of social inequality and in most cases, the energy poor and car dependent households are being faced with this issue, thus restricting their access to certain key services essential for their needs. This also has the ability to impact on a subjective wellbeing, health and social inclusion.

Some essential services such as healthcare, employment and shopping are very essential for human survival and as such one's inability to access them to a greater degree impacts their lives. According to Lucas et al. (2016a) 'accessibility poverty has assisted in identifying the social groups that lack the basic resources to support their life chances and if transport is regarded as a means to satisfy other needs and rights, then accessibility acts to reconstruct the general conditions of poverty and it is clearly connected with social exclusion' (Lucas et al., 2016a, p. 356; Cebollada, 2006).

Again, respondent **B4** mentioned that 'houses in Stavanger are quite expensive to buy or rent than those in Bryne and so I prefer living in Bryne'. This confirms that gentrification exist in the urban areas of Stavanger, thus displacing or prevents poor households from living in cities and other service-oriented areas. Low-income households may find themselves in peripheral locations where there are few local employment opportunities. Even when transport infrastructure and services are accessible, car-dependent peri-urban residents still have to travel longer distances and connect to transit services to the urban areas and city centres where local services, business and other activities are abundant. This, as a result, increases social exclusion amongst peri-urban residents and hinders their accessibility to vital services.

6.5.3.3. Issues of Forced car ownership (FCO)

Another alarming transport energy poverty issue at Bryne has to do with forced car ownership (FCO). According to Lucas et al. (2016a, p. 355), forced car ownership is when a household incurs more travel costs than it can reasonably afford, especially costs relating to car ownership and usage.

It appears that some low-income households living in Bryne have been forced to buy a car due to poor transportation services and longer distances, which they would not if they lived in the urban area. According to an expatriate living in Bryne, *"I have been forced to buy a car although it was not part of my plans. Commuting from Bryne to Stavanger is a problem most at times and now after buying an electric car, electricity has become super expensive and there is not enough ev charging spaces. I did not buy a fossil fuel car because I think more of the environment"* ***Stavanger expatriate living in Bryne***

6.5.3.4. Issues of Car-related economic stress (CES)

Lastly, another manifestation of transport poverty is 'car-related economic stress'. This is indicated in the reports of Bryne and suggests that despite limited income, a household may suffer from 'car-related economic stress' if they own and use a car, and therefore must make sacrifices between spending on transport and other essentials (Mattioli et al., 2017, p. 96).

"I am not a higher income earner and not married yet, but my workplace and the nature of my work is demanding that I need to get a car. Even before the car, acquiring the license itself was

very much expensive and I am able to only afford a fossil-fuel car. The car gives me a lot of trouble and I am thinking of selling or giving it out. I will start using the train soon. ***Stavanger expatriate living in Bryne***

This situation is synonymous to 'Forced Car Ownership'. However, a household under car-related economic stress spends a larger amount of his income on running a car, leaving him with less residual income for other essential services. Mattioli et al. (2016b) describes that a household is under 'car-related economic stress' if '(a) his equivalised income after housing and running motor vehicles cost is below 60% of the median and (b) if the percentage of income spent on running motor vehicles is more than twice the sample median (i.e., 9.5%).

In conclusion, the perception-based and expenditure-based responses of affected households in Stavanger, indicates in terms of distinction, that Bryne households are more vulnerable to TEP compared in households in the urban areas of Stavanger.

Summarised in table 11 and 16 are the social groups identified in both Østre Bydel and Bryne and their vulnerability to TEP based on their locations. Followed next is theme 2, which analysis energy poverty as a problem of distributive justice.

Table 11 - Summary of identified households or different socio-demographic groups vulnerability factor to Transport Energy Poverty (TEP) in Stavanger

IDENTIFIED SOCIAL GROUP	**VULNERABILITY TO TRANSPORT ENERGY POVERTY**
Low-income households	• Own fossil fuels or old and inefficient car • Less income to spend on transport or less money to pay for transport tickets • Are not able to afford privately-owned car
Part time or precarious workers	• Have lower income to afford a car • They are car dependent especially on public transport
Unemployed	• Have no car (privately-owned)

	• Difficulty in affording transport cost
Students	• Difficulty in affording transport cost • Overly reliant on public transport
Household with children	• Have increased travel patterns and are more dependent on private car due to the children • More likely to pay more for transport
Women	• Have fragmented and increased travel patterns than men due to functions and activities. Example entertainment, leisure, holidays, and vacations, visiting friends and relatives. • Car-dependent
Full time	• Faces problem of charging spaces even though is likely to afford a privately-owned electric car

Table (16) Summary of TEP related disadvantages in Stavanger

LOCATION (AREA)	**VULNERABILITY TO TRANSPORT ENERGY POVERTY (TEP)**
Urban	• Transport affordability
Peri-Urban	• Transport affordability • Transport accessibility • Forced car ownership (FCO) • Car-related Economic Stress (CES) (Greater dependence on both private and public transportation, Increased travel time and cost, longer distances to key services)

The next section (**theme 2**) analyses energy poverty as a problem of distributive justice

THEME 2

6.6. ANALYSIS OF ENERGY POVERTY AS A PROBLEM OF DISTRIBUTIVE JUSTICE

This section uncovers the unequal distribution of benefits and proves the inequalities regarding the availability and accessibility of government subsidies to some low-income and energy poor households in both study areas. Despite the fact that subsidy schemes were introduced by the government to help households who needed the most to lessen their energy burdens, not all low-income and energy poor households received it, while those who received it still complains that the electricity prices are still high. The tables below proves this point.

6.6.1. Distributive Injustices in Østre Bydel

Table 12 - Low-income households and NAV and Enova Subsidy Awareness and benefits receival in Østre Bydel

No.	Age range	Employment Status	Gross annual income / capita, k NOK	Aware / receive ENOVA subsidy	Aware/ receive NAV subsidy
201	46-55	Unemployed	<300	No	Aware. Tried but did not receive
206	56-65	M is a Student, F is unemployed	<300	No	Yes
208	66+	Retired	300	No	Not aware and do not receive
307	56-65	Unemployed	<300	No	Aware and yes, I receive
312	18-25	Part-time job and student	<300	No	No
501	56-65	Unemployed	No answer	No	Aware and yes, I receive

The NAV and ENOVA questions were directed at households with low incomes and energy burdens identified in Østre Bydel, to determine whether they were aware and knew about any government aid to ease their energy burdens. In the 6 low-income households identified, only respondents 206, 307, and 501, who were mostly unemployed and students, confirmed their awareness of and receipt of subsidies from the government, while respondents 208 (retired)

and 312 (students) did not. Those not aware of the NAV subsidy, it is assumed that they do not receive them, since you will have to apply for it.

More surprising is the fact that respondent 201 who is jobless reported "she was aware of the NAV subsidy and tried to access it but was not successful" and when asked why she was not successful in receiving the subsidy, she reported that "*we missed the deadline. The form was very difficult to fill out and there wasn't any help hep or advice from NAV"*. It is remarkable that none of the respondents had ever heard of ENOVA subsidy or had even received it, despite the fact that Enova offers subsidies to motivate home energy efficiency investments (Enova, 2021).

6.6.2. Distributive Injustices in Bryne

Table 13 - Low-income households and NAV and Enova Subsidy Awareness and benefits receival in Bryne

No.	Age range	Employment Status	Gross annual income / capita, k NOK	Aware/ Receive ENOVA subsidy	Aware/ receive NAV subsidy
600	18-25	Student	<300	No	No
602	18-25	Student & Part time	<300	No	No
607	26-35	Unemployed	300	No	Aware and yes, I receive
608	36-45	Unemployed	No answer	No	Aware and yes, I receive
605		Part time	<300	No	No
609	18-25	Student & Part time	<300	Not aware	No
606	26-35	Other	300	No	Aware and yes, I receive

The same situation applies to Bryne. Out of the 7 identified energy poor households, only 3 respondents (thus 607, 608, and 606) receives the NAV subsidy and was reported by respondent 606 that "*this month bill reduced from 10.5K to 6K*", while 607 acknowledges that he pays less electricity bill. On the contrary, the other 4 respondents (respondents 600,602,605, and 609) all do not receive government support. For detailed responses, this question was raised in the Stavanger expatriates' group on Facebook. When asked in the group, has your household benefitted from subsidies from the government, it generated 20 responses and out of this, 55% respondent 'No' to the question whilst 45% responded 'Yes'.

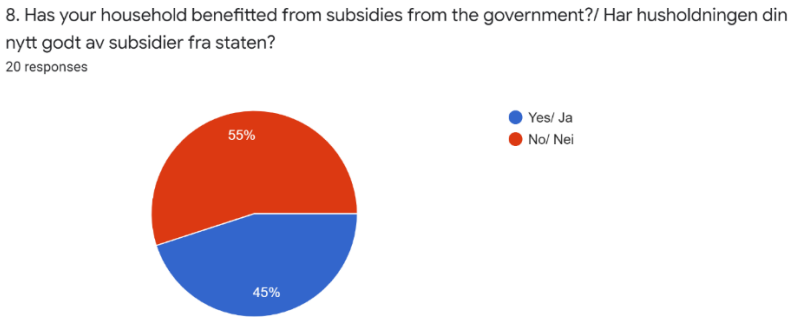


Figure 8- Households receival of subsidies (Stavanger Expats)

Those who received it confirmed that "*some of the high energy costs were refunded by the government subsidy*" meaning they received that and even though had received the subsidy and recommends the government for that, they still complained that it was too small to cover their entire cost and that it was still high. According to some expats, "*it is a small subsidy, but anything more than zero is positive"*

"*We have received little but not enough*"

"*The electricity is still very high"*

To conclude, a very peculiar point about the distribution of subsidies is that one household reported that the subsidy did not appear on their bills. According to her, "*I rent. My landlord does not pass the subsidies on to me*". If this is true, I argue that authorities must become involved in the landlord-tenancy agreement in order to prevent distributional inequalities at the household level.

THEME 3

6.7. Policy Recommendations of Households in addressing Double Energy Vulnerability in Stavanger

Norway's energy policy aims to establish an energy supply system that is just, efficient, climate-friendly, and reliable. Although the government has intervened in an effort to curb energy costs, households still report energy prices that exceed what is reasonable. There is already an explanation for this: relatively dry and depleted hydropower reserves, accompanied by a spike in wholesale gas and electric prices in Europe, but digitalization and decarbonization have made inequality and vulnerability worse.

Electricity prices in southwestern Norway is expected to reach NOK 3.26 per kilowatt hour, and low-income households with fewer options will bear the brunt of the situation. Nonetheless, affected DEV households have suggested desirable policy interventions necessary in addressing the current DEV situation in Stavanger. Aside from that, they have provided information about personal coping strategies that they use at home to deal with the current energy crisis.

Three broad categories with detailed subsections are outlined in this section, including government interventions, recommendations for a more efficient energy system, and recommendations for a more efficient transportation system.

6.7.1.Specific Governmental Policy Recommendations

6.7.1.1. Grid Interventions / Domestic and Foreign Interventions

To begin with, most households attributed the spike in electricity prices to the grid interconnections Norway has with other countries. In their comments, they stressed that it was imperative that grid interconnections be cut immediately to stabilize the price of electricity. According to the reports from respondents, *"Disapprove grid connection to Norway, because it can have negative effects on electricity prices in Norway, such as now. The government should put more taxes on foreign export of electricity. This will help in cheaper electricity"* – **Stavanger Expatriate**

"Norway should not follow European prices, as it would affect Norwegian energy market in a negative way"

Norway should focus on domestic electricity production and consumption needs rather than export

A point should be noted here that in addition to being a member of the Nordic joint power market, Norway is also a member of the European power market through interconnections with Germany, the Netherlands, Estonia, Poland, and Russia and this is thus part of a market that is integrated into the European power market through its own power transmission lines. It is understood that power market prices are determined on the Nord Pool Spot power exchange based on demand and supply, with the goal of ensuring that power flows to areas in which it may be of greater value, to ensure that power flows to the beneficiaries. Therefore, when a country is experiencing higher electricity demand and low production, for example in Norway where the hydropower reserves are depleted due to relatively dry climate conditions, the price of power will increase, thus making it easier to import power at a cheaper rate from abroad, which would otherwise lead to higher power prices.

6.7.1.2. Exploration of Fossil-Fuel Options

The consumers of Norway, they believe, are entitled to cheaper energy, but they would prefer Norway to explore its nuclear option, explore the gas reserves, and not to shut down their oil industry, just to leave the oil as stranded assets along with an impending carbon bubble. *"Keep our power to ourselves". Start building nuclear power plants and search for new gas reserves because these are the cleanest modes of energy when comparing to coal and oil.*

"Explore more nuclear power plants/Pro nuclear power"

"Norway should not shut down the oil industry." – **Stavanger Expatriate**

6.7.1.3. Renewable and Alternative Environmentally Friendly Solutions

The fact that some households believe that the current energy crisis will be resolved by becoming more environmentally friendly and shifting to renewable energy options is yet another contributing factor to its resolution. In essence, exploring renewable energy options is going to make Norway energy independent, guarantee greater energy security, and save its natural environment and resources from degradation and pollution by preparing for a future in which renewable energy is used. "*Norway should quit drilling the oil. We need to protect the Earth because our children will inherit it"*.

The government should invest more in hydropower development and stop drilling oil to avoid environmental deterioration especially pollution

No to wind power because it destroys the nature. Build on existing infrastructure, primarily making more efficient hydropower plants, instead of destroying more nature. – **Stavanger Expatriate**

6.7.2. General Household Recommendations for a Better Energy System in Stavanger

In addition, households in general, have suggested a better energy and transport system in Stavanger. It is believed by them that by utilizing these recommendations and suggested technologies, in conjunction with those that have already been proposed, the negative effects of price increases will be minimised. As long as they believe it is possible and are able to afford, they would be willing to implement these recommendations and use the technologies in order to accomplish this. "*More emphasis on weatherising (e.g., better insulation and moving from electric resistance to heat pump heat)".*

We are looking at getting solar panels for solar energy as well as triple glazed windows

We are big fans of energy efficiency and would recommend it as a top priority for all. Rogaland's energy system is robust, and renewables based. To ensure it continues developing within the boundaries of nature, energy efficiency, especially industry, should be explored. Any new sources of demand e.g., energy intensive industry and transport, should only be encouraged if they can develop within the current system instead of pushing towards over dimensioning. – **Stavanger Expatriate**

6.7.3. General Recommendations for a Better Transport System in Stavanger

Transport energy poverty is not only an issue predominant in Storhaug and Bryne. After local residents gave their recommendations on how to improve the energy system in Stavanger, particularly in the urban areas, many of them then went on to suggest what they believe is a better transportation system in Stavanger, as most of them commute to different places for work and such. *"More public EV charging stations for cars"*

"More subsidizing of public transit. We use it because we think it's the right thing to do, but it's expensive to use public transit if you already own a car." – **Stavanger Expatriate**

Safer cycling infrastructure and a roof over bike parking places can go a long way for improving urban transport. More buses to popular weekend getaways like Sirdal would be great. – **Stavanger Expatriate**

6.7.4. Personal Stavanger Household Strategies in Combating Price increases

Some households have outlined personal strategies for combatting price increases in the future. Additionally, this would also mean that consumers would be able to spend less money on non-essential goods and services and will find alternate ways to shop around for more affordable options and better deals as well.

We use garden rainwater to water our plants

Use energy efficient appliances and light bulbs

I buy more on promotions and to buy fewer products

6.7.5. Specific Recommendations for a Better Transport System in Bryne

Lastly, members of Bryne have emphasized the need of the transport sectors in Norway and in Stavanger to invest more in trains just as it has been done on electric vehicles and fleets. As a result of this, it would mean that there would be a reduction in inequalities in the transport system, which could lead to sustainable development, energy transitions, and the transition

towards a greener economy if equal attention and investment was given to all modes of transportation and not just a few.

The government should invest more in Trains, this is the only way they can help us, especially we who rely on it to go to school and work– **Bryne inhabitants**

"*The train from Stavanger to Bryne and back should be more efficient. Just like the buses and ferries, it should run on time, maintenance works should be done on it often and programmed in a manner to avoid delays and unnecessary stops". –* **Bryne inhabitants**

"Prices of fares should be reduced, including the fare of the train. In times like this, low-income households need to be prioritized in transport decision making, transport infrastructural designs and policies. Almost everything now is expensive". – **Stavanger Expatriate**

In conclusion, the numerous recommendations of households and suggested technologies in negating price increases reveals how urgent and impactful DEV situation in Stavanger is. In contrast, the wealthier households can afford the latest technologies for domestic and transport use and services to reduce their energy costs, whereas low-income households may face more energy concerns, since their options are limited, and their income is not sufficient to deal with the energy situation. Students who had their income included in their rent and received government support showed unconcern about the kind of policies to be implemented while others were satisfied on whatever is going on. Despite all this, the policymakers need to act as soon as possible on suggestions that have already been made by the affected population in order to mitigate future problems. The next chapter summarizes the key findings and major takeaways of the empirical analysis.

7. Chapter 7 - ANALYTICAL SUMMARY - FINDINGS AND DISCUSSION

This chapter summarizes (**in table 15**) the findings and provide major insights from the empirical analysis of households faced with double energy vulnerabilities in Stavanger, as well as how that contributes to inequality. The main finding of the thesis reveal that double energy vulnerability is gradually growing in Stavanger and that all forms of transport energy poverty (transport affordability, accessibility, forced car ownership and car-related economic stress) are evident amongst low socio-economic status (SES) residents in Bryne who commute from Bryne to mainland Stavanger for school, employment, and other functions.

Table 14 - Summary of the empirical analysis

Theme	Summary
Increasing emergence of Double Energy Vulnerability in Norway with less recognition	Although Norway is a rich and income equal country, there is a greater occurrence of double energy vulnerability and inequality among households – main issues of energy affordability. Energy poverty is widespread in Norway and the existence of energy poverty coexist with other forms of deprivation such as income poverty, severe material deprivation and social backwardness.
Identification of impact similarities and vulnerable groups to domestic energy poverty in both Østre Bydel and Bryne	The groups listed as vulnerable to double energy vulnerability in Østre Bydel are equal to that of Bryne.
Greater prevalence of domestic energy poverty than transport energy poverty in Østre Bydel	In terms of severity of impact, TEP situation in the urban areas are minimal compared to the peri-urban areas with longer distance commuting and complex travel patterns
Greater prevalence of double energy vulnerability in Bryne	High energy bills coupled with longer distance commuting and the lower levels of household car ownership are making Bryne households more vulnerable to double energy vulnerability.
Greater gender disparities in terms of severity of impact	Women faces an increasing impact from DEV than men in Stavanger

Unequal distribution of and lack of awareness and accessibility to subsidies to low-income households	Most households are not aware, cannot access and do not benefit from subsidies from the government
Lack of recognition to mobility issues in Bryne – There is a recognition that the system is not supporting their need	• Is there a need for reform? • Is it under-funding? • Is it a structural issue?
Double energy vulnerability in Stavanger lacks procedural justice concerns (especially inadequate information disclosure and local knowledge mobilization on fuel/ energy poverty problems, fuel prices and solutions) / Major issues of "Due process" and "Good governance"	Stavanger households lack early warnings and detailed information on energy consumption patterns. Energy prices suddenly increases without any detailed explanation of the cause.

7.1. Findings and Discussion: Emergence of DEV in Stavanger

The thesis's main finding reveals that domestic and transport energy poverty is emerging and impacting households in both the urban and peri-urban areas. Relating to DEP, the study has shown **13.33%** of households to be vulnerable to domestic energy poverty in Østre Bydel, while Bryne also sees **44.67%** of households' vulnerability to DEP. The analysis indicates that the main problem of DEP in Stavanger is affordability of energy, which coexist with other forms of deprivations such as income poverty, severe material deprivation, social backwardness, and division. Proven by the 10% indicator and lived-in experiences (voiced concerns of households), energy poverty impacts households' health, finances, capabilities, and well-being.

From the analysis, it is indicative that transport energy poverty is a significant problem in Bryne. All forms of transport-related disadvantages have been identified, including transport affordability, transport accessibility, forced car ownership and car-related economic stress. The Peri-urban area is characterised as an area with unique mobility challenges (Simonsen & Skjulhaug, 2019), and households that commute from Bryne to Stavanger attest to this fact, as they have expressed their perturbations over the travel times and disadvantages of the railway connecting both places. Train misfunctions, delays, and expensive transport fares hinder car-dependent households' mobility in Bryne, and the geographic location of residents makes them reliant on transport.

The empirical analysis reveals similarities in socio-economic characteristics of energy-poor households in Østre Bydel and Bryne. It identified households' vulnerability to EP based on income and energy prices and found unemployed groups, low-income households, students, older people or retired, single parents, part-time workers, women, and households with children to be vulnerable.

Part-time workers were identified as having unprotected jobs and unstable incomes sufficient to cater for their domestic energy needs. Besides being low in income, unemployed groups spent more time at home, used more energy and increased their cost. Students identified as energy poor also had low incomes and spent more time in their hostels, increasing their energy costs. Women and households with children also consume more energy due to their reproductive roles at home (especially in taking care of children), while the retired, due to their physiological conditions, need more heat to survive, especially in the winter periods.

7.2. Application of the three core-tenet framework of energy justice

7.2.1. Recognition Justice

7.2.1.1. Injustices as non-recognition

While policymakers duly recognize the vulnerabilities of children, part-time workers, the unemployed, students, low-income households, and the elderly to EP, they lack a comprehensive understanding of their energy consumption patterns, social support systems, social disparities, and their financial needs. In this case, the issue is who needs recognition the most and who is the most severely affected. We have observed throughout the analysis that in terms of severity of impact, some low-income women have been unrecognized. Despite the fact that incentives have been distributed, the analysis revealed that women amongst the identified categories of people were mostly impacted by the increases in energy prices.

Because energy consumption patterns, social and financial support for vulnerable groups, as well as strategies to help understand these nuances are not fully explored, policies always turn to the groups who obviously are likely to be impacted by the situation. Stereotypical is the fact that the elderly always require more heat because of their physiological condition, however, the unemployed, students, children and people with underlying health conditions also need caring for.

In the analysis, we saw that most retired groups and the aged, although had lower gross annual income, owned their houses with some greater than 110 sqm in size. This indicates their less vulnerability and financially stability due to their stable income often in the form of pensions. While many aged people invest in efficient housing conditions, they further receive support from their family members and children. As indicated in the analysis, one family member expressed her willingness to cater for the energy need of her grandmother, hence, reducing the impact of indoor temperature on her health. Even though it is true that the aged are more vulnerable to low indoor temperatures, especially during the winter periods, most family members and children are more likely and willing to cater for part, if not all, of their energy needs, especially heating and electricity.

Relating to TEP, there is lack of recognition to mobility issues in Bryne. There is a recognition that the system is not supporting their need, and this manifested throughout the analysis, the diverse forms of transport deprivation; transport affordability, transport accessibility, forced car ownership and car related economic stress. Aside train misfunctions, we saw in the analysis

that some households had difficulties in reaching certain key services at a reasonable time, while it was expensive to get to some destinations. Even those who had their own cars expressed their dissatisfaction on their usage owing to the enormous cost they incur while others have been forced to purchase a car because of the disadvantages in the peri-urban area.

The appreciable increase in the use of fossil fuel cars reflects the condition of low-income households' inability to cater for cost associated with charging a car. All these issues needs to be recognized and without understanding the dynamics to both domestic and transport energy needs, subsidies and other interventions may contribute less to solving double energy vulnerability situation in Stavanger. I argue that failure to acknowledge these nuances not only create injustices but leads to greater loss of knowledge, perceptions, and rich experiences of such marginalized groups.

Injustice as Misrecognition and Disrespect

Putting together the emergence of digital citizenship with current public protests and grievances, we see an emergence of a coordinated campaign to misrecognize and disrespect individuals. Justice as non-recognition is manifested not only as a failure to recognise but also undermining households' vulnerability and concerns to the current energy situation.

In general, it can be observed from the formation of the digital citizenship and the current demonstrations that households are still paying higher prices than are reasonable and that policymakers fail to recognize that many of the concerns voiced by vulnerable households have been legitimate. Sometimes, these protests are regarded by policymakers as self-interested and misinformed demonstrations on the part of households who are only after cheaper electricity and in need of what is reasonable electricity price against any other happenings that leads to such conditions. When this happens, the knowledge and concerns of impacted households regarding energy prices are viewed not only as 'insufficient' but also 'wrong' (Jenkins et al., 2016, p. 177), and are characterized by sweeping comprehensiveness with little attention to detail, selfishness and sheer ignorance. Policymakers tend to rely only on experts' knowledge and the global market price as the only factual and accurate information at the detriment of end users' knowledge and experiences.

7.1.2. Distributive Justice –Who qualifies and Who benefits?

7.1.2.1. Re-distribution of benefits

The case of EP in Stavanger gives a glimpse into the injustices in the distribution of benefits through financial means. The issue of who qualifies and receives subsidies points out to the distributional unfairness meted out to some low-income households. Jenkins et al. (2012) have argued that distributional justice involves distributing benefits and sharing burdens equally and people receiving less and not accessing benefits demonstrate unequal distribution and access to energy through financial means (page 176).

The empirical analysis revealed an unequal distribution, lack of awareness and accessibility to subsidies to some low-income and unemployed households in Stavanger. Thus, regardless of the government's intervention to the price increases, some households were not aware particularly of subsidies from NAV, Enova and Husbanken, while others could not access and hence could not benefit from it. While some of the unemployed respondents received unemployment benefits from NAV, no respondents were eligible for Enova subsidies, and very few respondents were even aware of the support schemes available for energy efficient homes.

I argue that two forms of distributional unfairness are involved in this – (1) distributional unfairness at a governmental level - with government subsidies not equally benefitting households and low-income households not being able to access subsidies; and (2) distributional unfairness at a household level - landlords not passing over subsidies to tenants.

On the governmental level, housing benefits and support for electricity expenditures constitute one of the many forms of government interventions to provide financial aid to low-income and high-expenditure households, and it is the municipality that is responsible for the registration of applications and for maintaining contact with those qualified to apply for such programs. A municipality is responsible for making sure that all households have access to equal services and ensure it understands that there are certain criteria that need to be met to qualify for subsidies. Other elements include accessible forms, easy navigation of the website, and an efficient response to subsidy inquiries in case of an emergency. Responses to this survey indicate the desire to address distributional injustice by clarifying who qualifies for subsidies. In addition, what conditions must be met for subsidies to be awarded and how they are to be awarded.

There has been recognition that some low-income private renters are facing unfair distributional issues regarding some landlords are not passing subsidies along to them. In some cases, landlords have demonstrated scant interest in investing in the energy efficiency of their buildings, and tenants can also be reluctant to ask for home improvements. As gentrification has created an expensive housing market in urban Stavanger, tenants are sometimes afraid to speak out about improving their homes for fear of eviction or increases in rent. So long as they have access to essential services and can participate in activities closer to the city centre, they endure poor housing conditions and remain silent despite their struggles.

7.1.2. Procedural Justice – Which processes are fair?

7.1.2.1. Local Knowledge Mobilisation

Double energy vulnerability in Stavanger lacks procedural justice concerns particularly inadequate information disclosure and local knowledge mobilization. Several useful recommendations have been provided by affected DEV households, as part of the analysis, to address the issue of double energy vulnerability in Stavanger. The Individual government policy recommendations and household coping strategies all illustrate households' interest in policy interventions and a level of local knowledge that has not yet been utilized. As procedural justice transcends mere inclusion to involve the mobilisation of local knowledge, early interventions are paramount to an effective consultation process and the engagement of vulnerable households is an imperative with regards to procedural justice aspects. I argue that effective participation does not necessarily equate to physical participation in the decision-making process. Rather, the inclusion of knowledge, discourse, and stories into policy decisions can have a significant impact on the way that policies are developed.

7.1.2.2. Full Information Disclosure

Finally, information on energy consumption and price increases needs to be disclosed to households. One household from the Stavanger expatriate group reported that,

"Because of good feedback and more importantly of an English version, we changed our electricity provider to Tibber. The electricity provider we had at first was unclear what

constituted the enormous bill and above all was all in Norwegian. We had to translate word to word to clearly understand some feedbacks which to us is unfair and unacceptable".

Providing consumers with information on energy production is one of the key factors that can encourage more ethical and sustainable consumption practices. A low level of information disclosure is meant to offer hints and tips on how households can reduce their energy consumption on a daily basis and Jenkins et al., (2016) have argued that through information dissemination, individual households can also provide their own usage feedback to authorities, upon reflection of past usage or usage patterns of their peers (Jenkins et al., 2016, p. 178). This can impact the direction of investment, the behaviours of the individual, and even the level of trust that people place in information about energy and the institutions that supply it.

8. Chapter 8 - Conclusion

In conclusion, it has been observed from the study that double energy vulnerability is prevalent in Stavanger and low-income households, particularly, residents of Bryne are facing severe transportation issues such as transport affordability, transport accessibility, forced car ownership and car-related economic stress.

The study has revealed that not only are retired people vulnerable to domestic energy poverty, but other low-income households such as students, part-time workers, unemployed groups, single parents, and households with children all face the consequences of double energy poverty. Grievous is that the most identified energy-poor households are women who earn less than 300,000 NOK, do not receive government support, and spend more than 10% of their income on energy bills.

Again, the research has revealed that some low-income households are not benefitting from government subsidies and even when the subsidy is distributed, does not get to them. Further discovery was that, regardless of the high energy prices, most households lacked adequate information disclosure from energy supply companies on their energy consumption, and so find it difficult to hold themselves accountable for their energy cost. The study has also spelt out sought-after policy recommendations of households for a better energy and transport system.

From the findings, I recommend that there be a need for more theoretical and empirical research on both domestic and transport energy poverty across municipalities and regions in Norway, spatial tailoring of policies, affordability of energy-efficient technologies or low-tech solutions, a thorough investigation into how subsidies trickle down to low-income households.

8.1. Limitations of study

A major limitation of the study was data collection. Data from Bryne was hard to collect owing to the researcher's limited proficiency in the Norwegian language and the ongoing pandemic, which deterred respondents from communicating freely. Also, data collection was conducted during the peak winter season (thus, from February to March 2022), and it became difficult for respondents to co-operate. The culturally sensitive nature of the research posed a challenge in

collecting data sufficient to carry out a comparative analysis needed to bring out a clear-cut distinction between the two areas.

8.2. Avenues for further research

Future research will have to focus on a wider range of theoretical and empirical research on Double Energy Vulnerability in Norway. Future research can focus on a cross-city analysis of both TEP and DEP in Stavanger and other regions of Norway. DEV in multiple cities can be investigated, as well as a comparative study of rural to rural, urban to urban, and peri-urban areas in all regions of Norway.

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APPENDICES

Appendix 1: Paper-based questionnaire for *Østre Bydel and Bryne*

The research Double Energy Vulnerability (DEV) will study the intersection of domestic energy poverty and transport energy poverty in the context of Norwegian cities. The topic has come to the fore internationally as under-researched yet key to enable equitable energy transitions. The project is explicitly cross-sectoral and will attend to the incidence of DEV in relation to urban housing, mobility and low-carbon energy transition policies. Norwegian cities are leading transitions in urban energy that make them ideal contexts for this research to generate actionable and transferable insights. It will employ a qualitative study in Stavanger (***Østre Bydel and Bryne)***, aimed at identifying emerging inequalities and seeks to address equity and vulnerability in the ongoing low carbon transitions.

1. Do you live in Bryne*? Bor du i Bryne /* *Østre Bydel**?***

Which area? hvilket område?……

2. How old are you?/*Hvor gammel er du?*

18-25 26-35 36-45 46-55 56-65 66+

3. What is your employment status?/*Hva er din yrkesstatus?*

Full-time job/*Fulltid* Part-time job/*Deltid* A student/*Student*

Unemployed/*Arbeidsledig* Retired/*Pensjonert* Other/*Annet*

4. What kind of house do you inhabit?/*Hvilken type bolig har du?*

Apartment/*Leilighet* House/*Enebolig* Townhouse/*Rekkehus*

Room in apartment or house/*Rom i leilighet eller hus*

Semi-detached house*/Tomannsbolig* Other*/Andre*

5. What is your housing status?/*Hva er din boligstatus?*

Self-owned/S*elveier* Rented/*Leie*

Social housing/*Sosialbolig* Housing association/*Borettslag*

6. How many are living in your household?/*Hvor mange bor i din husstand?*

7. How many in the household are adults?/*Hvor mange i din husstand er voksne?*

8. How many square meters is your residence?*/Hvor mange kvadratmeter er din bolig?*

Under 40 40-70 70-110 Over 110

9. Do you know what the energy certificate for your residence is?/*Vet du hva energimerkingen er for din bolig?*

10. How do you heat your residence? (you can choose several alternatives) /*Hvordan varmer du boligen din? (du kan velge flere alternativer*)

Heat pump/V*armepumpe* Electric heater/*Elektrisk varmeovn*

Floor heating/*Gulvvarme* Fireplace or furnace/*Peis eller vedovn* Other/*Annet*

11. Do you heat up the whole residence?/*Varmer du opp hele huset?*

12. Do you use any smart home devices for energy efficiency?/*Bruker du noen smart-hus teknologier for energieffektivitet?*

13. Who is your electricity supplier?*/Hvem er din strømleverandør?*

14. Do you have a fixed or variable tariff? *Har du fast eller variabel tariff?*

15. Do you follow elecetricity price fluctuations?/*Følger du med på svingninger i strømprisene?*

16. Have you ever received subsidies from Enova for environmentally friendly products or energy efficiency?/*Har du mottatt støtte fra Enova for miljøvennlige produkter eller energieffektivitet?*

17. What is the yearly income of your household, before tax?/*Hva er den årlige inntekten i din husstand, før skatt?*

<300 000 NOK 300 000-600 000 600 000-1 000 000 >1 000 000

18. Can you estimate what is the annual electricity bill in your household?/*Kan du estimere hva som er den årlige strømregningen i din husstand?*

19. Do you know what was your monthly electricity bill for the last 3 months? /*Vet du hva som var din månedlige strømregning for de siste 3 måneder?*

20. Do you think the electricity bill constitutes a big part of your monthly expenditure? Can you estimate the percentage?/*Synes du at strømregningen utgjør en stor del av dine månedlige utgifter?*

<5% 6-10% >10%

21. Does your household have access to a car?/*Har din husstand tilgang til bil?*

Own a car/*Eier en bil* Own two cars/*Eier to biler* Car-sharing/*Bildeling*

Able to borrow a car/*Har mulighet til å låne en bil* No access/*Ingen tilgang*

22. Did you buy your car as a new or second-hand?/*Kjøpte du bilen din som ny eller brukt?*

23. How many years ago did you buy your car?/*Hvor mange år siden kjøpte din bilen din?*

24. What type of car is it?/*Hvilken type bil er det?*

Fossil fuel powered car/*Fossilt brensel drevet bil* EV/*Elbil* Hybrid/*Hybrid*

25. How much money do you spend on your car(s)?/*Hvor mye penger bruker du på din(e) bil(er)?*

26. Do you plan to buy a car in the near future?/*Planlegger du å kjøpe en bil I nær fremtid?*

27. Do you use public transport? If so, how many days a week?/*Bruker du offentlig transport?*

1-2 3-5 5+

28. Do you have a monthly pass?/*Har du et månedlig pass?*

29. Do you use any other modes of transport? (you can choose several alternatives)/*Bruker du andre former for transport? (du kan velge flere alternativer)*

Public e-bikes/*Offentlig elsykkel*	E-scooter/*el-scooter*	Bicycle/*Sykkel*
HjemJobbHjem	Walk/*Gå*	Other/*Andre*

30. How do you get to the city center and any preferential places of your choice? /*Hvordan kommer du deg til sentrum?*

***Do you struggle to get there and are you able to get there on time?**

31. Do you try to cut down on your energy use on purpose? /*Prøver du bevisst å kutte ned på strømforbruk?*

32. Are you aware that it is possible to receive subsidies for your electricity bill from NAV?/*Er du klar over at det er mulig å motta støtte for strømregningen din fra NAV?*

33. What kind of energy efficiency subsidies would you be interested in, e.g. from ENOVA?/*Hvilke type energieffektiviseringstilskudd vil du være interessert i, f.eks fra ENOVA?*

34. Are there any changes in energy policy you would like to see from the government?/Ønsker du å se noe endringer i energipolitikken fra regjeringen?

Appendix 2: Interview Guide

- Do you live in ***Østre Bydel or Bryne?***
- Which area?

HOUSEHOLD ECONOMY AND ENERGY USE

1. Are you able to keep your home at an adequate temperature?
2. Do you have arrears on your electricity bills?
3. Is your monthly/yearly income able to cater for most domestic needs of your home?
4. In what way does spending on electricity bills limit your other expenditures?
5. How have you been impacted by the recent increases in electricity prices?
6. How has your household benefitted from subsidies from the government?
7. Do you consider your household a higher energy consumer?
8. What recommendations do you have for a better transport system?

HOUSEHOLD TRANSPORT USAGE

9. Are you able to afford a car? What type of car?
10. How easy are you able to meet all your transport needs?
11. How do your energy expenses affect your transport needs?
12. What percentage of your monthly income is spent on transport? Do you think it is a lot?
13. What recommendations do you have for a better transport system?

Appendix 3: Information Letter from NSD

Are you interested in taking part in the research project

"(Double Energy Vulnerability of Urban and Peri-urban areas of Stavanger – Addressing equity and vulnerability in low-carbon energy transitions)"?

This is an inquiry about participation in a research project where the main purpose is to *study the intersection of domestic energy poverty and transport energy poverty, referred to as Double Energy Vulnerability in the urban and peri-urban areas of Stavanger*. In this letter we will give you information about the purpose of the project and what your participation will involve.

Purpose of the project

The theme for the project is Norwegian Energy Poverty. The research studies the intersection of domestic and transport energy poverty, referred to as Double-Energy Vulnerability in the Urban and Peri-Urban areas of Stavanger. The study seeks to understand how equity, justice and vulnerability correlates with energy consumption and production in diverse and complex ways.

The growing concerns over security in energy supply, increases in energy prices and climate change has placed energy on political agendas around the world. According to the IPCC report (2021), the goal of meeting the Paris Agreement (reducing global annual average temperatures to well below 2°C and possibly 1.5°C) seems unlikely, as it is probable that temperatures will increase by more than 1.5°C above pre-industrial level within the next two decades. The IEA and its World Energy Outlook report further states that the world should prepare for increased annual average temperature trajectories of 3-6°C. It is very crucial, therefore, to decarbonize domestic energy and transport if we are to address issues of climate change. However, addressing these challenges will mean putting effective measures in place to ensure equity and justice while avoiding heightened inequality.

Domestically, energy deprivation is often described via the term 'energy poverty'. The concept has been employed, traditionally, to represent problems of insufficient access to energy in developing countries, necessitating a host of economic, infrastructural, social, equity, education, and health concerns. Energy poverty refers to "the inability to attain socially and materially necessitated levels of domestic energy services, particularly, for 10 percent of (household) income, on heating, lighting, and hot water". To be in energy poverty will mean one's inability to access or afford the required technologies or appliances to keep a home at a comfortable temperature or cook hot meals.

Transport energy poverty on the other hand is defined as the inability to attain socially and materially necessitated levels of transport services. This may include one's inability to afford or access essential transport services, reorganizing their ability to travel for fundamental needs. Recently, the Norwegian government proposed subsidies to ease pain of high-power prices. It further agreed increased electricity subsidy scheme and has provided 3000 kroner in electricity support to students. Despite electricity subsidies, winter in Norway, according to news articles and the media, will be extremely expensive this year (2022). Households, especially low-income and vulnerable ones, will suffer the most. It is on this note that I study how households are being affected by the increases in electricity prices and how the allocation of social benefits has helped to alleviate poverty and ensures equity amongst households. The research will help improve the quality of life of millions as well as enable decision-makers in government, industry, stakeholders, and society at large to make "just" choices regarding technology, economic and policy issues. This research is a masters thesis project and part of

fulfilling the requirements for a master's degree in Energy, Environment and Society at the University of Stavanger.

The research questions are;

- Main research question*:* What characterizes energy poor households in urban and peri-urban areas of relatively affluent city?

Sub-research questions are;

- What factors driving Double Energy Vulnerability exacerbates inequality?
- In what ways can policies target Double Energy Vulnerability to reduce household inequality?

Who is responsible for the research project?

The University of Stavanger is the institution responsible for the project.

Why are you being asked to participate?

Data is collected randomly, and the survey seeks to target households deemed vulnerable to both domestic and transport energy poverty. The survey seeks to target 50 households from both areas.

What does participation involve for you?

If you chose to take part in the project, this will involve that you either fill in a paper-based survey or take an interview. It will take approx. 30 minutes each. The survey includes questions about your energy expenditure, income, and energy consuming habit. Your answers to the interview will be noted on a response sheet.

Participation is voluntary

Participation in the project is voluntary. If you chose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw.

Your personal privacy – how we will store and use your personal data

We will only use your personal data for the purpose(s) specified in this information letter. We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

Professor Siddharth Sareen (Supervisor), Professor of Energy and Environment, at the Department of Media and Social Science, University of Stavanger will have access to the personal data. I will replace your name and contact details with a code. Personal data will be transferred and stored in an encrypted form to the university server and access will be restricted throughout the project. The age, occupation, and geographical location (the area you live) necessary for writing the research findings and report will only be included in the research.

What will happen to your personal data at the end of the research project?

The project is scheduled to end *on August 8, 2022. At the end of the project, the personal data will be anonymized and deleted after August 8, 2022.*

Your rights
So long as you can be identified in the collected data, you have the right to:

- access the personal data that is being processed about you
- request that your personal data is deleted
- request that incorrect personal data about you is corrected/rectified
- receive a copy of your personal data (data portability), and
- send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data

What gives us the right to process your personal data?
We will process your personal data based on your consent.

Based on an agreement with *the University of Stavanger*, NSD – The Norwegian Centre for Research Data AS has assessed that the processing of personal data in this project is in accordance with data protection legislation.

Where can I find out more?
If you have questions about the project, or want to exercise your rights, contact:

- *University of Stavanger* via *Professor Siddharth Sareen on siddharth.sareen@uis.no or +4751831646 as well as Jeffery Boakye Botah (Student) and on +4792067057].*
- Our Data Protection Officer: *Professor Siddharth Sareen- University of Stavanger*
- NSD – The Norwegian Centre for Research Data AS, by email: (personverntjenester@nsd.no) or by telephone: +47 53 21 15 00.

Yours sincerely,

Project Leader

Student (Jeffery Boakye Botah)

(Professor Siddharth Sareen)

Consent form

I have received and understood information about the project *Double Energy Vulnerability in the Urban and Peri-urban areas of Stavanger – Addressing equity and vulnerability in low-carbon energy transitions* and have been given the opportunity to ask questions. I give consent:

- ☐ to participate in *an interview*
- ☐ to participate in *paper-based survey*

I give consent for my personal data to be processed until the end date of the project, approx. *June 15, 2022.*

(Signed by participant, date)

Appendix 4: **Sample Map of Stavanger and graphs from survey data collected from Stavanger Expats**