**“Effective Interventions for Addressing Energy Poverty in the Municipality of Leeuwarden”**

R. Fokkens (s4119878)
University of Groningen, University Campus Fryslân
BSc. Global Responsibility and Leadership
CFB063A10: Capstone Project
PhD. Hendriks, A., & prof. Dr. J.A. Beaulieu
June 10, 2022

# FOREWORD

In front of you lies a Capstone Project on effective interventions against energy poverty for the Municipality of Leeuwarden. This study was conducted by Richt Fokkens, a third-year student of the program Global Responsibility and Leadership (GRL) at University Campus Fryslân. The following study includes the possibilities of 'matching' the indicators of energy poverty by TNO to interventions against energy poverty. The aim is to discover whether an approach like this is possible and whether it makes the intervention strategy more effective. Over the past three years, I have gained interest in the local energy transition. I feel closely connected to my frisian surroundings and I aspire to contribute to its current and future developments. This passion has prompted me to do research on (1) resistance against energy projects (Living Lab), (2) improving participatory processes in the heat transition in collaboration with Ekwadraat Leeuwarden, and currently (3) effective interventions against energy poverty for the Municipality of Leeuwarden. I am very grateful for all the opportunities I have been given during these three years. I would like to thank a number of people who have contributed to my experience at UCF. Starting with my peer and friend Amber Beernink who greatly supported me by giving feedback, writing endless reports together and most importantly, (mentally) supporting me when needed. Secondly, I would like to thank my Capstone supervisor PhD. Abe Hendriks for providing feedback and making time for discussions about the topic. Thirdly, I would like to thank my brother who, throughout my studies, continuously aimed to improve my English writing skills by giving an endless amount of feedback. Lastly, I want to thank other friends and family who supported me during the process of writing this Capstone thesis.

Richt Fokkens

Easterein, 10 juni 2022

## ABSTRACT

Over half a million households in the Netherlands are affected by energy poverty (EP). To address this, municipalities received funding from the Government where they have been given the freedom to determine how to spend it. This is based on the argument that every region has different needs. A literature review was conducted to present the definition of EP, the challenges of measuring EP, and negative impact of EP, and effective interventions for addressing EP. Moreover, it shows the EP indicators as developed by TNO (Mulder et al., 2021) in the context of the Netherlands as well as the Municipality of Leeuwarden. This showed that some neighborhoods for instance do have low income and high energy costs, but do not have low energetic quality homes. However, the main impediment of using these indicators for an intervention is the current AVG regulation, which constrains the use of data on individual/household-level. Moreover, not every energy-poor household self-reports their situation to the Municipality as the respondents argued that they are occupied with completely different things like 'making ends meet'. These factors make interventions more complex as respondents and the literature argued that personal contact with an energy coach that can ensure tailor-made interventions is considered to be the most important intervention. To circumvent the AVG, the Municipality of Leeuwarden uses their internal data, including the WOZ-value, energy labels and the data about households that are on social assistance to map energy-poor households. When this phase is completed, larger-scale actions can be implemented. This study concludes that there might be a possibility to link interventions to the TNO indicators and transform them into three specializations: specializations: (1) *consumer behavior,* (2) *technical solutions;* (3) *financial and legal support*. However, practice should show whether this proves its effectiveness. To do so, energy poverty should be measured and monitored in an accurate way.

# TABLE OF CONTENTS

# INTRODUCTION

The heating at 15 degrees and wearing multiple sweaters; energy poverty (EP) within the Netherlands is an increasing problem. EP it is a multifaceted and complex problem that is difficult to define in a single definition (Mendoza et al., 2019; Bouzarovski & Tirado Herrero, 2016). That is because it is strongly dependent on the context and the country of reference (Mendoza et al., 2019; Bouzarovski & Tirado Herrero, 2016). In the Netherlands, one could speak of energy poverty *when a household has insufficient access to good energy facilities at home* (Pye, et al., 2015; Mulder et al., 2021). Currently, more than half a million households in the Netherlands are affected by EP (Mulder et al., 2021). It is particularly challenging in the north of the Netherlands, where the concentration of EP is substantially higher than in other areas of the country (Rekenkamer Leeuwarden, 2018). Therefore, this study focuses on the Municipality of Leeuwarden, which is located in the Province of Friesland. Almost a quarter of Frisian homeowners want to make their home more energy efficient, but are not able to finance it (Rekenkamer Leeuwarden, 2018). Energy-poor households are generally distinguished by high energy expenses, a poorly insulated home, and a low income (Mulder et al., 2021). The current rise in gas prices makes paying energy bills even more challenging (van Middelkoop et al., 2018). To address this, the Dutch Government granted funds to the municipalities to support energy-poor households. Because each region has different demands, municipalities have the authority to decide how they want to spend these funds. In general, municipalities are pleased with the level of freedom they have been given to use the subsidies as they mention that “it creates possibilities to help energy-poor households in a tailored manner” (Ministerie van Binnenlandse Zaken Koninkrijksrelaties, 2022, p.1). However, little is known about 'matching' interventions against EP to indicators of EP to ensure an effective strategy. Exploring this, may

help to ensure that government funds are used as efficiently as possible and that priorities are set to support the most vulnerable households.

Accordingly, The foundation of this research relies on a study by the Dutch research institute TNO that is written by Mulder, Dalla Longa and Straver (2021). They developed indicators and data for measuring energy poverty in the Netherlands. The study uses the information from the Central Bureau for Statistics of the Netherlands (CBS) that dates from 2019. The calculations include almost 80% of the households within the Netherlands in 2019 (Mulder et al., 2021). Accordingly, this study aims to answer the following question: "*How could the TNO indicators be linked to interventions against energy poverty in order to develop a more effective strategy for the Municipality of Leeuwarden?*". Within this, an 'effective' strategy could mean that the interventions either decrease EP among households or increase the energetic quality of homes (Straver et al., 2017)

Due to the General Data Protection Regulation (AVG), the data is presented on neighborhood-level instead of household-level. Despite this, Mulder et al, (2021) argue that the indicators can serve as a foundation for targeted measures and policy development at the governmental, provincial, and neighborhood levels (Mulder et al., 2021). Accordingly, the study intends to contribute to the development of an intervention strategy for the Municipality of Leeuwarden. These recommendations will be based on a review of current literature as well as the experiences of experts in the field. This region was chosen because the municipality of Leeuwarden has been actively combating EP since 2016 (Ministerie van Binnenlandse Zaken Koninkrijksrelaties, 2022).

### 1.1 Reading guide

First, this study aims to define energy poverty in order to better understand the specific difficulties and needs that energy-poor households face. Secondly, it investigates the challenges of measuring EP and the impact of EP. Thirdly, it seeks to explore EP in terms of nature, size and distribution in the Netherlands. After that, the indicators by TNO will be described in the context of the Netherlands and specifically the Municipality of Leeuwarden. Accordingly, the components of current (effective) interventions against EP will be discussed. Then, the results aim to bridge the gap between the effective interventions and indicators by TNO based on experiences of experts in the field. Lastly, the discussion section aims to combine all results with the goal to contribute to the development of addressing energy poverty in the Municipality of Leeuwarden.

## LITERATURE REVIEW

This section starts by defining the concept of EP. Secondly, the challenges to measure energy poverty are presented as well as the impact that energy poverty has on households. Moreover, energy poverty is explained in terms of the nature, size and distribution of energy (poverty) as studied by Mulder et al., (2021); Middlemiss et al., (2021), and Middelkoop et al., (2018). Thereafter, the new indicators by TNO are presented which show different perspectives on EP (Mulder et al., 2021). Finally, known (effective) interventions against EP are presented, as well as the components that contribute to developing an effective intervention strategy.

### 2.1 Defining energy poverty

Although the fact that EP is recognized as one of the greatest challenges in both developing and

developed countries, there is no consensus on the definition yet. This is often seen as a barrier to understanding and addressing EP (Thomson et al., 2016). Accordingly, there are two major challenges to reach theoretical consensus (Bouzarovski & Tirado Herrero, 2016). First, the variety of forms that energy poverty could take depending on and secondly, the multidimensional nature of this phenomenon's causes and consequences (Bouzarovski & Tirado Herrero, 2016). Both elements are context-dependent (Bouzarovski & Tirado Herrero, 2016).

Nevertheless, many researchers have contributed to the development of a definition. Accordingly, the term ´energy poverty´ can perhaps be traced back to Brenda Boardman's research on 'fuel poverty' in the UK in the early 1990s (Boardman, 1991). During that time, the fuel prices increased which resulted in many households (especially those with low income) being unable to afford adequate heating for their homes (Boardman, 1991). In addition, Boardman (1991) showed that 'cold homes' can have harmful effects on occupants both mentally and physically. A study by Grevisse & Brynart (2011) looked into how EP is understood in Europe by looking at various indicators of energy poverty. In that context, energy poverty was defined as "the impossibility for a household to gain access to the energy it needs to ensure dignified living conditions at an affordable price from the point of view of its income" (Grevisse & Brynart, 2011, p. 538). However, this definition requires a common understanding for multiple terms which likely differ per region and country (dignified living conditions, adequate heating levels, and affordable costs) (Grevisse & Brynart, 2011). In line with Grevisse & Brynart (2011), another study argued that, EP is often referred to as "a situation where individuals are not able to adequately heat (or provide necessary energy services) in their homes at affordable cost" (Pye, et al., 2015, p. 64). Furthermore, EP can also be defined as a lack of choices and possibilities which can have an impact on people's well-being. Meaning that one does not have the choice to, for

example, heat their homes at a comfortable temperature. This is in line with the capability approach adopted by Amartya Sen (1999) which was developed in the field of development economics. In this view, EP is not seen as the lack of income, but rather as a lack of capabilities that households need in order to make choices (Day et al., 2016). In that sense, EP can be defined as "the inability to realize essential capabilities as a direct or indirect result of insufficient access to affordable, reliable and safe energy services, and taking into account available reasonable alternative means of realizing these capabilities" (Day et al., 2016, p. 260).

More generally, it is argued that the effects of EP are driven by a combination of three factors: 1) low income, 2) increased energy bills and 3) poor energy performance of buildings resulting in inadequate delivery of essential energy services in the home (Bouzarovski & Tirado Herrero, 2016; Pye, et al., 2015; Mulder et al., 2021). Moreover, Preston et al. (2014) established five factors that (in combination) function as the risk of households of energy poverty: 1) the rate of energy price rises versus income growth, 2) ability to access cheaper energy prices, 3) household energy needs, 4) efficiency of energy use, 5) policy interventions.

Despite numerous uncertainties and the different definitions, many EU Member States recognize the scale of the problem and its negative consequences (Middlemiss et al., 2021). This recognition is of high importance as it will help to understand the specific difficulties faced by households that are dealing with EP (Middlemiss, et al., 2021).

### 2.2 Challenges of Measuring Energy Poverty

Energy poverty must be measured and monitored in order to determine the scope of the problem and the best way to combat it. However, measuring EP has its own set of difficulties. Until now,

research into energy poverty within the Netherlands has mainly been focused on the affordability of energy bills (Middlemiss et al., 2021). In line with that, the most commonly used indicator of energy poverty is the so-called ‘energy burden’ or the ‘10% indicator’ (Middlemiss et al., 2021). This describes the percentage of energy costs as part of the total household income. In that context, a household is ‘energy-poor’ if it spends more than 10% of its income on energy costs (Middlemiss et al., 2021, p. 11). This measure has been criticized since it does not account for changes in income or improvements in energy efficiency (Robinson, et al., 2018). Middelkoop et al. (2018) argued that high-income households can also have high energy burdens because of their energy-intensive lifestyle. For example, households that own a jacuzzis, multiple TVs or high energy-consuming refrigerators. Other than that, Middelkoop et al. (2018) also looks at payment risk. A payment risk concerns households not budgeting for living expenses after paying for housing and energy costs. Furthermore, one may examine EP by concentrating on (energy) payment arrears (Middlemiss et al., 2011, p.11). Despite efforts, the above-mentioned attempts still appear to be insufficient to come to a single definition of energy poverty. The indicators and definitions of EP will continue to evolve and hopefully eventually allow EP to be measured and monitored in an accurate manner. This might be needed in order to design effective intervention strategies.

### 2.3 The Impact of Energy Poverty

Studies have shown that EP has a major impact on people's health and well-being (Ballesteros-Arjona et al., 2022; Dear & McMichael, 2011). For instance, a relationship was found between insufficient heated homes and increased mortality and morbidity (Dear & McMichael, 2011). Moreover, it is argued that EP can lead to social isolation (Middlemiss et al., 2018). That is because not having enough money for heating, lighting, or cooking may cause

people to be afraid to have guests over. Furthermore, Middlemiss et al. (2019) presented a framework based on the Central Capabilities by Nussbaum to understand and categorize the harms of EP. This framework shows the detrimental impacts on people's well-being, as a consequence of unaffordable energy cost and/or inadequate heating services (Middlemiss et al., 2019). This study showed the increased feelings of fear, anxiety and distress which negatively impacts everyday tasks such as studying and working, but also recreational activities and educational opportunities (Middlemiss et al., 2019). Furthermore, evidence was found that EP adversely affects people's ability to form meaningful relationships which in turn impacts people's ability to access energy services, as people rely on their interactions with others (family, friends or experts) for information, advice and other services (Middlemiss et al., 2019).

### 2.4 Size, nature and distribution of EP in the Netherlands

Mulder et al. (2021) explains that a household is considered 'energy poor' when they do not have sufficient access to good energy facilities in their home (Mulder et al., 2021). This can be seen, for example, by turning down the thermostat to save money, even if this is not deemed comfortable (Mulder et al., 2021). As mentioned before, it is argued that households can suffer from emotional stress and physical health issues (Mulder et al., 2021). This is linked to the 48% of households in the country that currently live in poor or moderately poor insulated houses (Mulder et al., 2021). One of the issues with EP is that a large share of these households do not have the ability to modify this. About 40% of the energy poor households live from social assistance or another social provision (Mulder et al., 2021). This group has a much lower income than non-energy poor households since their income is less than half of the population's average annual income (Mulder et al., 2021). Currently, single-person homes, especially single-parent families, are overrepresented in the group of energy-poor households in the Netherlands (Mulder

et al., 2021). The rising gas prices will also negatively affect the amount of energy-poor households in the Netherlands in the coming years.

Second, it is critical to understand the scale of the problem. Mulder et al. (2021) presented that about 550.000 households are considered energy poor, which is 7% of the Netherlands. In addition, they estimated that about 140.000 households fall under 'hidden energy poverty'. Meaning that, households utilize less energy than they would want, most likely due to budgetary constraints (Mulder et al., 2021). Within the group of energy-poor households (500,000), about half of the households have a low income and a home with low energetic quality as well as high energy costs (Mulder et al., 2021).

Besides the nature and size of the problem, TNO also studied the geographical distribution of EP in the Netherlands. It underlines the connection between energy poverty and money poor, yet the phenomena do not always coincide (Mulder et al., 2021). Income poverty often occurs in urban areas, whereas EP mostly occurs in the North, East and Southeast of the country and partly in Zeeland (Mulder et al., 2021). EP is also geographically more concentrated than income poverty. This makes it easier to make targeted interventions (Mulder et al., 2021). A relatively low level of energy poverty was found in Randstad.[1] The following figure shows the level of EP on municipal-level on the left and neighborhood-level on the right. It clearly shows that energy poverty is mainly concentrated in the north (east) of the country.

[1] Large and medium-sized cities in the provinces of Noord-Holland, Zuid-Holland, Utrecht and Flevoland

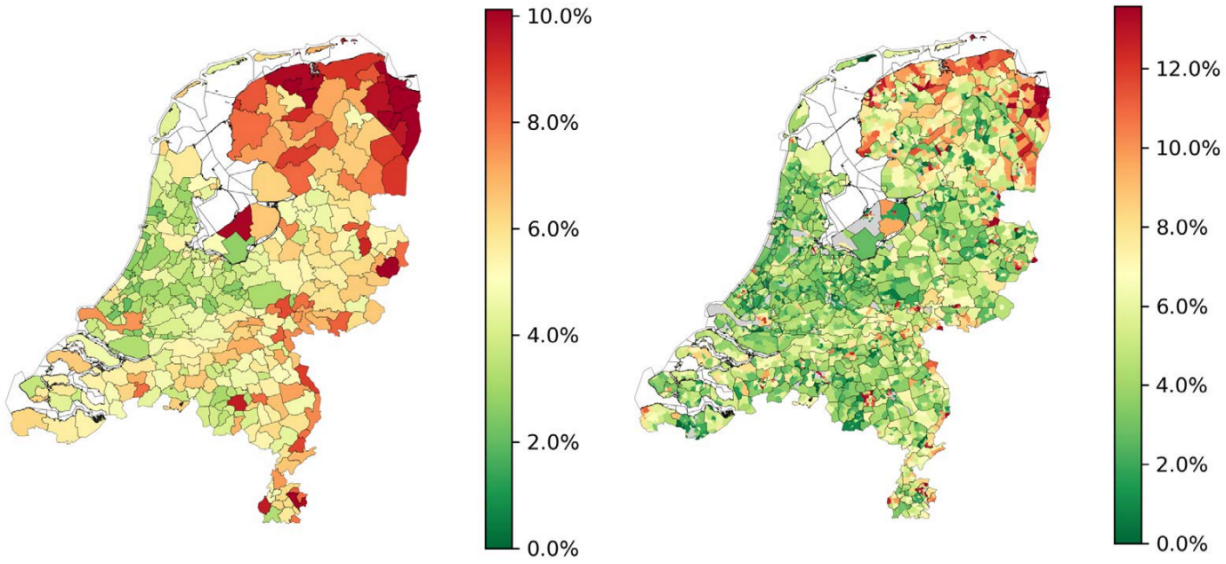


**Figure 1:** Level of energy poverty* per municipality (left) and neighborhood (right) (Mulder et al., 2021) * EP is measured as the % of households with a low income + either high energy costs (LIHK) or a house with an energetically low quality (LILEK)

### 2.5 Indicators of Energy Poverty by TNO

Based on numbers from the CBS, TNO developed several indicators for measuring energy poverty (Mulder et al., 2021). Mulder et al., (2021) transformed these indicators into three dimensions which are: 1) Affordability, 2) Energetic quality of the house, 3) Choice for sustainable investments. Monitoring these dimensions is essential as it can provide insight into the effects of policies and interventions to address energy poverty. In addition, these indicators can provide perspectives to guide policy makers on government level (e.g. subsidies), provincial level (e.g. knowledge sharing, funding and networking to support municipalities) and at municipal level which is the focus of this study (Mulder et al., 2021). At municipal level the indicators can help to design a targeted policy at neighborhood level (Mulder et al., 2021).

Accordingly, table 1 provides an overview of the dimensions and indicators for energy poverty. The original Dutch abbreviations are used as described by Mulder et al. (2021). The following paragraph explains the dimensions and its indicators as well as the current state of EP within the Municipality of Leeuwarden on neighborhood-level. An overview of this is also presented in table 2. It should be mentioned that when a percentage of an indicator turns out low, it does not mean that the neighborhoods cannot be considered energy-poor. While they do not stand out on a certain indicator, they can be energy poor on another indicator. That is, according to Mulder et al. (2021), because EP cannot be captured using one definition and one indicator. Likewise, when indicators are rated low for a neighborhood, it can still contain energy-poor households.

| **TNO INDICATORS** | | | |
|---|---|---|---|
| ***Affordability*** | **HEQ:**<br>- (high) energy costs as % of income | **LIHK**<br>- Low income, high energy costs | |
| ***Energetic quality of the house*** | **LILEK:**<br>- Low income, ow energetic quality | **LILEK-**<br>- Low income, low energetic quality and ‘underconsumption | **LILEK+**<br>- Low income, low energetic quality, and ‘overconsumption’ |
| ***Choice for sustainable investments*** | **eLEK**<br>- Homeowners with low energetic quality of the house, without choice to change that. | **hLEK**<br>- Tenants with a low energetic quality of the house, without choice to change that. | |

**Table 1:** Adapted from TNO indicators by Mulder et al. (2021)

| | | | ENERGY POVERTY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | **Total** (Affordability or energetic quality of home) | Affordability | Energetic quality of the home | Affordability and energetic quality of the home | Hidden energy poverty | Relative low energetic quality of the home and not being able to invest in sustainable measures | |
| | | | Low Income & High Energy Costs (LIHK) OR Low Income & home with relative Low Energetic Quality (LILEK) | Low Income and High Energy Costs (LIHK) | Low Income and home with relative Low Energetic Quality (LILEK) | Low income and High Energycosts (LIHK) and Low Income + home with relative Low Energetic Quality (LILEK) | Low Income & home with relative Low Energetic Quality & Underconsumption (LILEK-) | Homeowners of a home with relative Low Energetic Quality - not being able to invest in sustainable measures (eLEK) | Tenants of a home with relative Low Energetic Quality - not being able to invest in sustainable measures (hLEK) |
| **Name of municipality** | **Name of neighborhood** | | % | % | % | % | % | % | % |
| Leeuwarden | Westeinde e.o. | | 5.86% | 3.29% | 4.02% | 1.45% | 2.17% | 42.31% | 40.10% |
| Leeuwarden | Vossepark & Helicon | | 2.63% | 2.31% | 1.41% | 1.09% | 0.32% | 30.39% | 25.30% |
| Leeuwarden | Huizum-West | | 5.46% | 4.17% | 2.82% | 1.53% | 0.83% | 29.92% | 15.03% |
| Leeuwarden | Nijlân & De Zwette | | 4.63% | 4.47% | 0.60% | 0.44% | 0.16% | 14.24% | 1.00% |
| Leeuwarden | Heechterp & Schieringen | | 9.99% | 9.20% | 1.63% | 0.85% | 0.67% | | 3.41% |
| Leeuwarden | Camminghaburen e.o. | | 4.11% | 2.89% | 3.01% | 1.79% | 0.68% | 38.45% | 42.33% |
| Leeuwarden | Bilgaard & Havankpark e.o. | | 14.54% | 10.08% | 7.75% | 3.29% | 3.69% | 45.99% | 17.68% |
| Leeuwarden | Vrijheidswijk | | 15.82% | 11.21% | 10.55% | 5.93% | 4.33% | 40.82% | 24.23% |
| Leeuwarden | Dokkumer Ie e.o. | | 6.37% | 4.03% | 5.34% | 3.00% | 1.87% | 32.25% | 72.96% |
| Leeuwarden | Stiens e.o. | | 5.21% | 2.47% | 4.52% | 1.79% | 2.25% | 35.75% | 42.32% |
| Leeuwarden | Aldlân & De Hemrik | | 7.80% | 4.39% | 7.05% | 3.64% | 2.66% | 51.32% | 49.88% |
| Leeuwarden | Goutum | | | | | | | 21.87% | 74.58% |
| Leeuwarden | Hempens/Teerns & Zuiderburen | | 1.14% | 0.98% | 0.92% | 0.76% | 0.11% | 30.09% | 50.00% |
| Leeuwarden | Dorpen Zuid-Oost | | 8.41% | 5.51% | 5.96% | 3.05% | 2.83% | 30.94% | 44.82% |
| Leeuwarden | Dorpen Zuid-West | | 6.71% | 5.46% | 5.09% | 3.83% | 1.25% | 31.22% | 62.45% |
| Leeuwarden | Grou e.o. | | 8.85% | 5.53% | 6.62% | 3.30% | 2.39% | 33.35% | 44.90% |

**Table 2:** Energy poverty in the Municipality of Leeuwarden. Retrieved from CBS and used by Mulder et al. (2021**)**

### *2.5.1 Dimension one - Affordability (HEQ & LIHK)*

The first dimension is ‘affordability’ and is divided into two perspectives that determine whether a household can be considered energy poor (Mulder et al., 2021). First, the ‘high energy quote’ (HEQ) perspective, meaning that a (too) high share (over 10%) of the income is spent on energy costs (Mulder et al., 2021). HEQ is a relatively well-known and easy measure for EP. However, this indicator comes with various disadvantages. Firstly, it is a rather rough indication for EP which is likely underestimated or overestimated the problem. For example, it can show an overestimation of ‘energy-poor households’ that consciously choose for a lifestyle with high energy consumption. Secondly, it does not take into account households that ‘under consume’ energy, meaning that they use less energy than they would like often due to financial problems (Mulder et al., 202). Due to these limitations, this indicator is not included in this research for the Municipality of Leeuwarden. However, on a national level, HEQ shows that about 9.6% of the

households in the Netherlands are energy poor (Mulder et al., 2021). The second indicator is LIHK, which includes households with low income and a relatively high energy cost (Mulder et al., 2021). A 'low income' is defined in this context as having a disposable (net) income that is less than 130 percent of the social minimum. (Mulder et al., 2021). This group's financial wealth is in the bottom 10 percent in the Netherlands (Mulder et al., 2021). A ‘high energy cost’ can be defined as energy costs that belong to the highest 50 percent of the country (Mulder et al., 2021). The LIHK indicator excludes households that have high energy costs and have a relatively high income as this group is not considered energy-poor. However, the LIHK indicator has a disadvantage as the rate of energy poor households does not alter regardless of increase in energy prices (Mulder et al., 2021). Another limitation is that it excludes the hidden poverty households, which consume less due to financial problems (Mulder et al., 2021). However, this form of energy poverty is included in the second dimension ‘energetic quality of the house’. If EP is calculated using the LIHK indicator, Mulder, et al. (2021) show that (merely) 5.3 percent of households in the Netherlands are energy-poor.

#### *2.5.1.1 Affordability dimension - Leeuwarden*

By looking at the LIHK indicator for the Municipality of Leeuwarden on neighborhood-level, one could see that Heechterp & Schieringen (9,20%), Bilgaard & Havankpark (10,08%), Vrijheidswijk (11,21%) are significantly higher indicated in percentage than the other neighborhoods in the Municipality. Meaning that those neighborhoods have a higher percentage of households with low income and high energy costs. The other neighborhoods have a percentage that is lower (or about the same) percentage as the overall LIHK percentage of EP in the Netherlands which is 5,3% (Mulder et al., 2021). Meaning that, when prioritizing certain neighborhoods, it appears logical to start the interventions on the outliers (Heechterp &

Schieringen, Bilgaard & Havankpark, Vrijheidswijk). When the LIHK is high for a certain neighborhood, one could for instance explore the origin of the high energy costs. Generally, that could be either due to low energetic quality of the home or consumer behavior of the household. If the high costs *are not* due to the low energetic quality of the house, it might be useful to target consumer behavior of the household. In this case, the indicators LIHK and LILEK (low income, low energetic quality of the home) do not overlap. Accordingly, to come up with an effective intervention, it might be relevant to differentiate between the indicator LIHK (low income and high energy costs) and LILEK (low income and low energetic quality).

### *2.5.2 Dimension two - Energetic quality of the house (LILEK, LILEK-, LILEK+)*

The second dimension is about the energetic quality of the house, which is divided into three perspectives. The first one measures EP in terms of homeowners with low income and living in a home with low energetic quality (LILEK) (Mulder, et al., 2021). The energetic quality of a home determines which energy label class a home falls in. 'Low energetic quality' homes are defined as a home with an energy label D or lower as well as half of the houses with an energy label C (Mulder et al., 2021). However, in the Netherlands, not all houses have these labels, or they are not up-to-date which makes it difficult to measure and monitor this number accurately (Mulder et al., 2021). To deal with this, the energetic quality of a home is therefore also characterized by a combination of housing characteristics and the energy consumption (Mulder et al., 2021). This indicator is important for measuring EP as it is no longer considered to solely be a financial problem, but rather in terms of vulnerability as these households have low income with a low energetic quality home. According to the LILEK indicator, 4,9% of the Dutch population is considered energy poor, which is about 390.000 households (Mulder et al., 2021). Besides LILEK, there are two more perspectives, which are: low income, relatively low energetic quality

and ‘underconsumption’ of energy (LILEK-) (Mulder, et al., 2021). Meaning that, households use insufficient energy for comfort due to financial problems (Mulder, et al., 2021). This is also called: ‘hidden energy poverty’. Based on the indicator LILEK- (hidden energy poverty) it is estimated that 1,8 % of the Dutch population is energy poor, which is about 140,000 households in total. The last perspective includes households with low income, low energetic quality and a high use of energy ‘overconsumption’ (LILEK+) (Mulder, et al., 2021). Based on the LILEK+ indicator, about 250,000 households are considered energy poor, which comes down to 0,8% (Mulder et al., 2021).

#### *2.5.2.1 Energetic quality dimension - Leeuwarden*

By looking at the specific neighborhoods within the Municipality of Leeuwarden, it becomes clear that the neighborhood ‘Vrijheidswijk’ stands out as the percentage of energy poor households in terms of LILEK is 10,55%. This is significantly higher than other neighborhoods, but is followed by Bilgaard & Havankpark with 7,75%. Moreover, the data shows that Dorpen Zuid-West (5,09%), Dorpen Zuid-Oost (5,96%), Dokkumer Ie (5,34%), and Grou (6,62%) also show a slightly higher energy poverty rate in terms of LILEK. Compared to the whole of the Netherlands, it appears that those neighborhoods show a higher percentage of energy poverty than the average percentage of 4,9%. It is interesting to note that regarding the neighborhood Nijlân & De Zwette, only 0,6% of households are considered energy poor using the LILEK indicator. This percentage increases to 4,47% when using the LIHK indicator. A similar situation can be observed when looking at Heechterp & Schieringen where 1,63% are considered energy poor using the LILEK definition, while 9,20% are considered energy poor by using the LIHK indicator. In other words, the LILEK indicator turns out to be lower than the LIHK indicator on a few occasions. This means that there sometimes is no overlap between low income with high

energy prices (LIHK) and low income and low energy quality of their homes (LILEK) in these neighborhoods. Exploring this, can specify whether the intervention should focus on the high energy price (LIHK) or on investing in sustainable measures in a way (LILEK). Using the second perspective LILEK-, it can be observed that the percentage of hidden poverty is considerably lower than the other percentages of EP. However, it can be noticed that Vrijheidswijk (4,33%), and Bilgaard & Havankpark (3,69%) are (again) the two highest percentages, meaning that hidden poverty is the most visible in these neighborhoods. In addition, the neighborhoods: Westeinde, Stiens, Aldlân & De Hemrik, Dorpen Zuid-Oost, and Grou districts are between 2% and 3% based on this indicator. The other districts are below this number. The third perspective is not included in TNO's data for the municipality of Leeuwarden, the reason for this is unclear.

### *2.5.3 Dimension three - Choice for sustainable investments (eLEK & hLEK)*

The third dimension is about (not having the) choice to invest in sustainable measures. This is also called ‘choice poverty’ (Mulder, et al., 2021). It measures EP in terms of households that live in poorly or moderately insulated houses, and are unable to make their homes more sustainable (Mulder, et al., 2021). This dimension recognizes EP not only as a payment problem, but also in terms of having the choice and opportunity to invest in sustainable measures. In practice, this could mean that a household lives in a home with low energetic quality and is able to pay the energy bill, however they are unable to invest in energy-saving measures. This indicator can be divided into two perspectives: tenants which depend on choices of landlords (hLEK); and households with insufficient (financial strength) for (large) investments (eLEK) (Mulder, et al., 2021). Using the indicator choice-poverty, Mulder et al., (2021) showed that 48% of households live in a home with a moderately poor or poor energetic quality without having the

ability to do something about this. For homeowners this comes down to a 21,%3 in the Netherlands. However, the group of tenants who are dependent on their landlords is even bigger, which is 26,7%. The latter comes down to about 2.115.985 households in the Netherlands (Mulder et al., 2021). In comparison to other provinces in the Netherlands, this number is relatively high in the province of Friesland as it covers almost 25% of the households. It is argued that due to the lack of choice and possibilities, they may run behind in the energy transition (Mulder et al., 2021).

#### 2.5.3.1 Choice for sustainable investments dimension - Leeuwarden

By zooming in on the Municipality of Leeuwarden, it can be noted that 11 out of 16 neighborhoods have a higher EP rate than the average in Friesland (25%). The following neighborhoods have percentages higher than 40% on the indicator choice poverty for tenants: Westeinde (40.10%), Cammingaburen (40.10%), Stiens (42.32%), Aldlan & De Hemrik (49.88%), Hempens/Teerns & Zuiderburen (50%), Dorpen Zuid-Oost (44.82%), Dorpen Zuid-West (62.45%), and Grou (44.90%). The two real outliers are Goutum (74.57%) and Dokkumer Ie (72.69%), meaning that a large share of these tenants in these neighborhoods has a home with a low energetic quality and is unable to invest in sustainability measures. Interventions based on this indicator are complex for tenants from a private rental sector, who cannot rely on housing associations. However, municipalities could aim at performance agreements with housing associations as an option to deal with this form of EP. Using the second perspective eLEK (homeowners), it can be observed that again there are three outliers, which are: Westeinde (42,31%), Bilgaard & Havankpark (45,99%), and Vrijheidswijk (40,82%). However, it is interesting to note that Bilgaard & Havankpark has more tenants that are energy poor (45,99%) than homeowners (17,68%). The opposite applies to the neighborhood Nijlân & De Zwette

where it can be seen that 1% of the tenants is considered energy poor using this definition, while 14% homeowners are considered energy poor. When designing an intervention, it seems interesting to analyze whether choice poverty comes is linked to tenants or homeowners. For instance, where tenants would benefit more from proper agreements with the housing association, owners might benefit more from insulation programmes.

**2.6 Combining indicators**

A broader definition of EP can be measured when these indicators are combined. LILEK and LIHK are often combined as they are highly correlated according to Mulder et al., (2021). This 'total' EP indicator (as shown in table 2) shows the percentage of households with low income that have either higher energy costs (LIHK) or relatively low energetic quality (LILEK). High percentages of total EP is located in Vrijheidswijk (15,82%), followed by Bilgaard & Havankpark (14,54%), Heechterp & Schieringen (9,99%), Dorpen Zuid-Oost (8,41%), Grou (8,85%), Aldlân & De Hemrik (7,80%), Dorpen Zuid-West (6,71%), and Dokkumer Ie (6.37%). Besides that, this total indicator can also show the importance of differentiating between the indicators. For instance, when looking at Heechterp & Schieringen the 'total' energy poverty is 9,99%. However, when looking at LILEK, only 1,63% of the households in that neighborhood are energy poor, while the LIHK indicator shows that 9,20% of the households have a low income and high energy costs. Accordingly, interventions that are focused on reducing high energy costs might therefore be more useful than focusing on increasing the energetic quality of the homes in Heechterp & Schieringen. On the other hand, by looking at the neighborhood 'Vrijheidswijk' (which is often highly indicated in terms of different indicators of energy poverty), it could be observed that the total EP is 15,82%. The difference with Heechterp & Schieringen is that there is not a big difference between the indicators LIHK (11,21%) and LILEK (10,55%) in this neighborhood. This means that there are households with high energy

costs and low incomes as well as households with low incomes and low energetic quality of their home. Accordingly, when the municipality would only focus on, for example high energy costs, you 'forget' the other group and vice versa. Again, this stresses the importance of segmenting the energy-poor neighborhoods into the dimensions by TNO as it helps to determine an effective intervention strategy.

### 2.7 Interventions for tackling energy poverty

It is essential to design interventions to combat EP because simply providing financial support does not guarantee that households will save energy or invest in energy efficiency technologies (Middlemiss, et al., 2017) However, more than 40 percent of European Member States utilize financial assistance as the primary means of addressing EP, which is either provided through the social welfare system or through direct payments to cover expenditures (Pye et al, 2016). It is argued that financial interventions may however be needed either for addressing affordability in the short-term, or used to complement long-term measures (Pye et al., 2016). Furthermore, Pye et al., (2016) indicate that 30 percent of European Member States focus on energy efficiency initiatives to address EP, including the Netherlands. It is argued that increasing the energy efficiency of homes often results in the largest energy savings which leads to clear decrease in energy costs (Middlemiss et al., 2017). Moreover, using energy-saving measures such as insulation results in health improvement as it reduces dampness in the home (Middlemiss et al., 2017). Overall, one could say that increasing energy efficiency has benefits for both physical and mental health (Middlemiss et al., 2017).

### 2.7.1 Components of an intervention

In line with the latter, a study has been conducted on interventions against EP and their effectiveness within the Netherlands (Straver et al., 2017). It provides general recommendations to increase the effectiveness of projects within the Netherlands (Straver et al., 2017). This study does not yet reveal a link between EP dimensions and interventions, but rather shows effective interventions to combat EP in general. However, it provides a foundation of effective interventions that can be used to build upon. According to Straver et al. (2017) interventions often consist of a number of components. These components include: (1) energy-savings products; (2) an energy coach; (3) (personal) energy advice; and (4) analysis/advice on housing defects (Straver et al, 2017). To determine the effectiveness of the interventions, Straver et al. (2017) conducted a comparative analysis using five different projects within the Netherlands. The extent to which the following factors are included determines the quality of advice and therefore the effectiveness of the intervention. These factors include: (1) the expertise of the advisor, (2) whether clear calculations were provided, (3) whether one looked for intrinsic motivation of households, (3) whether one provided help by installing energy-saving appliances, (4) whether one provided an overview of possible actions that would result in financial savings, and lastly (5) whether multiple (opposed to just one) home visits were organized (Straver et al., 2017). These home visits provide positive reinforcement which is essential for households that are struggling with (financial) difficulties (Straver et al., 2017). Additionally, visiting several times helps to gain trust and build a relationship (Straver et al., 2017).

# METHODOLOGY

## 3.1 Study design

To build upon the literature review, semi-structured in-depth interviews were held. The aim of these interviews was to (1) explore (effective) interventions for dealing with energy poverty, (2) whether the indicators by TNO could be linked to the interventions (3) whether the TNO indicators could contribute to the current approach by the Municipality of Leeuwarden. These interviews were conducted among seven experts on the field of the energy sectors, specifically energy poverty. Their expertise included: being a researcher, trainer for energy coaches, policy officer, to data analyst at the Municipality. Accordingly, these interviewees theoretical knowledge as well as hands-on experience that was gained over time. Given the scarcity of research and practical experience, it was critical to gather as many viewpoints as possible in order to construct the most complete picture of effective energy poverty intervention strategies. Respondents were chosen from various areas in the Netherlands, sectors, age groups, and male/female ratios in order to provide as many varied viewpoints as possible in the data collection. The overarching goal of the interviews was to bridge the research gap and provide recommendations for the Municipality of Leeuwarden regarding their approach to deal with energy poverty.

During the interviews, an exploratory design was used to gain as much insights as possible. This was done to determine whether the interviewees had prior experience with energy poverty initiatives and their effectiveness. Also, because the respondents were already aware of the TNO indicators, these were discussed in relation to interventions to explore whether there was a link. Again, the emphasis was on acquiring insights from various viewpoints and experiences relevant

to the issue. Because experiences and opinions cannot be quantified objectively, an interpretative method was adopted.

For recruiting the interviewees, network-connections were used as well as a snowball sampling technique. First, professional contacts who could know suitable candidates for this study were contacted. Second, potential candidates were asked if they wanted to be interviewed. Third, interviewees were asked whether they knew additional experts in this subject after the interview. This strategy ensured that seven candidates were conducted for the interviews.

### 3.2 Data collection

For this study's data collection, individual in-depth interviews were conducted with a selection of (1) experts in the field of energy poverty, (2) project leaders in energy poverty projects, (3) an energy coach, and (4) a data analyst of the Municipality of Leeuwarden. In-depth interviews provided detailed information about (1) the perspectives of the experts on the effectiveness of interventions for dealing with energy poverty, and (2) the current state of energy poverty within the Municipality as well as their experiences with interventions and how they can be made more effective.

First, a brief introduction to the research was given. After that, there was enough space for questions to help the interviewees feel at ease. Interviewees were given the option to leave at any time for any reason. Then, the first questions focused on the interviewees' professional backgrounds. Thereafter, the main questions were asked, which can again be divided into two different categories: 1) the current state of energy poverty within the Municipality and their interventions, and 2) the effectiveness of interventions to deal with energy poverty. The latter included questions regarding the link between the indicators by TNO and the interventions that

were mentioned. For example, to ask an expert about the effectiveness of an intervention, the following question was asked: *What is, according to you, an effective intervention when dealing with certain forms of energy poverty?* After the main questions, closing questions were used to ensure that the interviewees had no further questions or uncertainties regarding the study or the interview.

To make the interviewees feel comfortable, all interviews were conducted in their native language, which was Dutch. In general, the interviews took around 40 minutes up to an hour, which enabled the interviewees to provide thorough answers. Depending on the interviewee's preference, the interviews were performed online through Google Meet or on-site. All interviews were taped utilizing a mobile device's recording application. As a result, the recorded sessions were only stored on a private disk, which was deleted once the research was concluded. When the recording began and concluded, the interviewees were alerted.

### 3.3 Data analysis

To arrange and prepare the data for analysis, the interview recordings were first transcribed . To prevent any potential privacy concerns, the data were anonymized and names were exchanged by “[NAME]”. Also, names of companies were replaced with “[COMPANY]”.

A phenomenological technique was utilized to analyze the data. Phenomenology is a type of qualitative inquiry that examines an individual's experiences. This helps to understand the participants' perspectives on the issue. Using this strategy, a range of perspectives were investigated, resulting in the creation of a database based on subjective perceptions. Following that, the database was reviewed for commonalities and reoccurring viewpoints. Following that,

the findings were condensed to key statements from the participants' points of view. Finally, these data were combined and compared to those acquired in the section on literature review.

### 3.4 Ethical approval

Certain measures were taken to prevent unethical issues. First, interviewees were allowed to ask questions at any point in time and they were not forced to answer any question. Also, the interviewees were allowed to leave at any given moment. During the interviews, it was ensured that the interviewees were aware of the purpose of the interview and how long the interview would take. Also, the interviewees were notified when the recording started and ended. These precautions were made to ensure that respondents felt respected and at ease while participating in the interviews.

## RESULTS

The following section presents the outcomes of the in-depth interview with experts in the field of energy poverty. Accordingly, it aims to contribute to answering the following question: “How could the TNO indicators be linked to interventions against energy poverty in order to develop a more effective strategy in the Municipality of Leeuwarden?”. To answer this, the current situation regarding energy poverty and its (effective) interventions within the Netherlands will be described by the interviewees. It will then present the approach taken by the Municipality of Leeuwarden to combat energy poverty. Also, it will show what the new indicators by TNO can contribute to an intervention strategy and how municipalities can benefit from this (Mulder et al., 2021). Finally, the possible link between the TNO indicators and the interventions will be discussed. It should be noted that, the interviewees responded based on their own experiences or based on their own research on the topic. Moreover, the link between the indicators LILEK+

(overconsumption) and HEQ (energy costs as % of income) and the interventions were covered during the interviews.

### 4.1 Approach and interventions - Netherlands

The first question was asked regarding the situation of energy poverty in the Netherlands and its current interventions. In line with Mulder et al., (2021), respondent 1 argues that households that live in energy poverty often have high energy bills, a poorly insulated house and a low income. “Especially, these households would benefit from energy-efficient measures”(1). However, “people who live in energy poverty are often not concerned with sustainable investments”(1). “They are concerned about making ends meet at the end of the day.”(1). Therefore, the first and most important intervention would be to lighten the financial burden (1)(3)(5). “This creates more space in people’s minds”(1) “this is necessary to be able to consider additional actions”(1). Also, serious health concerns that are related to energy poverty could be alleviated by this as “unburdening can help to ease stress”(1) (Middlemiss et al., 2019). In addition to financial incentives, the usage of energy coaches was suggested as one of the primary interventions. “These energy coaches should make personal visits to the energy-poor households”(1)(2)(4). “The energy coach engages with the energy-poor household to identify what may be changed in their home”(4), but also “they can also discuss people's conduct”(2)(4). The following tasks for energy coaches were mentioned: “discovering where the energy leaks are”, ”informing about good ventilation”, “observing whether hydronic balancing of the radiators is possible”, and “if radiator foil and weather strips can be used”(1)(2)(3)(4). Besides that, energy coaches can also help to “install small energy energy-saving measures”(1). However, energy coaches are not allowed to make adaptations to the central heating boilers”(4). In line with that, respondent 3 argues that “after the energy coaches have done their work, concrete follow-up steps are

needed”(3). This could for instance be an “installer who is licensed to hydronically balance the radiators” (4). Without these follow-up steps, “energy coaches are not effective” according to respondent 3. Respondent 6 also contends that "merely donating money does not help" (6). In line with Middlemiss et al. (2021), respondent 6 notes that "it is often not spent on what it is intended for," namely "sustainable measures" (6). Most respondents mentioned that the main task of an energy coach is to “gain trust and build a relationship with the people”(1)(2)(4)(5)(6). This is in line with the research by Mulder et al. (2021) which identified that gaining trust is important for the effectiveness of the interventions against energy poverty. According to that, “it should be kept in mind that inviting an energy coach might already be a big step for people”(4). Energy coaches should therefore be “properly trained to deal with all the different situations which they may encounter”(1).

### 4.2 Barrier to dealing with energy poverty

The main barrier to effectively dealing with energy poverty in the Netherlands is the current General Data Protection Regulation (AVG) (1)(2)(3)(4)(5)(6). Meaning that, although all data regarding the TNO indicators for energy poverty are known at individual/house-level, this may not be shared due to privacy regulations. “This makes tailoring interventions more complex”(6), because “we do not know exactly where the energy-poor households are located, what kind of energy poverty they have and how bad it is”. Regardless of this, municipalities have been given the difficult task of distributing the funds to energy-poor households “preferably in an equal manner”(2). In practice, respondents mention that “it is just frustrating, because we actually know a lot, but we are not allowed to use it”(1)(6)

### 4.3 Approach and interventions - Municipality of Leeuwarden

The Municipality of Leeuwarden's approach to dealing with energy poverty emphasizes the importance of their "sustainability department" (4) with energy coaches which provide "tailor-made advice and solutions, which is essential for dealing with energy poverty"(1)(2)(4)(5)(6). In the Municipality of Leeuwarden, energy coaches "first take ten (half-day) courses, then a number of viewing moments in practice, and a brush up course 4 times a year"(2)(4). So, the education of the energy coaches can be considered "an ongoing process"(4). Furthermore, the literature review showed that multiple home visits can increase the effectiveness of the interventions (Straver et al., 2017). This is in line with the approach by the Municipality of Leeuwarden which is to "visit energy poor households three times in the first year"(4). This also has to do with "building trust and a relationship"(4) as mentioned before. These energy coaches can be either paid or unpaid (voluntary) functions. Most respondents argued that voluntary energy coaches are not desirable in an ideal world (1)(3)(4)(5)(6). That is, because volunteers can "negatively affect the continuity"(5)(6). Other respondents agreed that "if you really want to achieve something, municipalities will have to hire people" (3)(4)(6). By doing so, a win-win situation could be created as "municipalities can deploy people that are currently on welfare"(4)(6), "which are often people who can relate to the target group"(2)(4)(6). This is currently happening in the Municipality of Leeuwarden. They have a sustainability department with seven energy coaches (2)(4). The majority of this group has previously received assistance from the municipality (2)(4). That is, because "they, like no other, know what it is like to live in poverty". They want to give energy-poor households the feeling of "if you can do it, so can I" (1)(4).

Also the Municipality of Leeuwarden is drawn back due to the AVG barrier that prevents interventions from being implemented at the individual/household-level. This degree of detail is required since “not every energy-poor person discloses their situation to the municipality”(2). That is, for example, due to "a sense of embarrassment"(2)(6) or "being too busy making ends meet(2)". To obtain more spatial data on the energy-poor households, municipalities can “connect their internal departments, such as the social domain, the spatial domain, the sustainability department”(2)(4)(5)(6) and the “legal department”(4). “Where other municipalities are only now starting to work with data, the Municipality of Leeuwarden has been doing so for years”(4). This started by “approaching households that are currently on welfare”(7). At first, they only supported owner-occupied homes by using the ‘Regulation for Reduction of Energy Use’ (RRE), which is a one-off benefit that municipalities can apply to. Later this also included households that reside in rental units (RREW). At this moment, the Municipality of Leeuwarden utilizes their internal data that includes the “WOZ-value and the energy label of the homes”(4)(7). According to respondent 7, this “is the only data that can presently be utilized that actually contributes to finding the energy-poor households”. As the data that they use is considered sensitive under the law, the Municipality mentions that they are “on the edge”(4)(7) with this approach. Meaning that, there is a fine line between what *is* allowed and what *is not* allowed in terms of privacy. “There are not many municipalities that go that far yet”(4). Respondent 4 adds that “this does not always go well” (4) and “sometimes we are rebuked by the legal department”(4). However, this approach ensures that the Municipality of Leeuwarden can “help as many energy poor households as possible”(4).

### 4.4 Matching TNO indicators to energy poverty interventions

As presented in the literature, it is possible to segment the different forms of energy based on the TNO indicators. Accordingly, the question remains whether and how these indicators can be linked to the interventions against energy poverty in practice. In general, respondent 6 acknowledges that linking interventions to the TNO indicators “only works at neighborhood or municipality level”(6) due to the “General Data Protection Regulation”(6). However, also “on neighborhood-level it can still contribute to a more targeted intervention”(6). For example, if the municipality decides to address energy poverty “neighborhood-by-neighborhood"(6). The drawback of that approach is that “you are also supporting individuals who do not truly need it"(6). Moreover, respondent 2 mentions that “energy poverty is about people and not numbers”. Additionally, the TNO indicators might create an “overarching view while every situation is different”(3). However, next to the individual approach by using internal data of the Municipality, “this might be the best way to deal with energy poverty on a larger scale”(6). Accordingly, respondents were asked to identify interventions that were effective for dealing with energy poverty while being aware of the TNO indicators.

The first dimension of energy poverty is ‘affordability’. The indicator LIHK represents the households that suffer from low income and high energy costs. Interviewees argued that, “in that case an energy coach could focus on behavior”(3)(4). Respondent 3 adds that it is for instance “about informing households about their energy use and the optimization of devices". However, specific interventions on the LIHK indicator are complex, because “habitual behavior is difficult to change”(6). Moreover, the cause of the high energy bills is not necessarily the same for households. For instance, “some people might have high energy costs due to medical reasons”(6) or “elderly couples who would like to keep their home a little warmer”(6). Those households

“need support in a different way"(6). Again, this shows that customization for interventions remains essential.

The second dimension is the ‘energetic quality of the house’. This includes the indicator LILEK, which covers low income households with low energetic quality of their homes. Interviewees responded that “this often concerns technical interventions”. However, “there is often an overlap between LIHK and LILEK(6). Meaning that, energy poor households have low income, high energy costs and poor energy quality. In that case too, it could be effective “to look at technical adaptations, but also at behavioral interventions”(4)(6). Furthermore, respondent 6 emphasizes the importance of the LILEK- indicator as it also includes low income households “wearing three sweaters, but having their central heating system at 16 degrees”. Because of this, “energy poverty is frequently disregarded”. This makes it more difficult “to establish effective interventions for LILEK-”(6). Respondent 4 mentions that the Municipality of Leeuwarden aims to pinpoint the “LILEK- households by using WOZ-value, energy labels and the people who are on social assistance”(4). Accordingly, they focus on housing quality by using “offering insulation or subsidies for insulation". In addition, “support is provided on the proper use of the technical adjustments”(4). Multiple interviewees also responded that “behavioral interventions to lower their energy use are typically inappropriate since these households often do everything in their energy costs already”(2)(4)(6).

The third dimension is about having the choice and opportunity to invest in sustainable measures. This includes the indicators eLEK (owners) and hLEK (tenants) with low income and low energetic quality and being unable to invest. The interventions of these perspectives “are really complex, especially for tenants”(3). Respondent 3 emphasizes that “Municipalities have to

cooperate with housing associations” to support this group. Accordingly, it must be made clear that "it is about people, not about stones”(3). Meaning that, the municipality “must make it clear to housing associations that it is not necessarily about which building is the worst in terms of house quality, but also about which residents need it the most”(3). Respondent 3 mentioned that "Municipalities could conduct research into the households who need it most and that housing associations would then pay for the adjustments". However, this is a challenging task because “they usually have other interests”(3). “We must aim to generate win-win scenarios”(3). Furthermore, interventions for the homeowner perspective could be focused on providing “social credit” (4). This concerns both 'lightening the financial burden'(1)(4) as well as supporting or facilitating sustainability measures for increasing the quality of their homes.

## DISCUSSION

Currently, Municipalities are given the freedom to develop their energy poverty intervention strategy, since it allows for a more targeted approach. However, this may also lead to inconsistencies among municipalities which can reinforce inequalities. In line with that, it can also be argued that without a national policy there is neither a clear goal nor a strategy to tackle energy poverty in the most effective way. In this regard, the funds by the Government may be considered as ad hoc, whereas the objective should be to consistently measure and monitor energy poverty in the Netherlands. This is also critical for determining the effectiveness of policies and interventions. Regardless of that, Municipalities are tasked with distributing the funds to support energy-poor households. The first impediment is the General Data Protection Regulation (AVG) which restricts the use of individual/household-level data in the development of this plan. This is a concern since, according to the interviews, (multiple) personal visits by energy coaches are the interventions for addressing energy poverty. Only in this way, tailor-made

solutions can be designed to support energy-poor households. Furthermore, trust and relationship building have been highlighted as a key part of an effective intervention which is only possible at the individual/household-level. Added to that, Straver et al. (2017) mentions that intervention should also include (1) energy-savings products; (2) (personal) energy advice; and (4) analysis/advice on housing defects (Straver et al., 2017). To maintain continuity, respondents argued that the energy coaches should preferably be paid employees instead of volunteers, which ideally come from the target group itself, like the Municipality of Leeuwarden does in their approach. The second impediment for individual and tailor-made interventions, is that, even though households have the option of reporting energy poverty to municipalities, many people do not. According to the interviews, that is because energy-poor households are more concerned with making ends meet, than with sustainable measures and getting in contact with the municipality. In addition, energy poverty is related to a variety of (health) concerns, including higher mortality and morbidity, increased feelings of fear, anxiety, and discomfort. Moreover, it can have a detrimental impact on recreational and educational opportunities, as well as the formation of relationships. This should underline the gravity of the situation and the implications that it entails. As a result, it is critical for these households to get assistance as soon as possible and in an effective manner.

So, how should the Municipality map the energy poor households when AVG limits this and not everyone self-reports? The Municipality of Leeuwarden does so by setting up collaborations between its internal departments. By integrating the WOZ-value, the energy labels as well as the households that are on social assistance, the Municipality can approach the households that likely suffer from energy poverty. According to the interviews, this is the only data that can presently be utilized and really contributes to finding the energy-poor households.

Furthermore, this study shows that it seems possible to segment the TNO indicators in context of the Municipality of Leeuwarden and to match them to interventions to address energy poverty. The literature review on the TNO indicators has for instance shown that for the neighborhood Heechterp & Schieringen the indicator LIHK (low income, high energy costs) shows that 9,20% of the households in energy poor, while 'only' 1,63% of the households is energy poor according to the indicator LILEK (low income, low energetic quality of home). In that case, respondents mentioned during the interview that interventions could be focused on (consumer) behavior. On the contrary, the indication LILEK is rarely higher than the indicator LIHK, let alone by a substantial margin. This may indicate that high energy costs (LIHK) are not always due to the poor energetic quality of a home, while a low energetic quality home (LILEK) is often accompanied by high energy costs in the Municipality of Leeuwarden. This is confirmed by the respondents, who argued that indicators often overlap. This could mean that segmentation is not always possible and that interventions may also have to focus on both behavior (LIHK) as well as LILEK (technical adaptations). While the differences are not always significant, practice will have to prove whether it is helpful to use the percentages of the indicators to define the form of energy poverty in the neighborhoods.

However, when it is proven to be useful, this study could contribute to informing about the possibility to match interventions to the indicators for a more effective interventions strategy. Hence, the interviews have shown that interventions can generally be divided into three main specializations: (1) *consumer behavior,* (2) *technical solutions;* (3) *financial and legal support*. To begin with the first dimension, which is 'affordability' in which it is shown that a household can have high energy costs without having a poorly insulated home. In that case, the

specialization of the energy coach could be on *consumer behavior.* According to the interviews, this could include informing households about their energy use and the optimization of devices. Further interventions regarding energy consumer behavior could be explored in further research. The second dimension is 'energetic quality of the house' which contains households with poorly-insulated homes. Households that suffer from this type of energy poverty, have benefits by technical adaptations. Therefore, an energy coach could also be specialized in *technical solutions.* As a consequence, technical solutions focus also on optimizing device use, but not at altering behavior. This is especially true for underconsumption (LILEK-). The third dimension is 'having the choice for sustainable investments'. This indicator is more difficult in terms of interventions as it differentiates between tenants and owners. However, the overlap between the two is that there is a lack of abilities. This could be due to a financial situation, because the household is dependent on a housing association. Accordingly, the specialization based on this dimension could be *financial and legal support.* Meaning that, the energy coach should have knowledge on the opportunities for subsidies and know ways to contact housing associations. However, with regard to this indicator there is also a major task for the municipality itself.

It should however be noted that, despite segmenting the specializations, the goal should remain to provide tailored advice as was indicated by the respondents. As mentioned before, the current strategy by the Municipality of Leeuwarden (and many other municipalities) is to use energy coaches to support energy-poor households. These energy coaches are expected to be knowledgeable about technical adaptations, consumer behavior, financial support as well as psychological aspects to deal with all circumstances. This does not imply that energy coaches must install technical adaptations or request for instance subsidies themselves, but they do have to be knowledgeable about the options that are available. Approaching interventions in terms of

specializations, might create an overview of the different roles that energy coaches could have and it might also ensure that individuals will be deployed for purposes that they are interested in.

### 5.1 Limitations

This study is based on the analysis of the newly developed TNO indicators by Mulder et al. (2021). Readers should bear in mind that these indicators are not yet reflected in current policy documents which makes comparing approaches and measuring the effectiveness of the interventions not possible. As a result, the goal of this research is not to offer concrete recommendations to the Municipality, but rather to contribute to the thinking process of the next step in dealing with energy poverty. The effectiveness of segmenting the specializations of energy coaches and matching interventions to the TNO indicators should be tested in practice. Moreover, it should be mentioned that the literature as well as the measurements and monitoring of energy poverty are at an early stage. More research on this topic would increase the understanding of the problem which in turn could lead to more effective interventions.

## CONCLUSION

The Government provides funds to municipalities in the Netherlands to support energy-poor households. According to the interviews and Mulder et al. (2021) the AVG regulation makes it impossible to locate energy-poor households at individual/household-level. This is a concern as personalized visits by energy coaches are considered to be critical in combating energy poverty. By layering internal data, the Municipality of Leeuwarden is taking critical steps in the right direction. Once these phases have been completed, the Municipality will have to upscale their approach as there are currently no more options on an individual level. The TNO indicators can help in this regard, as they indicate at neighborhood-level which type of energy poverty is present and to what extent. Since this is the main focus of the current approach by the

Municipality of Leeuwarden, it seems logical to continue with this. However, scaling up the approach also requires more energy coaches. To do so, the Municipality of Leeuwarden could choose to train energy coaches based on the specializations: (1) *consumer behavior,* (2) *technical solutions;* (3) *financial and legal support*. In this way, people are deployed for what they are interested in and they do not need to be knowledgeable on all aspects of an energy coach, as currently is the case. Consequently, this approach may allow for more effective larger-scale interventions based on specific types of energy poverty. However, practice will have to show whether this is actually a more effective way for dealing with energy poverty. In that sense, this study contributed to the thinking process for effective intervention strategies against energy poverty in the Municipality of Leeuwarden.

## REFERENCES

Ballesteros-Arjona, V., Oliveras, L., Bolívar Muñoz, J., Olry de Labry Lima, A., Carrere, J., Martín Ruiz, E., Peralta, A., Cabrera León, A., Mateo Rodríguez, I., Daponte-Codina, A., & Marí-Dell'Olmo, M. (2022). What are the effects of energy poverty and interventions to ameliorate it on people's health and well-being?: A scoping review with an equity lens. *Energy Research & Social Science*, *87*, 102456. https://doi.org/10.1016/j.erss.2021.102456

Boardman, B. (1991). Fuel poverty: from cold homes to affordable warmth. Belhaven Press. London.

Bouzarovski, S., & Tirado Herrero, S. (2016). Geographies of injustice: The socio-spatial determinants of energy poverty in Poland, the Czech Republic and Hungary. *Post-Communist Economies*, *29*(1), 27–50. https://doi.org/10.1080/14631377.2016.1242257

Bouzarovski, S., Robinson, C. & Lindley, S. (2018). Getting the measure of fuel poverty: The geography of fuel poverty indicators in England. Energy Research & Social Science 36, 79–93.

Carley, S., & Konisky, D.M. (2020). The justice and equity implications of the clean energy transition. Nat Energy 5, 569–577.

Dalla Longa, F., Sweerts, B., & van der Zwaan, B. (2021). Exploring the complex origins of energy poverty in the Netherlands with machine learning. *Energy Policy*, *156*, 112373. https://doi.org/10.1016/j.enpol.2021.112373

Day, R., Walker, G., & Simcock, N. (2016). Conceptualising energy use and energy poverty using a capabilities framework. Energy Policy, 93, 255-264.

Dear, K. B., & McMichael, A. J. (2011). The health impacts of cold homes and fuel poverty. *BMJ*, *342*(may11 2), d2807–d2807. https://doi.org/10.1136/bmj.d2807

Grevisse, F. & Brynart, M. (2011). Energy Poverty in Europe: Towards a more global understanding. ECEEE 2011 Summer Study. Energy Efficiency First: The Foundation of a Low-carbon Society

Guevara, Z., Espinosa, M., & López-Corona, O. (2022). The Evolution of Energy Poverty Theory: A scientometrics approach. https://doi.org/10.31235/osf.io/xqkup

Kyprianou, I., Serghides, D. K., Varo, A., Gouveia, J. P., Kopeva, D., & Murauskaite, L. (2019). Energy poverty policies and measures in 5 EU countries: A comparative study. Energy and Buildings, 196, 46–60. https://doi.org/10.1016/j.enbuild.2019.05.003

Mendoza, C. B., Cayonte, D. D., Leabres, M. S., & Manaligod, L. R. (2019). Understanding multidimensional energy poverty in the Philippines. *Energy Policy*, *133*, 110886. https://doi.org/10.1016/j.enpol.2019.110886

Mulder, P., Dalla Longa, F., & Straver, K. (2021). De feiten over energiearmoede in Nederland inzicht op nationaal en lokaal niveau. *TNO-rapport*. Amsterdam 060.47628. P11678

Middelkoop, M., Van Polen, S., Holtkamp, R., & Bonnerman, F. (2018). Meten Met Twee Maten. Een studie naar de betaalbaarheid van de energierekening van huishoudens. Planbureau voor de Leefomgeving (PBL). 3124

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties (2020). Kamerbrief over de stand van zakan Klimaatakkoord Gebouwde Omgeving https://www.rijksoverheid.nl/documenten/kamerstukken/2020/09/28/kamerbrief-over-stand-van-zaken-klimaatakkoord-gebouwde-omgeving

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties (2022) Leeuwarden pakt energiearmoede ‘gewoon’ aan. https://www.volkshuisvestingnederland.nl/documenten/praktijkverhalen/2022/03/16/leeuwarden-pakt-energiearmoede-gewoon-aan

Ministerie van Binnenlandse Zaken en Koninkrijksrelaties (2021). Middelen aanpak energiearmoede. https://www.rijksoverheid.nl/documenten/brieven/2021/12/14/gemeentebrief-middelen-aanpak-energiearmoede

Middlemiss, L., Gillard, R., Pellicer, V., & Straver, K. (2018). Plugging the gap between energy policy and the lived experience of Energy Poverty: Five principles for a multidisciplinary approach. Advancing Energy Policy, 15–29. https://doi.org/10.1007/978-3-319-99097-2_2

Middlemiss, L., Mulder, P., Hesselman, M., Feenstra, M., Tirado Herrero, S. & Straver, K. (2021) Energy Poverty and the Energy Transition. Towards improved energy poverty monitoring, measuring and policy action. *Frontiers in Sustainable Cities*. https://doi.org/10.3389/frsc.2021.645624

Middlemiss, L., Ambrosio-Albalá, P., Emmel, N., Gillard, R., Gilbertson, J., Hargreaves, T., Mullen, C., Ryan, T., Snell, C., & Tod, A. (2019). Energy poverty and social relations: A capabilities approach. *Energy Research & Social Science*, *55*, 227–235. https://doi.org/10.1016/j.erss.2019.05.002

Moore, R. (2012). Definitions of fuel poverty: Implications for policy. *Energy Policy*, *49*, 19–26. https://doi.org/10.1016/j.enpol.2012.01.057

Pellicer-Sifres, V., Simcock, N., & Boni, A. (2021). Understanding the multiple harms of energy poverty through nussbaum's theory of central capabilities. *Local Environment*, *26*(8), 1026–1042.

Preston, I., White, V., Blacklaws, K. & Hirsch, D. (2014). *Fuel and Poverty: A Rapid Evidence Assessment for the Joseph Rowntree Foundation*. Bristol: Centre for Sustainable Energy.

Pye, S., Dobbins, A., Baffert, C., Brajković, J., Deane, P., & De Miglio, R. (2016). Addressing energy poverty and vulnerable consumers in the energy sector across the EU. *L'Europe En Formation*, *n° 378*(4), 64–89. https://doi.org/10.3917/eufor.378.0064

Rekenkamer Leeuwarden (2018) Voortgang Energietransitie Leeuwarden. Eindrapportage. Retrieved from: https://www.gemeenteraadleeuwarden.nl/nl/file/35022/download

Straver, K., & Mulder, P., (2020). Energie Armoede en de energietransitie. Energie Armoede beter meten, monitoren en bestrijden.

Straver, K., A. Siebinga, J. Mastop, M. de Lidth, P. Vethman & M. Uyterlinde (2017) *Rapportage Energiearmoede. Effectieve interventies om energie efficiëntie te vergroten en energiearmoede te verlagen.* Amsterdam: ECN.

Thomson, H., Snell, C., & Liddell, C. (2016). Fuel poverty in the European Union: A concept in need of definition? *People Place and Policy Online*, *10*(1), 5–24. https://doi.org/10.3351/ppp.0010.0001.0002

Villavicencio Calzadilla, P. & Mauger R. (2017), The UN's new sustainable development agenda and renewable energy: the challenge to reach sdg7 while achieving energy justice, *Journal of Energy & Natural Resources Law* - 1–22. doi:https://doi.org/10.1080/02646811.2017. 1377951.