EnergyMeasures

Tailored measures supporting energy vulnerable households

D4.1

Initial report on energy consumption of participating households

http://www.energymeasures.eu

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June 2022

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 894759

Document Information

Document ID	D4.1		
Document Title	Initial report on energy consumption of participating households		
Lead beneficiary	Kamp C		
Contributing beneficiaries	UCC, EA, DUNE, PON, SO, PNEC, HABI, ECOE, TIG, OKP, GAB, BUR, ENE		
Due date Annex I	2022.05.31		
Issue date	2022.06.30		
Modification date	2022.09.30		
Dissemination level	Public		
Author(s)	Maro Saridaki, Paola Velasco-Herrejón, Lauren Quinlivan		
Document checked & revised	Niall Dunphy	Date:	2022.09.30

The EnergyMeasures Project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 894759. For more information on the project, its partners, and contributors please see http://www.energymeasures.eu.

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About EnergyMeasures

EnergyMeasures is working to address energy poverty in seven European countries, namely: Belgium, Bulgaria, Ireland, Netherlands, North Macedonia, Poland, and the United Kingdom. The project comprises two complementary and synergistic strands of work.

The first strand involves working with energy poor households to improve their energy efficiency through a combination of low-cost measures, and changes in energy-related behaviours and practices. Recruited householders will be provided with low-cost energy measures and empowered to change their energy-related behaviours and practices through an approach that takes account of existing housing conditions and is reflective of their lived experience.

The second strand comprises working with municipalities, energy authorities, housing associations and other relevant actors to assess how current multi-level institutional contexts affect efforts to alleviate energy vulnerability in the participating countries. This knowledge will be used to develop and support the implementation of policy and practice measures which will address structural issues that combine to trap households in energy poverty.

Through this work the project contributes to reducing participants' vulnerability to energy poverty, while at the same time cutting household energy consumption and associated GHG emissions.

For more information see **http://www.energymeasures.eu**

Description of the deliverable and its purpose

This document describes the baseline against which so-called 'energy savings'; changes in electrical energy demand, thermal energy demand and reductions of people living in energy poverty will be measured throughout the project. The deliverable comprises a brief overview for each country of the most important energy sources and energy-related challenges, the number of households recruited, characteristics of dwellings, and information about energy use, household composition, and plans to gather future energy data for the remaining time of the project. The task has progressed well in its baseline related activities. However, at this time, the document does not provide calculations for energy savings achieved due to Covid-19 pandemic related delays with household recruitment and engagement. The deliverable outlines the measures taken to remedy the impacts of the pandemic and the plans for ensuring the effective collection of data and the evaluation of the project's impact.

Glossary

BCR	Brussels capital region
DoA	Description of Action
DSO	Distribution System Operator
EPC	Energy Performance Certificate
EPS	Expanded Polystyrene
ESRI	Economic and Social Research Institute
FEBEG	Federatie van de Belgische Elektriciteits- en Gasbedrijven
LPG	Liquid Petroleum Gas
MoU	Memorandum of Understanding
NGO	Non-Governmental Organisation
PM10	Particulates of a size less than 10 µm
POPD	Protection of personal data
RES	Renewable Energy Sources
SEAI	Sustainable Energy Authority of Ireland
WHO	World Health Organisation
WP	Work Package

1 Introduction

The EnergyMeasures project is working to implement coordinated household energy engagement programmes and address structural issues surrounding energy poverty in seven European countries. For this purpose, the project is working with energy poor households to improve their energy efficiency through a combination of low-cost measures, and changes in their energy-related practices. During Task 2.2 key indicators that characterise those most at-risk of energy poverty were mapped out, and energy poor and at-risk households were recruited. Then, for Task 2.3 householders were provided with low-cost energy measures and facilitated to change their energy-related behaviours and practices through an approach that both took account of the nature of the housing units and is reflective of the lived experience of the household members.

This document commences the package of work in charge of monitoring and quantifying the impact of Task 2.2 and Task 2.3 activities related to energy consumption. Given the multifaceted nature of the project, there are several different impacts to be measured such as the reduction in energy consumption in participating households, reductions in energy consumption triggered by the project over its duration, trends in consumption of electrical energy and thermal energy, and the reduction in people living in energy poverty. This report comprises the description of the baseline against which so-called 'energy savings'; changes in electrical energy demand, thermal energy demand and reductions of people living in energy poverty will be measured throughout the project.

The impact of the Covid-19 pandemic had a serious impact on gaining access to households, causing delays in household recruitment and engagement. The household recruitment originally scheduled to commence in March 2021, only really started in January 2022. The information presented in this report represents recruitment and data collection at time of writing data (*i.e.,* up to Apr 2022). The pandemic related delays resulted in engagements and data collections proceeding at different schedules reflecting local specificities. Accordingly, the reports from the different countries will contain different levels of information. The engagement was therefore rescheduled to fit in with the planned 'reopening' of society as the vaccination programme progressed and the pandemic threat lessened. As a result, the household

This report consists of ten sections. This introductory section provides context and background and gives an overview of the document. The second short section presents an overview of the methodology used in data collection, describing the rationale for the approach taken, while noting and explaining any differences arising from each country's context. Sections 3 to 9 present the initial energy approaches to consumption data collection during the reporting period for the engagement in each of the seven participating countries. As part of this baseline, the section includes a brief overview of the major energy sources and energy-related challenges within each country. Then it focuses on the individual strategies for data collection followed, as well as generalised data, such as energy sources and heating systems used in each country, characteristics of the households visited, main challenges and opportunities and initial analysis of lessons learned for iteration purposes. Lastly, Section 10 offers some initial conclusions based on the results presented.

2 Note on methodology

Task 4.1 requires the calculation of key metrics relating to energy in participating households over the duration of the household energy engagement programmes, namely: so-called “energy savings”; changes in electrical energy demand and thermal energy demand; reductions of people in energy poverty. To achieve this goal, the task involves the definition of a baseline figure against which energy savings can be measured, where possible for each participating household, otherwise in the form of the average consumption for a typical household in each local action. The average consumption of energy is aimed to be based on a combination of utility bills and remote measurement (where applicable) for each household at the outset of the project, and periodically rechecked over the course of the task. Where this is not possible a representative sample of households is envisioned to be used in each locale.

A standard approach to, and criteria for, measurement has been devised to be used by all partners. However, the participating countries in EnergyMeasures are very diverse. Equally diverse are the weather patterns, the energy landscape, the energy sources available, the building stock, and the household compositions. Cultural and social differences not only play an important role in the experience and use of energy, but also in the willingness to share data. Bureaucracy and processes play a part too. Access to current and historic data can be reached in some cases only through personal approval, while in others information can be accessed collectively or through smart devices. Contracts, energy bills and the information available on them also vary widely. These differences became more and more outspoken during the partnership meetings, especially since January 2022, when most counties moved from soft launch to an accelerated pace of engagement. In this deliverable, it was therefore deemed important to provide differentiated strategies and approaches, to ensure that the outputs of the EnergyMeasures project are meaningful and provide guidelines for replication within its own boundaries, as well as maximising the potential of trans-regional inspiration.

Project partners will measure the energy savings achieved over the duration of EnergyMeasures using, where available, historic data from participating households, and other available anonymised consumption data, and assess what proportion of these are being used to increase comfort and minimise rebound effects. Data on energy consumption (energy bills, fuel receipts, *etc*.) will be collected from participating householders over the project’s life. While analysis will be carried out on a continuing monthly basis, results will also be considered in terms of the cooling and heating seasons.

This document represents the first report on data collection for these metrics. As such, it presents the baseline data for all the households recruited. Given the short duration of recruitment thus far, and the ongoing sourcing and collection of data for these households, data in some countries is still quite limited. Results and analysis of household energy consumption over the remaining duration of the project will be presented in D4.2 ‘Report on energy consumption in participating energy poor households, updated’ due in February 2024.The data was collected at a household level in keeping with the objectives of the project. However, to provide for the protection of personal data (POPD) only pseudonymised and aggregated data was used for reporting purposes.

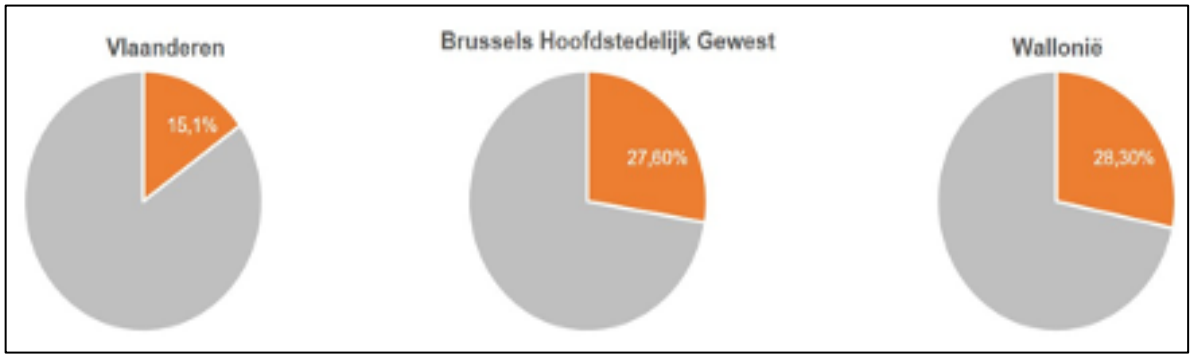
3 Belgium

3.1 Country profile and the lived experience

3.1.1 Figures on Energy Poverty in Belgium

In Belgium, more than one household in five is affected by energy poverty (20.7% of Belgian households in 2019). This value has not varied significantly since 2009. However, as shown in Figure 1 there are strong differences between the regions: 15.1% of households are affected in Flanders, 27.6% in Brussels and 28.3% in Wallonia (Meyer & Coene 2021). In Flanders, this equates to 431,860 households or 993,278 people affected by energy poverty.

Figure 1: Percentage of the population living in energy poverty, Belgium by region (Meyer & Coene 2021)



According to Coene *et al.* (2021) The vast majority (*c*. 70%) of energy-poor households are single people or single-parent families. Single elderly women (+65) and single parent families headed by a woman are particularly vulnerable. There are also twice as many renters as owners who are affected by energy poverty. Although households with no income from employment are more at risk of energy poverty (36% of such households are energy poor), almost 15% of households with one income from employment also experience energy poverty. One-third of people in energy poverty also live in poor housing conditions: they live in non-insulated houses, suffer from mould and damp or have inadequate sanitary facilities.

The main causes of energy poverty are insufficient income, poor housing quality, and rising energy prices. Additional reinforcing factors are a low level of education, a small social network, low technical skills and a lack of access to the necessary information and services. Energy poverty has many consequences, which make the situation even more complex. Households in energy poverty have more health problems, more frequent housing costs, difficulties in school or work, debt and suffer from social isolation. In recent years, we have seen an increase in electricity prices, as well as in the number of payment instalment plans with energy suppliers. Moreover, more and more instalment plans are not followed (Koning Boudewijnstichting 2020).

There are several social housing companies active in Belgium, but the share of social housing is still far too small to cope with the social housing shortage. The waiting time for a social house is 4 years on average and is still rising. As a result, a large proportion of families with the lowest incomes are forced

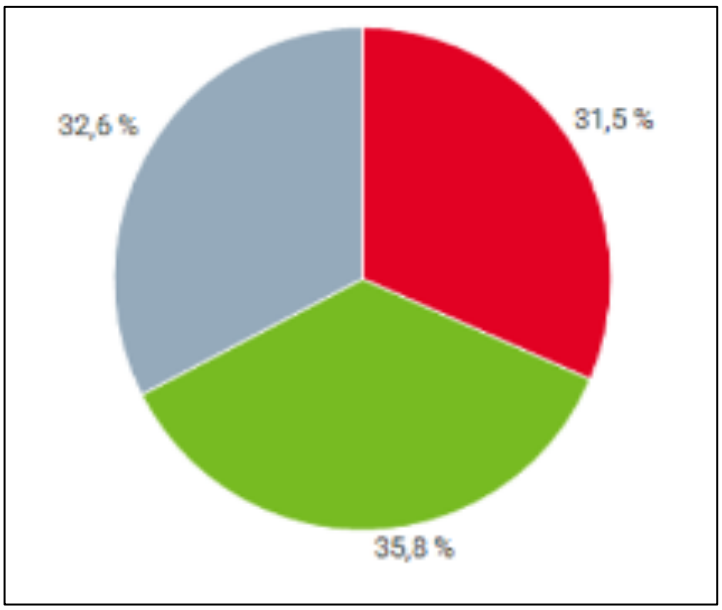
to rent on the private rental market. Here demand far exceeds supply, forcing many poorer tenants to live in substandard housing. The quality of the homes in which the lowest income households live is below average in several respects: less or no insulation, more frequent moisture problems, less space, less comfort, and hardly any renewable energy sources (Heylen & Vanderstraeten 2019).

The government offers various forms of support to energy-poor households. For instance, there is a social tariff for gas and electricity (and water), but the conditions for eligibility are quite strict, and its target group does not cover the entire segment of poor households (FOD Economie, 2021). In addition, there is an annual heating allowance for poor households that heat with fuel oil or petroleum. There is also an energy fund, from which households experiencing difficulties in paying their energy bills can receive an additional allowance, but this is a favour and not a right, and its allocation is rather exceptional. Both the government and the network manager of gas and electricity also offer various premiums for owners who renovate their house or make it more energy efficient (Wonen-Vlaanderen, 2021). However, these premiums do not apply to landlords in the private rental market. Also, for poor owners these premiums are not sufficient to cover the costs of a renovation.

3.1.2 Energy sources in Belgium

As shown in Figure 2, Belgium is still heavily dependent on nuclear energy (grey), imported mostly from France, and fossil fuels (red), evident in the dashboard below. Renewable energy (green) has still a lot of potential for growth but requires serious investment.

Figure 2: Total fuel mix in Flanders 2020 (VREG)



In 2020, 35.8% of the electricity supplied came from renewable energy sources. Hydropower (17.8%) was the most important renewable energy source, followed by onshore wind power (5.5%) and biomass from agriculture or forestry (3.6%). The largest share of renewable energy came from Flanders itself (7.2%). In addition, France (5.6%) and Norway (5.3%) were the most important import countries for renewable energy. In 2020, 32.6% of the electricity supplied came from nuclear sources (grey) and 31.5% from fossil fuels (red). As shown in Figure 3, Belgian electricity consumption was 80.87 TWh in 2020, rising to 83.66 TWh in 2021. In 2020, 23% of consumption was by households, compared to 45.2% by industry (Figure 4).

Figure 3: Electricity consumption in Belgium (FEBEG, 2021)

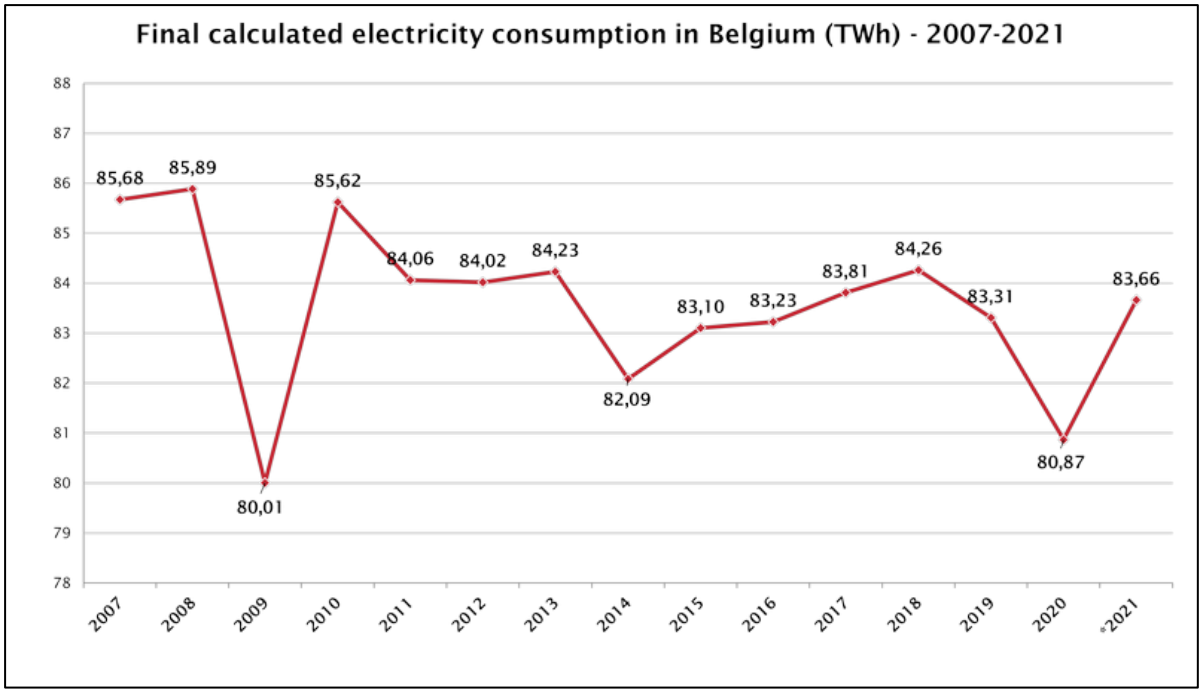
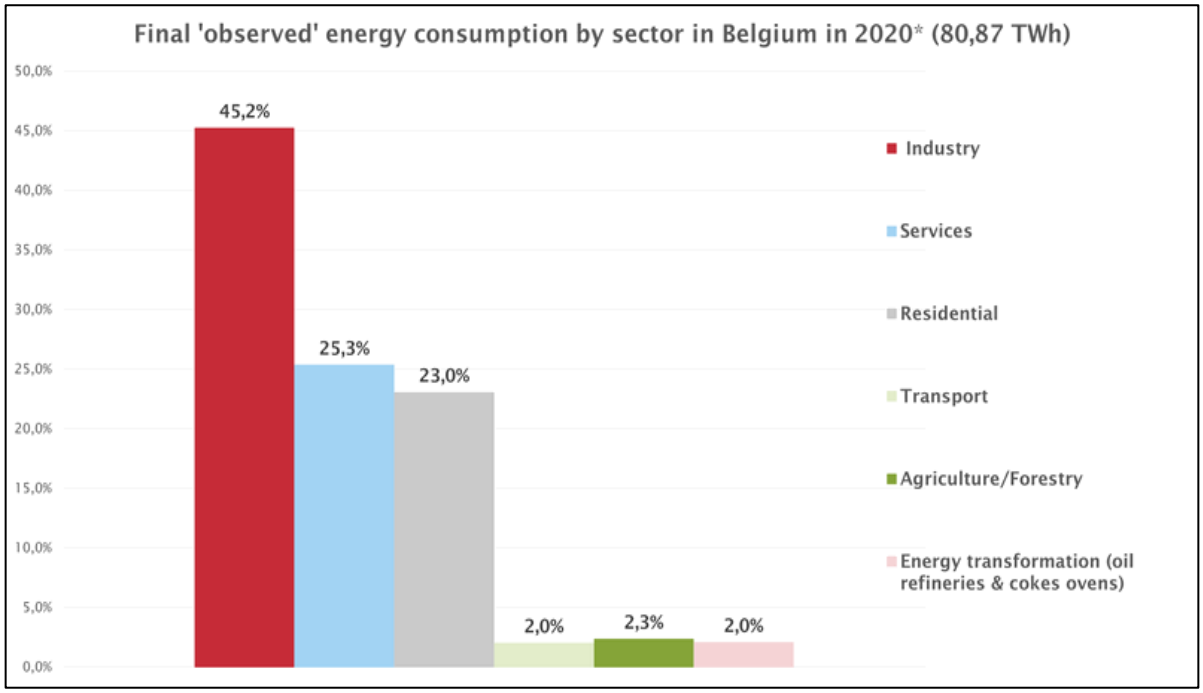


Figure 4: Distribution of electricity consumption, in TWh, by market segment, Belgium 2020 (FEBEG 2021)



In recent years, there has been an argument that we should all share the burden for 'loading the network'. The figures presented above as Figure 4, however show that households pay a disproportionate share in network costs and taxation, while industry usually also profits from preferential pricing. Belgium is a densely populated country, heavily industrialised, with a capitalised focus north and socially focused south. Whether these differences will ever be resolved remains to be seen.

3.1.3 Major energy related challenges

Throughout the last years, Belgium has failed several times to reach the commitments agreed at the European level. Several climate dossiers have gone back to the drawing board. The complex composition of governments (federal, regional, municipal) and the often-unstable political situation, makes governmental agreements difficult. A difficult to reach decision back in 2003 to withdraw from nuclear energy was largely motivated by the high risks associated with this form of energy, particularly the risk of accidents and proliferation. Since 2003, however, no government had made it a priority to properly plan an outline for the 'nuclear exit'. The most recent federal government (minister from the Green party) took radical steps towards the nuclear exit, but then the War in Ukraine came and the surrounding volatility and uncertainty in the energy market which caused extreme price surges. This in turn provided arguments for lobbyists who warned of the dangers of energy supply and potential blackouts from a nuclear exit. However, the only salvageable nuclear power-plants in Belgium only provide 2-3% of the total energy supply. Their inflexibility in the face of the rapidly changing energy market and transition to electrification is still not enough to place them outside of the energy realm.

Belgium (as other European countries) has and will continue to feel the knock-on consequences of the Russian invasion of Ukraine. Energy prices saw a record high in March 2022. For the time being there is no impact on the Belgian supply of natural gas. Belgium is a hub for gas supplies to the European Union but has a very small share of Russian gas for its own consumption (6%). In the meantime, the energy giants do not appear to be shying away from profit taking. "*Thanks to the energy crisis, in 2021 Belgian gas-fired power stations will have made the highest profits in fifteen years. In total, these could amount to €353 m. This is what a new report by the federal energy regulator reveals*" (Van Horenbeek 2022). In 2021, Engie, the French parent company of the previously Belgian Electrabel, made €3.7b profit, thanks to – among other things – high electricity and gas prices. Engie, also did very good business in the first quarter of 2022 thanks to high energy prices. Operating profit rose 75 per cent compared with the result for the first three months of 2021. The biggest profit drivers were the Belgian nuclear power plants and the gas trading business. Of the total €3.53b operating profit, €583m came from these nuclear power plants and €520m from the natural gas trading business. Engie has raised its net profit forecast for 2022 sharply from between €3.1b and €3.3b to between €3.8b and €4.4b (Sertyn 2022). Engie, is now demanding from the Belgian the government - and thus the taxpayer - to help pay for the disposal of additional nuclear waste. "*This is totally unacceptable, according to Bond Beter Leefmilieu, Greenpeace and Inter Environnement Wallonie. Because what does the Belgian get in exchange for these sky-high costs? The nuclear extension does not contribute to security of supply or lower energy prices*" (Clarysse 2022). Opponents of nuclear power argue that keeping the last 2 nuclear power-plants open with the associated renovation and maintenance costs, could prevent Belgium from properly investing in renewable energy sources and retrofits in a large scale, such as for wind turbines at sea.

3.2 Number of households recruited, Belgium (April 2022)

The goal for the Belgian action cluster, comprised by SAAMO and Kamp C, is to engage 500 households. By the end of April 2022, 35 households were engaged while more than 100 addresses are scheduled for home visits during the summer months. The Belgian team SAAMO (previously Samenlevingsopbouw) & Kamp C, remain hopeful but also realistic to the prospect of a return to (a form of) normality, but the ever-changing nature of the Covid-19 pandemic has, unfortunately, left its mark in recruitment efforts. The pandemic has exasperated existing issues in all levels of society but also with bureaucracy and specifically with key organisations that SAAMO and Kamp C have been depending on for collaboration and referrals: the city/region of Turnhout and the OCMW (the public centre for social welfare in Turnhout).

As of December 2021, SAAMO and Kamp C managed to finalise signing of contracts with both organisations, something which is meant to facilitate the collaboration and allow SAAMO and Kamp C to gain (limited) access to target group via these organisations. These contracts have not led to a surge of immediate referrals. The Belgian team has therefore decided to revise the primary sources of referrals (less dependence on organisations, more efforts on the ground) and recruiting strategy (collective engagement) as well as lightly adjusting the data collection processes. The war in Ukraine has added a layer of uncertainty and mistrust to all consumers that is difficult to shake off.

Table 1: Households engaged to date (April 2022)

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021			8	4	12
2022	23		-	-	23
					35

Table 2: Estimated household engagement adjusted to Covid-19 (SAAMO and Kamp C revised targets April 2022)

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021			8	4	12
2022	23	17	88	160	238
2023	250[1]				250
					500

While recruitment numbers to have been disappointing, they are not reflective of the effort expended. The Belgian partners have undertaken a large amount of recruitment activities, including, *e.g.,*

- Collective outreach actions (education and outreach for newcomers, ethnic minorities, senior citizens; initiatives in collaboration with college students; *etc.*).

[1] Due to the low engagement numbers of the Belgian cluster so far, it will not be possible to complete the expected engagement target without the inclusion of the winter quarter of 2023.

- Engaging other organisations (and signing MoUs) to arrange for referrals (including from the 'Goed Plan' advisory desk within SAAMO; social organisation such as public centre for social welfare, municipalities like the city/region of Turnhout).

Going forward, these activities will continue and be built upon including through *e.g.,*

- leveraging the work of related projects and initiatives (such as the 'Binken weten beter' information campaign against aggressive sales for energy contracts; 'Energiesnoeiers' or energy cutter initiative which provides similar services to that of EnergyMeasures; Energy masters volunteers).
- Extension of activities into regions outside of Turnhout.
- Working though social NGOs including *e.g.,* schools, food banks, churches, women's groups *etc.*
- Greater emphasis on publicity and media.

3.2.1 Characterisation of the dwellings

Belgian households participating in the project have been recruited from Turnhout, a medium-sized city in the province of Antwerp, in northern Belgium, in the region of Flanders. The city is very close to the border with the Netherlands. Turnhout, which has c. 45,000 inhabitants is at first sight a typical small Flanders municipality, it has, however, a surprisingly high percentage of poverty in comparison to others. The recruited households are very diverse, they include single parents, old people, singles, immigrants with small or large families. Most dwellings have been either terraced housing or apartments as illustrated in Figure 5 below.

Figure 5: Detached homes (blue) and apartments (red) consist of the larger proportion of engaged households.

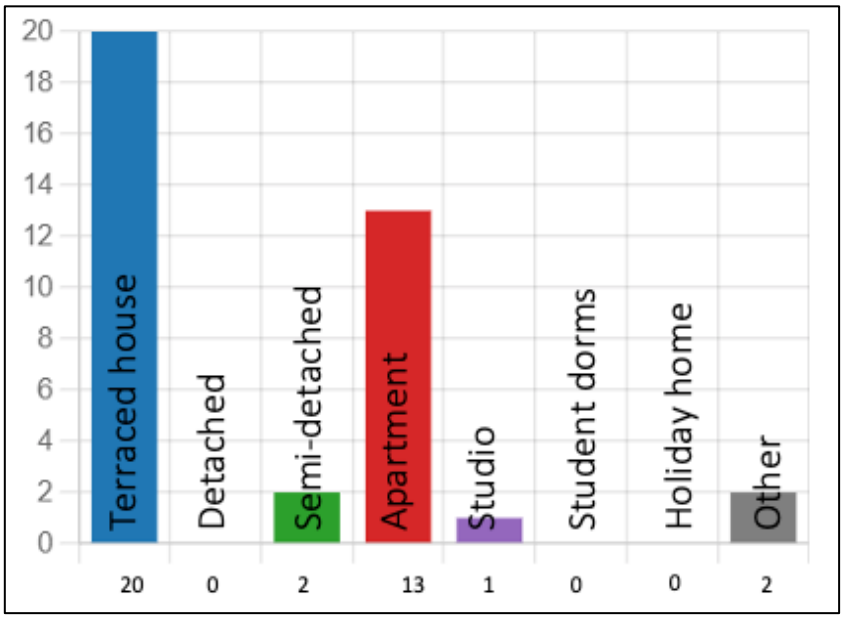


Figure 6 shows typical apartment blocks in Turnhout from the 1970s, many of which have been waiting for energy retrofitting for several years already.

Figure 6: Typical apartment blocks in turnhout dating from the 1970s

The photos in Figure 7 on the following page show detached brick housing typical of some of the participating households in Turnhout. These are reflective of the condition of the housing stock in the private market, where households in poverty are often circulating for years: with common issues such as: mould (see also Figure 8), poor quality double-glazing, with often insufficiently insulated walls and roofs.

Figure 7: Typical detached brick houses in Turnhout

Figure 8: Mould due to poor ventilation, insufficient heating and/or cold bridges.

3.3 Establishing a baseline

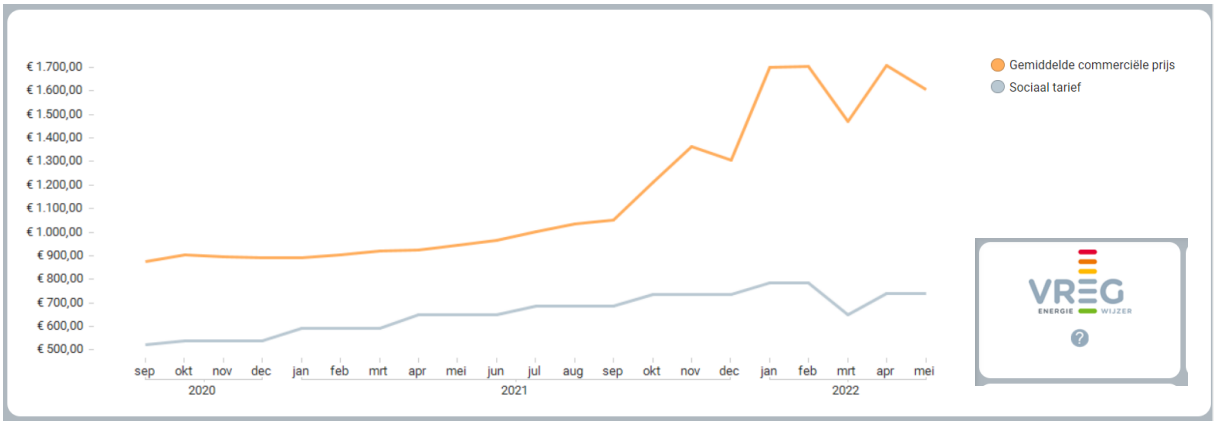
In Belgium almost all homes have gas fired space heating and water heating meaning that in the overwhelming majority of cases electricity and gas data accounts for practically all energy consumption. Where fuel oil is used by households (less likely in an urban setting such as Turnhout), data will be collected from invoices, customer receipts. The baseline for electricity and gas is derived from analysis of meter readings and historic data. Meter readings are recorded at the start of the process – more than half of the households have an analogue meter, a quarter have a digital meter

and a fifth have a budget-meter or a pre-paid energy card. Households are also requested to provide their annual yearly statements. These statements are usually provided in March or April of each year. On most yearly statements, the energy consumption of previous year (or two) will also be shown. In this establishing a baseline for most households is relatively straightforward. For those that have only lived in their house for a short period of time, and estimates will be made based in similar households and calibrated based on periodic meter readings. At the end of engagement, we will ask for each household's meter readings again and we will be able to compare if savings were made.

3.3.1 *Use of electricity*

According to VREG, the 'Flemish Electricity and Gas Market Regulator', the last couple of years have seen dramatic volatility in both the electricity and gas market. Although it should be noted that Belgium has social tariffs for energy, where those on very low incomes pay a reduced cost and the government pays the difference to the supplier. While many of these household can still be energy poor, energy poverty really affects those just above the threshold. Figure 9 shows the trends in electricity process up to May 2022 for a 'typical' household in Flanders. The normal commercial rate has almost doubled since late 2020, and while social tariffs do protect vulnerable customers, it if noteworthy that social tariff for electricity increased by more than 30% in this period. Furthermore, the increasing difference between the commercial prices and the social tariff means that there is a growing energy poverty trap for those households who are just above the thresholds for qualifying for the social tariff.

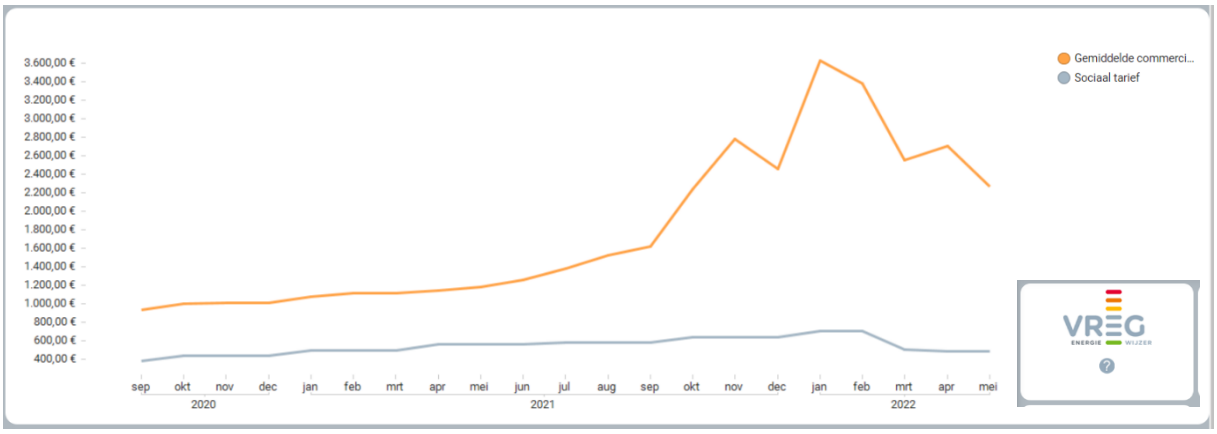
Figure 9: Evolution of 'average' household electricity prices Flanders (commercial price: orange; social tariff: grey) (VREG)



3.3.2 *Heating*

On average, 70 to 80% of the household energy consumption in Belgium is spent on heating and hot water. As mentioned above, most Belgian households use gas for heating. Figure 10 below shows the trend in gas prices for a 'typical' household since the last quarter of 2020, with the average gas bill reaching a record high of €3,500 in March 2022, and while social tariffs has not increased as much there is a lot of volatility in the market due to the Ukraine war. While many on the social tariffs may continue to be in energy poverty, as mentioned in the case of electricity the large increase in the commercial rates means that there is a growing number of energy poor households just above (and maybe more than just above) the qualification thresholds for the social tariffs.

Figure 10: Evolution of gas prices in Flanders, (orange: average commercial price, grey: social tariff) Source: VREG

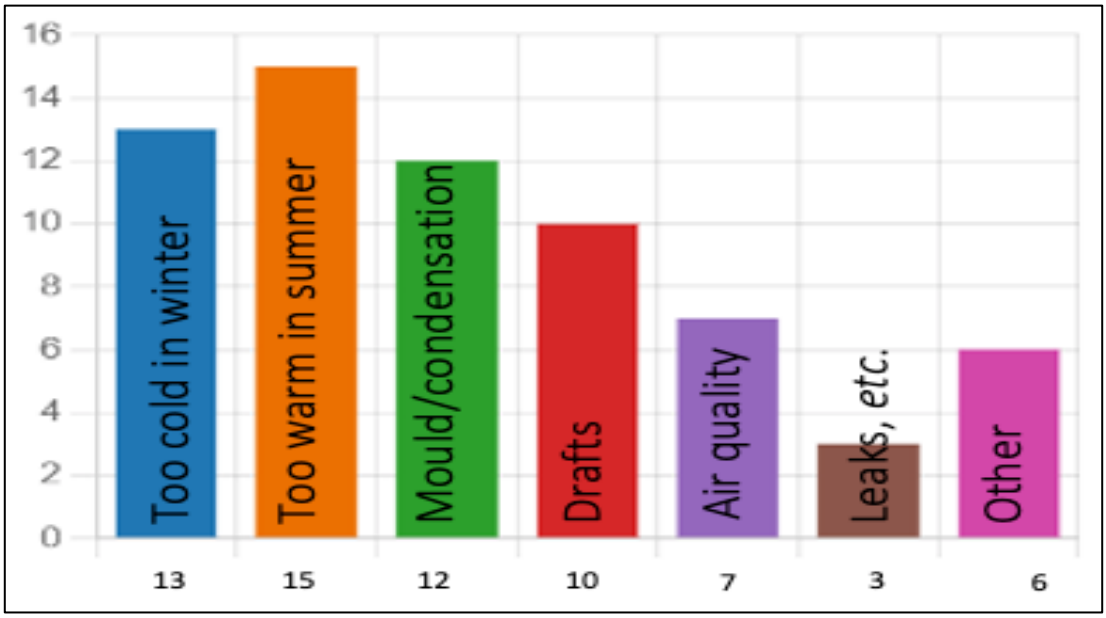


Those households not connected to the gas grid typically use systems based on oil boilers running fuel oil (kerosene). The price of this fuel oil has increased substantially rising from €0.44/litre (Sept 2020) to €1.26 / litre (May 2022).

3.3.3 Examples of energy issues

The recruited dwellings are typically built from brick and often are in very poor condition, with old windows and doors, poor (if any) insulation, and old inefficient boilers. Some homes are in dire condition, but householders are clearly doing their best they can with the little they have. One in three the recruited households receive support to pay their energy bills, Figure 11 below outlines an overview of the issues reported by these households.

Figure 11: Overview of problems experienced in the homes



3.4 Looking forward

The Belgian strategy to collect energy data for the duration of the project can be summarised as:

- *Baseline*: Historical data from yearly statements.
- *Current*: Meter readings at first contact.
- *Future*: Meter readings at follow-on contact, shared via WhatsApp photo or message and/or energy use readings 2022 via yearly statement.

We maintain the view that in-person visitations are a necessary part of engagement, but given the fact that they will are sometimes neither possible, nor always welcomed by our target groups, we will follow the following adjusted strategy: Collective engagement as a starting point (through organised events and action days); Remote engagement (via telephone) including initial advice, support and data collection; Informed home visit with draft behaviour plan and further data collection; Finalised plan of measures; Remote follow-up as collective engagement through a WhatsApp group with tips. This strategy in fact reflects the shift in our primary sources of referrals. Instead of depending on individual referrals from the city/region of Turnhout and OCMW, we will move towards initialising collective engagement as a starting point.

In our engagements we use the incentive of the Woonmeter, as SAAMO has scaled up its use even in other Flemish provinces having received very positive feedback. As we are strategically moving towards more collective engagements, other incentives could come into play, such as “win energy-efficient household appliances” for those who submit data. At the moment, we are developing a booklet to be given with the Woonmeter, where the households can record their meter reading at more regular times if they wish.

Engagement in Turnhout has clearly been a challenge, partly due to Covid-19 but also due to structural problems between key actors within the municipality. The goal for SAAMO and Kamp C is to identify these barriers and to establish a working strategy that could prove useful for upscaling in other cities/municipalities. We remain committed to establishing networks and working out a method and instruments to achieve as many of the goals that we set out to achieve as possible. We firmly believe that households need to be empowered. Data and what they mean are essential for a successful transition in behaviour.

In the next stages of the project, we will try to incorporate our experience so far, the learnings from previous projects (*e.g.,* ASSIST) and through our collaboration other organisations (*e.g.,* EnergieID). We intend to adjust our message towards: “*A smart resident is better that a smart home*”. The intention is that these insights, the small measures actions centred around the Woonmeter and collective engagement with the right partners on the ground, will be framed in a province-wide strategy, that all 69 municipalities in Antwerp (and beyond) can potentially benefit from.

4 Bulgaria

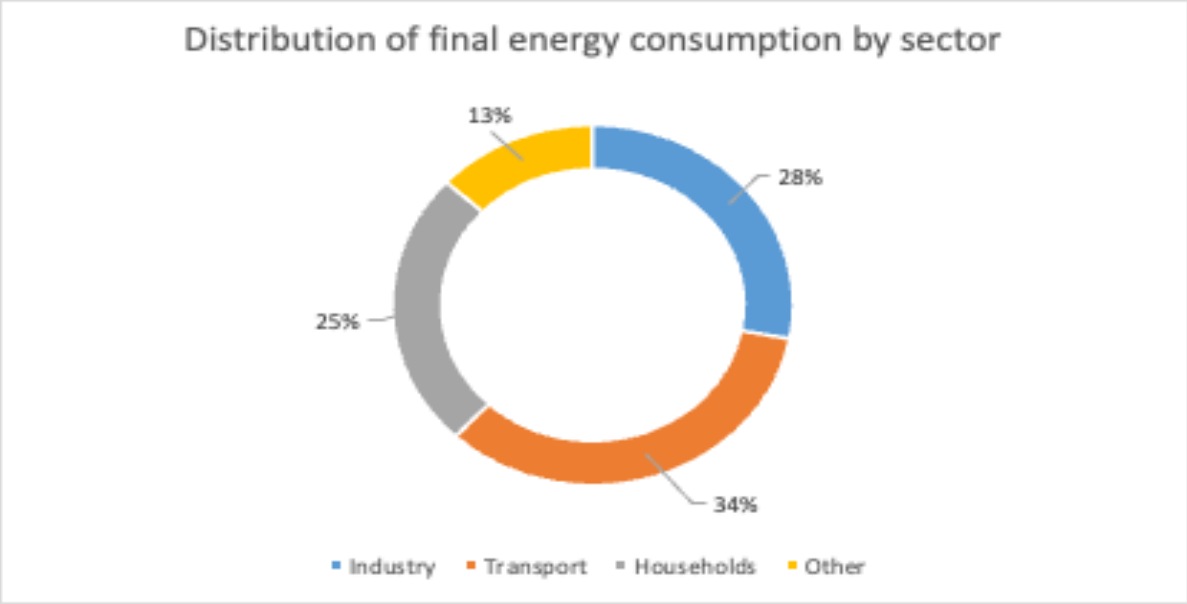
4.1 Country profile and the lived experience

At this stage, no official definition for energy poverty has been adopted in Bulgaria, and the existing ones of the few countries that have already adopted such are inapplicable given the differences in the socio-economic status of the population. Bulgaria is still the poorest country in the EU, and it should also be noted that many households use extremely cheap energy sources, such as wood and coal. Another country specific feature is that over 96% of housing is privately owned by individuals and over 85% of the useful living space is in buildings built before 2000, after which higher energy efficiency requirements came into force.

4.1.1 Energy Sources in Bulgaria

The 2020 energy balance of the courtly shows that about 25% of the final energy is used in the households.

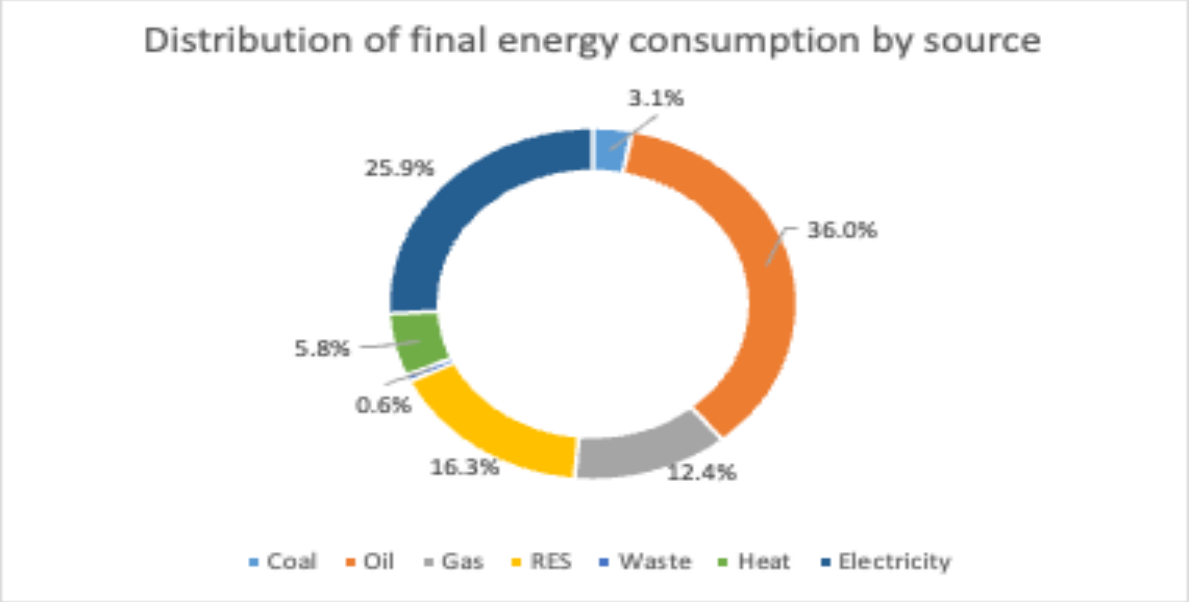
Figure 12: Energy consumption by sector, Bulgaria



Another cross-section of the statistical data shows the final energy consumption by different sources. The highest percentage (36%) is for the oil-based liquid fuels mainly used in the transport. Second place is for electricity (26%). The share of RES is 16.3% which was the national goal up to 2020.

About 75% of the electricity in the country is generated by the few coal power plants (39%) and the nuclear power plant (37%). Coal is mainly mined locally while nuclear fuel is supplied from Russia.

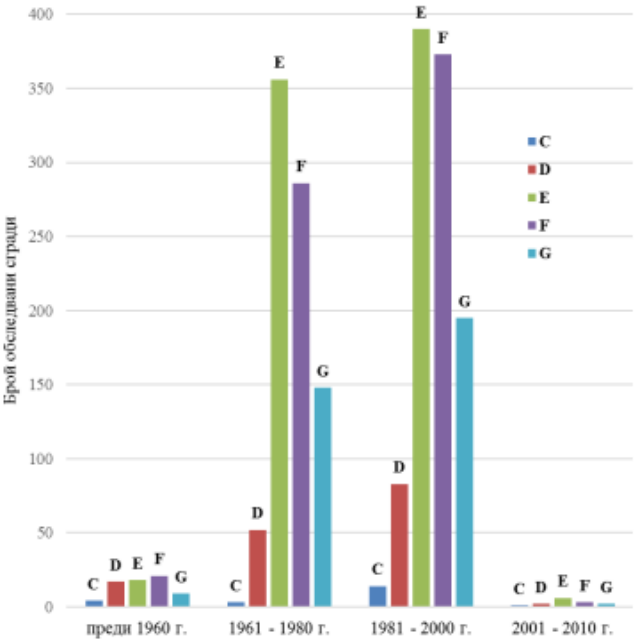
Figure 13: Energy consumption by source, Bulgaria



Currently, there are no detailed statistics on the distribution of different energy sources in household consumption, but according to the National Long-Term Renovation Strategy (Bulgarian Government 2017) about 36% of the energy in the household sector is provided by solid fuels (mostly firewood and coal), characterised by extremely low cost and having a strong negative impact on air pollution. Such fuels are mostly used in rural areas and small towns. Energy from district heating accounts for 18% and electricity (including heating) for 45%. It is the latter two that are the most used sources for heating in urban environments. The use of natural gas for domestic heating is still insignificant as a share.

The available data on the energy performance of multi-family residential buildings, presented in the National Long-Term Renovation Strategy (see figure below), show that buildings with energy classes between E and G have the highest share, which is actually logical given the lack of financial instruments and communication with households about the benefits of energy efficiency, which in any case should not be considered only from a financial point of view, as high CO_2 levels, the presence of mould and condensation and high dust levels lead to increased health issues for the population.

Figure 14: Energy classes of residential building by year of construction, Bulgaria



Легенда:	Caption:
Брой обследвани сгради	Number of audited buildings
Преди 1960 г.	Before 1960
1961-1980 г.	1961-1980
1981-2000 г.	1981-2000
2001-2010 г.	2001-2010

4.1.2 Major Energy-Related Challenges

Having lived in poverty for many years, most Bulgarian households have long ago, and the hard way, arrived at a large set of behavioural measures leading to energy reduction and increased comfort (sticking sealing strips on windows in winter, turning off or reducing heating in unoccupied rooms, using a night tariff for electric water heaters, *etc.*). However, this is always done at a household level, and in fact the sustainable solution to energy poverty is deep renovation. Unfortunately, this is where the main problem lies, and that is the association of owners of multi-family residential buildings to introduce large-scale energy efficiency measures at the building level. The most recent evidence of this problem was the extremely low interest in participating in the National Programme for Energy Efficiency, where despite the 100% grant offered on the sole condition that individual owners create an association, gathering 2000 buildings to participate in the programme proved to be a challenge.

4.2 Number of households recruited, Bulgaria (April 2022)

Local authorities played the key role in attracting households to participate in the programme, and those that put effort into organising meetings with households and awareness campaigns also achieved the best results. Two of the most active municipalities (Burgas and Gabrovo, members of the Municipal Energy Efficiency Network - EcoEnergy) committed to support the organisation of meetings with household representatives in multi-family residential buildings. EcoEnergy will provide free

energy audits of their buildings, where energy consumption in the buildings will be analysed in detail and specific recommendations for the implementation of energy efficiency measures will be made.

Another major factor that weighed in the selection of households to participate in the project was the migration of the population from the villages to the cities, where housing is mainly in multi-family apartment buildings built during the socialist era. In recent years there has also been a reverse migration, but mostly from more affluent households to the villages around the large cities. Therefore, EcoEnergy's focus during the EnergyMeasures project is on the occupants of old multi-family residential buildings where a larger share of the population in Bulgaria lives.

So far EcoEnergy has reached a total of 434 households (245 in Gabrovo and 189 in Burgas), and we expect the number to increase significantly in the coming months, given the increased interest of citizens in the second phase of the National Programme for Energy Efficiency of Multi-Family Residential Buildings.

Table 3: Households engaged to date – Bulgaria as of April 2022

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021			145	189	334
2022	100	-	-	-	100
					434

Table 4: Estimated household engagement numbers adjusted to Covid-19 – Bulgaria revised targets April 2022

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021			145	189	334
2022	100	116	50	-	266
2023	0[2]	-	-	-	-
					600

4.2.1 Characterisation of the dwellings

Households participating in the programme in Bulgaria are living in multifamily residential building commissioned between 1960 and 1980 during the Soviet era. Almost equally distributed to 1, 2, 3 and 4 persons per household all of them are living in 2 or 3 room apartments. About 75 of the dwellings are not insulated, 25% installed 5 cm of EPS on the external walls and only few have thicker insulation up to 10 cm. The windows are usually double glazed without selective coating and the framework is either old wooden or in case replaced PVC. More detailed statistical data will be presented on later stage when the detailed energy audits of the buildings will be completed.

[2] The target is to have the full complement of households recruited by month 24, with provision made for potential household dropouts with a small level of recruitment after month 24.

Figure 15: Multifamily residential building in Gabrovo, Bulgaria

4.3 Establishing a baseline

The electricity market in Bulgaria is still at regulated prices, with consumption information available monthly, both in the invoices issued by the suppliers and on the websites of the three electricity distribution companies operating in the country. For the needs of the project, EcoEnergy, together with representatives of the municipalities of Burgas and Gabrovo initiated the sending of letters to the electricity distribution companies to provide information on electricity consumption for a three-year period in a convenient form. The electricity distribution company operating on the territory of the municipality of Gabrovo provided the data almost immediately for a minimal fee, while negotiations are still ongoing with the company operating on the territory of the municipality of Burgas, given the extremely complicated internal procedures for providing data, requiring notarised powers of attorney from the household representatives.

Data on heat consumption by district heating companies and water consumption by water utilities for the last 3 years, by month, in both municipalities were obtained quickly and without additional charges.

The baseline will be calculated according to the requirements of the national methodology for energy auditing and buildings certification, which is in line with European best practice and is considered to be one of the most accurate and detailed methodologies in the EU. Through this methodology, based on the energy consumption data provided, the interviews taken, and the questionnaires regularly filled in by households, the achieved savings resulting from our efforts will be calculated.

4.3.1 Use of electricity

The electricity consumption strongly depends on the main sources for heating and DHW in the dwellings. In case they are connected to the local district heating network, the consumption is relatively low while if they use air conditioners for heating and electric boilers for DHW the consumption is higher. In all cases the size of the household is the main factor for the consumed energy. It has to be considered that the electricity price for the households is relatively low (about 0,1 Euro/kWh) as they are still under regulated prices. Thus, the energy crisis in the end of 2021 didn't reflect in their energy bills. The average monthly expenses of the households for appliances (mainly ovens, TVs, washing machines and PCs) vary between 20 and 50 EUR depending on the number of inhabitants.

4.3.2 Heating

In the largest cities in Bulgaria district heating is a relatively cheap alternative (prices vary around 45 – 50 EUR/MWh). This is the main source for a number of multifamily residential building connected to the heating network. However, there is still a high percentage of building not connected to the network, where the main heating sources are air-conditioners, wood stoves and pellet boilers. Unfortunately, the national policies are not prioritizing centralised heating and the services provided by the district heating companies are often with low quality. Frequent stoppages of the heat supply or insufficient temperature of the heat carrier are observed.

4.4 Looking forward

As mentioned above, almost all energy and fuel consumption data for the period 2019 – 2021 (except for electricity consumption of households in Burgas) are already available on monthly basis and presented to the EcoEnergy team. Currently the team is processing the data and detailed statistics are expected by the end of the summer. The surveyed households, as well as representatives of the municipalities of Gabrovo and Burgas, have committed to cooperate and continue to provide this data throughout the project period.

Given the specific context of the long-standing lack of trust in central government, all attempts at a national communication campaign, no matter how minor, have been characterised by complete failure. It turns out, however, that local authorities can be a major driver in communicating with citizens. It is local authorities that EcoEnergy relies on to help organise meetings and training and to get people to act together to improve their own buildings.

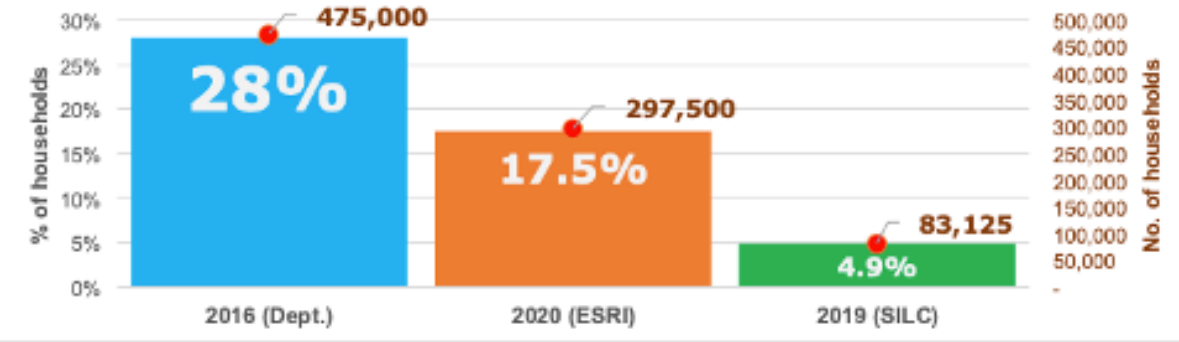
5 Ireland

5.1 Country profile and the lived experience

5.1.1 Figures on Energy Poverty in Ireland

Ireland's Energy Poverty Strategy estimates that the rate of households experiencing energy poverty in the country falls between 8.8 – 28%, depending on whether this is based on self-reported inability to heat or derived from modelled expenditure and building energy rating data (DCENR, 2016). In 2016, this upper estimate would have been equivalent to 475,000 households. More recent research produced by the Economic and Social Research Institute (ESRI) in 2020 revises this figure, estimating 'core' energy poverty to be 17.5% of households throughout Ireland, approximately 297,000 in total (O'Malley *et al.*, 2020). Similarly, the Survey on Income and Living Conditions (SILC) indicates that the proportion of those who self-report being unable to afford to heat their homes has fallen from 9% in 2015 to 4.9% in 2019 (Lawlor & Visser, 2022). As can be deduced from these variable estimates, it is relatively difficult to discern a true picture of the levels of energy poverty throughout Ireland.

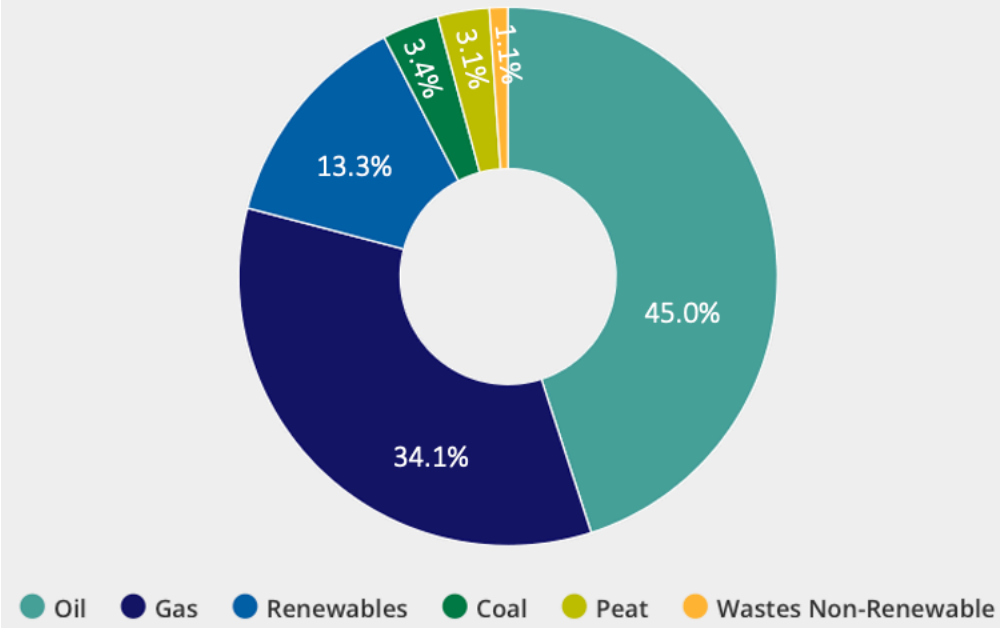
Figure 16: Three estimates of the number and percentage (%) of households experiencing/at risk of experiencing energy poverty in Ireland (Source: Lawlor & Visser, 2022)



5.1.2 Energy Sources in Ireland

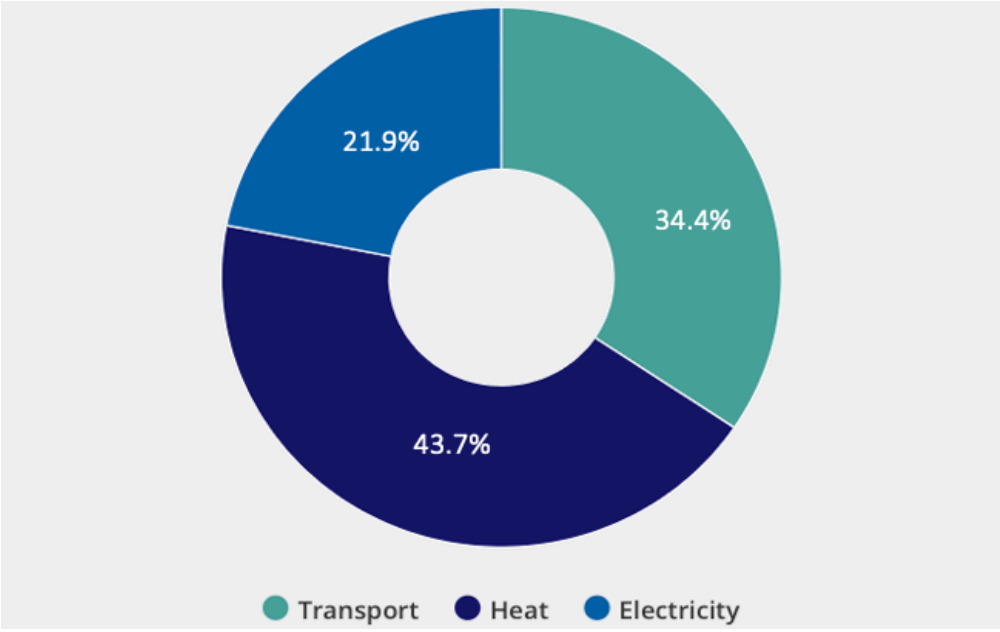
Ireland's economy is strongly reliant on fossil fuels, with 86% of all energy used in the country stemming from fossil fuel-based sources in 2010. The residential sector is the second-largest source of energy demand in the country, behind the transport sector, as of 2020 (SEAI, undated).

Figure 17: Percentage (%) share of primary energy by fuel for 2020 (SEAI, undated).



Primary energy fell by 8.7% in 2020 due to the Covid-119 pandemic. Oil remains the dominant energy source, and is mostly used for transport, followed by heating. Natural gas, the next largest source of energy, is mainly used for electricity generation. Within the share of renewable energy, 56% of this is accounted for by wind energy (SEAI, undated).

Figure 18: Final energy use by mode in 2020 (SEAI, undated).



As shown in Figure 18, heat became the largest mode of energy use in 2020 at *c.* 44% of the total; this was followed by transport (34%) and electricity (22%).

5.1.3 Major Energy-Related Challenges

Ireland is currently in the process of attempting to transition to a low-carbon energy system, which presents several unique challenges for the country, namely energy security, meeting climate commitments, energy costs, sectoral issues and challenges around physical infrastructure development and employment opportunities:

In terms of energy security, Ireland has a heavy reliance on external sources of energy, being identified as the 10th most dependent EU Member State in 2016. Energy imports cost Ireland €5.0 billion in 2018. International developments like the war in Ukraine and Brexit are likely to have an impact on Ireland's energy security in future (Byrne Ó Cléirigh, 2020). As of 2014, Ireland was halfway to meeting its climate change targets across all sectors and the overall target for 2020. Ireland was recently called out for being off track in meeting its interim GHG emissions targets for both 2020 and 2030, for decarbonising the Irish economy by 2050. Based on projections, Ireland was expected to exceed its EU Effort Sharing Decision target of 338m t CO_2e by *c.* 16m t.

The cost of energy supply is significant from the perspective of a country's competitiveness and growth potential; it is also a key resource for businesses and an important item in the household budget for consumers. For low-income households, the cost of energy can prove to be a particular challenge. At the time of writing in early 2022, electricity prices in Ireland were 26% above the EU average, coming in behind only Germany, Belgium and Denmark (Eurostat). Ireland was identified as the eight most expensive country in the EU for gas. Compared to the EU average, however, energy is one of the few areas where Irish citizens are taxed relatively lightly. However, the Carbon Tax as part of Budget 2021 included an increase of €7.50 from the previous €26 per tonne to €33.50 per tonne for auto fuels from October 2020 and solid fuels from May 2021; this will continue up to 2030 (Ireland's EU emissions target). The price increases have had an effect on gas and diesel, as well as electric power stations driven by gas, and will impact the Irish public; the government has subsequently introduced €200 refund credits to all householders on their recent fuel bills which will be drawn down from the Carbon Tax Funds (Eurostat).

Certain sectors can present unique circumstances in relation to energy and its use. The transportation sector, for example, is heavily reliant on fossil fuels and a major rethink would be required to prevent increases in greenhouse gas emissions from this sector. Other sectors, like the technology sector, may present specific challenges arising from energy-intensive activities, like the operation of data centres; in 2021, a total of 14% of the total electricity requirement demand came from data centres (Central Statistics Office 2022).

Currently, Ireland lacks the necessary physical infrastructure, like energy networks and interconnection with other countries' energy systems, that will be required to make the transition to decarbonise the energy system. At present, Ireland is focusing on becoming a major investment hub for Clean Technology, driven by energy price hikes, environmental issues, and resource shortages; the country offers abundant natural resources, a strong research and development environment, high-level skills and supportive policies at government level which continue to support its success in this pursuit.

5.2 Number of households recruited, Ireland (April 2022)

5.2.1 Dublin

Energy Action are leading the engagement in Dublin. Their primary target group are elderly people living in single-family, owner-occupied houses in a large urban area, namely Dublin City and environs. The organization aims to recruit 500 households by tapping into their existing networks including SEAI, Dublin City Council, Housing Associations and NGOs including the Money and Budgetary Service and the Saint Vincent de Paul Society to engage with target householders.

Figure 19: Households recruited to date (Dublin as of May 2022).

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021			-	7	7
2022	17	66	-	-	81
					90

Figure 20: Estimated household engagement numbers adjusted to Covid-19 (Dublin Revised targets May 2022).

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021			-	7	7
2022	17	66	190	220	493
2023	0[3]	-	-	-	-
					500

Household recruiting activities have included the distribution of 10,000 leaflets with information about the project and energy advice at key locations such as Senior Citizen Complexes, Money and Budgetary Service, Saint Vincent de Paul Society, Senior Citizen Groups, Friends of the Elderly, Age Action, Third Age Ireland, ALONE, Irish Environmental Network, Environmental Protection Agency.

Energy Action's is also working with local Authorities, namely Dublin City Council (120k) and South Dublin County Council (20k) to help with the recruitment process as most tenants will be low income or senior citizens. Other recruitment efforts have included liaising with Housing Associations and NGOs to engage with target householders. Covid-19, had a huge impact on accessing homes and accessing key local authority staff, and therefore the strategy has changed to directly liaise with private households. Energy Action along with other interested parties had been lobbying different Energy Ministers over the last 4 years to influence change to the Department of Energy to change their decision to exclude fuel poor households who already received shallow measures from receiving upgrades. In February 2022, Energy Minister Eamon Ryan announced that for the first time, applications will be accepted from qualifying homeowners who previously received support under the scheme. This has allowed Energy Action to contact private households who received previous shallow measures to register for EnergyMeasures and help them apply to SEAI for upgrades.

[3] The target is to have the full complement of households recruited by month 24, with provision made for potential household dropouts with a small level of recruitment after month 24.

5.2.2 Cork

UCC are leading the engagement in Cork. They have two main target groups, the first are disadvantaged communities in Cork City (*c.* 70k households), which University College Cork has traditionally engaged in educational and social outreach programmes. The second comprises retired communities living in Cork region that are unable to keep their houses adequately warm.

Figure 21: Households recruited to date (Cork as of May 2022).

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021			-	9	9
2022	22	54	-	-	76
					85

Figure 22: Estimated household engagement numbers adjusted to Covid-19 (Cork Revised targets May 2022).

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021			-	9	9
2022	22	54	20	45	141
2023	0[4]	-	-	-	-
					150

UCC's household recruiting activities have included liaising with local organisations, distributing leaflets in target areas, and organising energy clinics in community centres and through active retirement associations. From the launch of the project in September 2020 the implications of Covid-19 and its social impacts have been a constant background to the EnergyMeasures project. Due to the pandemic and the extensive 'lock-downs' and social restrictions imposed in Ireland to mitigate its impacts, it has not been possible to commence engagement from March 2021 as originally envisaged in the description of action.

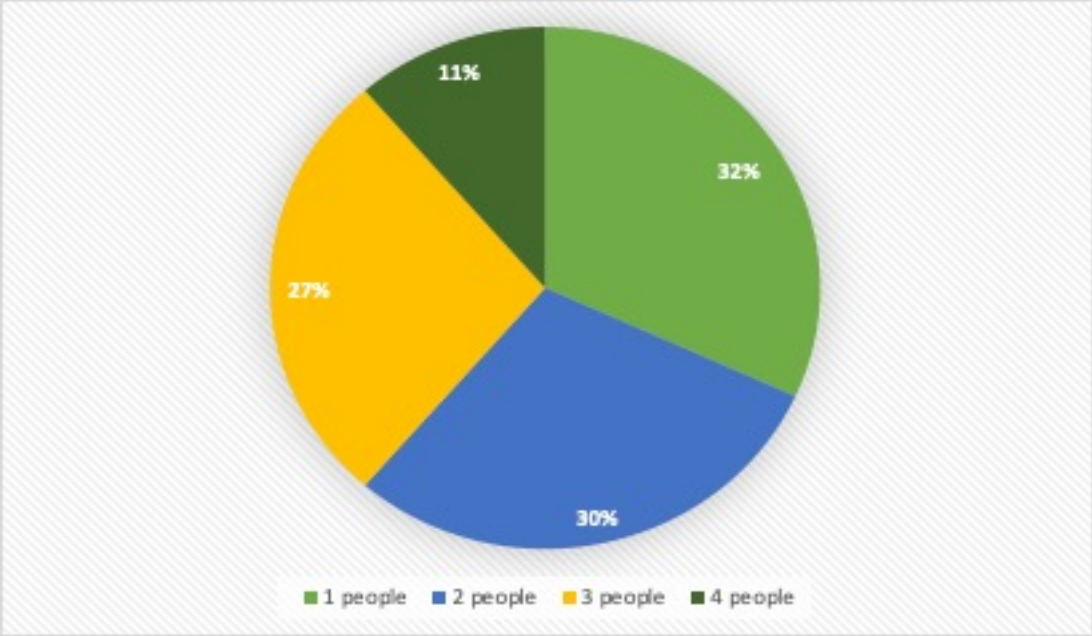
The engagement in Ireland has been rescheduled to fit in with the planned 'reopening' of society as the vaccination programme progresses and the pandemic threat lessens. The Irish government commenced a staged phasing out of social restrictions, substantially lifting these in February 2022. As a result, the household recruitment and engagements that were originally scheduled to commence in March 2021, started in January 2022 (with some preliminary recruitment over November and December as circumstances allowed). As of the end of April 2022, a total of 175 households have been recruited to the programme (between both Dublin and Cork). 75 of these households have been registered and engaged in the programme through a first household visitation that comprised a questionnaire and a semi-structured interview. These tools were used to collect energy consumption data, discuss household practices, examine the use of particular appliances, discuss perceived energy-related problems, and explore potential solutions. The discussion was followed by a tour of the household to gather information about the physical and technical aspects of the dwelling.

[4] The target is to have the full complement of households recruited by month 24, with provision made for potential household dropouts with a small level of recruitment after month 24.

5.2.3 Characterisation of the dwellings

Households participating in Ireland are usually composed of one person (32%), couples (30%) and families of more than 3 people (38%) as shown in Figure 23. Most of the survey respondents are full-time employees (35%) and retired (33%). 16% of participants have a respiratory condition.

Figure 23: Household composition in Ireland



As shown in Figure 24, the dwelling type of participating households is usually a semi-detached (30%), mid-terrace (21%) or detached house (23%). Apartments in buildings only constitute 7% of all surveyed households. Photographs of “typical” participating households can be found on page 33.

Figure 24: Dwelling type of participating households in Ireland

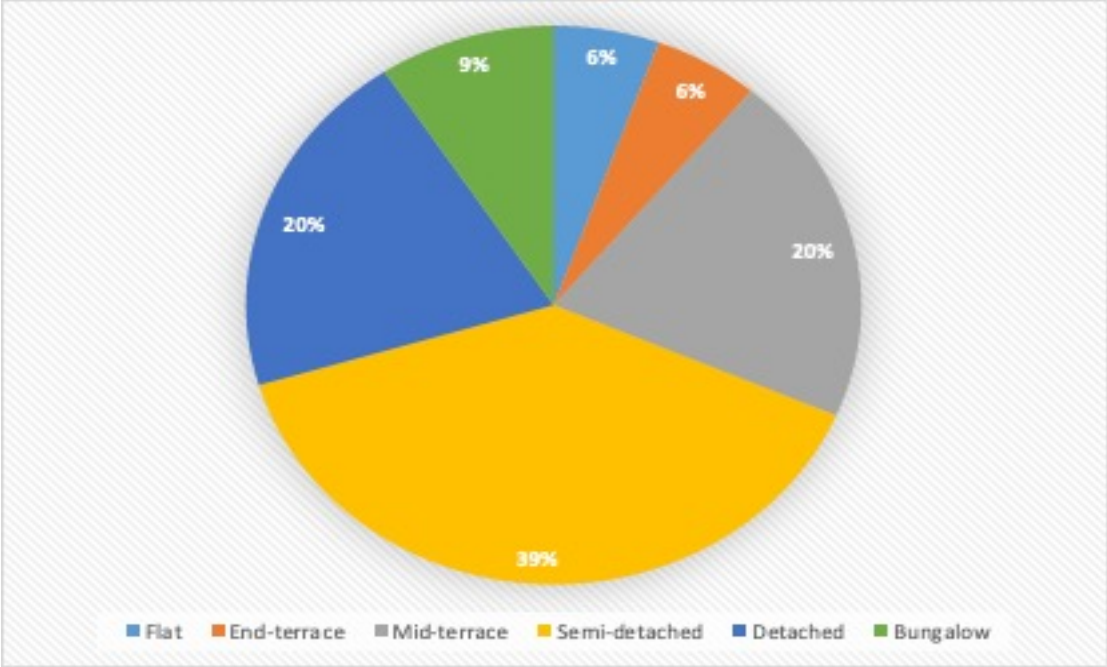


Figure 25: House in Cork City

Figure 26: Apartment building in Dublin City

Figure 27: House in Dublin City

Almost 86% of all households are either self or family owned. Most dwellings are two stories and have between 6 and 11 rooms in total. Most of the houses were constructed in either of two period: mid-1800s or between 1930 and 2000.

As you can see in Figure 28, energy efficiency in the homes across Ireland is poor, with 13% having no insulation. The type of insulation that is most prevalent is cavity filled insulation (43%). Another factor to consider when analysing the efficiency in Ireland is that 18% of the dwellings have single glazed windows (Figure 29).

Figure 28: Type of insulation in households

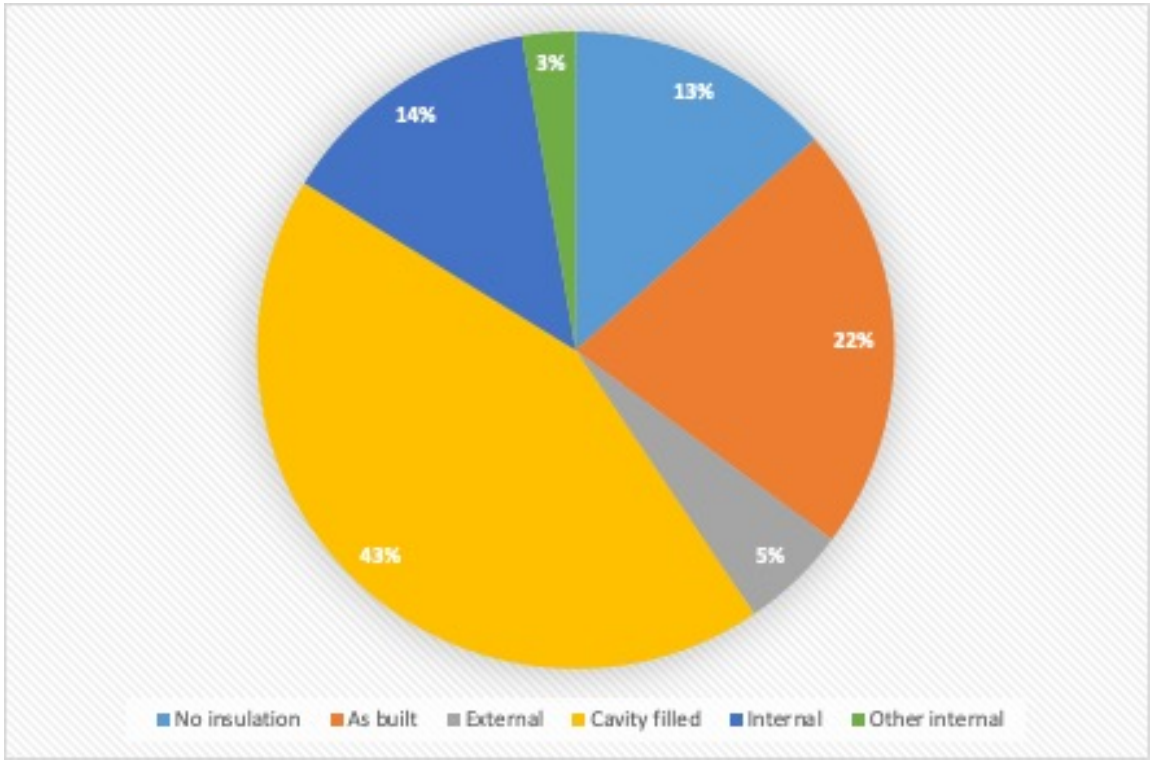
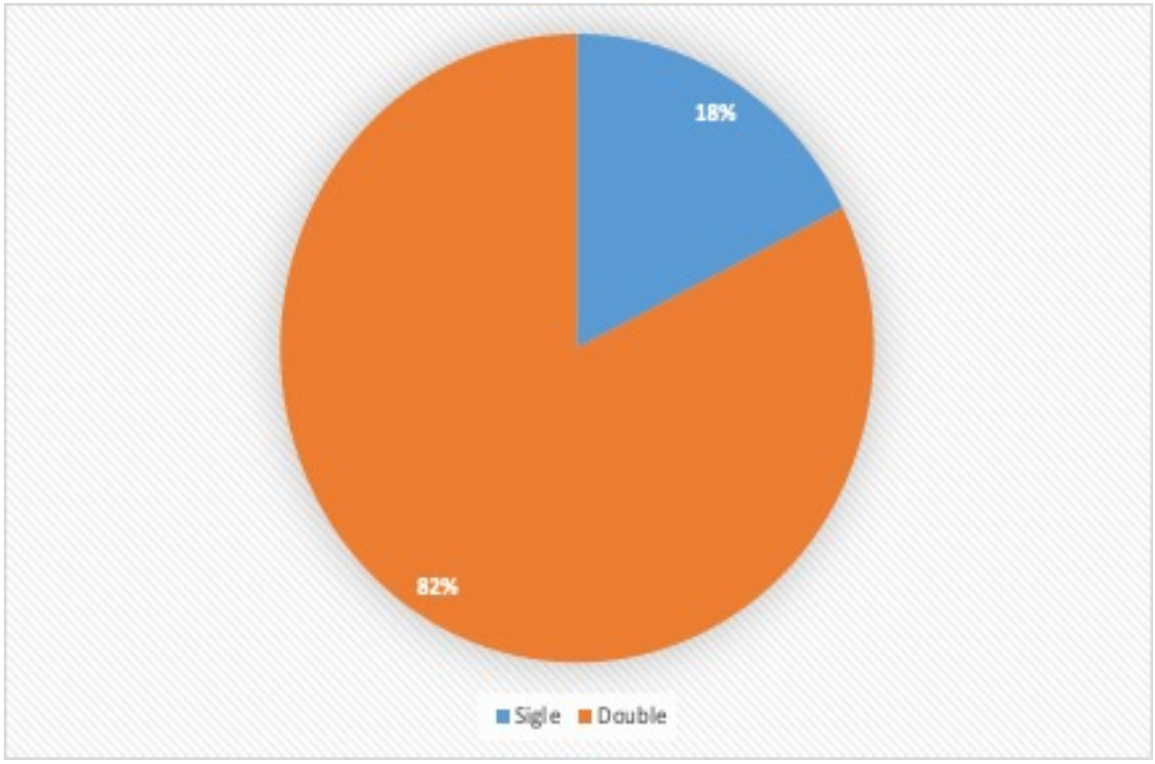


Figure 29: Window glazing type of participating households in Ireland



5.3 Establishing a baseline

Householders have been required to collect all available energy billing data in advance of the first visitation to analyse consumption patterns. The main sources of historic data on energy use for households are bi-monthly energy bills for the case of centralised grids of gas and electricity. We have been able to retrieve information for at least six months for all households. For the case of oil, householders have provided us with receipts of the loads they have done during the last year. Biomass is often bought at the local store or collected by householders. Therefore, we only have an estimation of the amount of biomass used and the cost per month for the winter months.

The information collected from the householders is being analysed in a systematic manner. This includes the interview notes/transcripts providing information on daily practices, data collected on the dwelling and energy using appliances as well as the quantitative data collected on energy consumption. In achieving this, the UCC and Energy Action team are:

- Comparing the consumption data with that of similar households to highlight elevated levels of consumption and indicate those households where there is particular scope for energy savings.
- Comparing the aggregate power consumption data for appliances with the total energy consumption to indicate so-called hidden energy use within the household *i.e.,* consumption attributable to devices unaccounted for (*e.g.,* second freezer) or incorrect estimates of usage time of known devices.
- Examining individual device-level consumption data to indicate saving potentials associated with them, and so determine the relative importance of behaviour associated with each.
- Reviewing the consumption data and analysing the information supplied by the households to develop an understanding of their household practices and what they mean for their patterns of energy use.

This information is used to work to select, with the support of householders, a package of no-cost and low-cost energy conservation and efficiency measures which are most appropriate for the dwelling and to devise a tailored behaviour change plan for householders to implement in their daily lives, including a relevant mix of efficiency, curtailment, and maintenance behaviours.

5.3.1 Use of electricity

Surveyed households in Ireland consume between 60 and 1,150 kWh every two months on average a year. The electricity use of a typical household is 680 kWh bimonthly during wintertime.

The minimum cost of electricity for all surveyed households was €45 every two months, and the maximum price paid was €1,201, with an average of €203.

5.3.2 Heating

The two main heating sources of participating households are gas (54%) and oil (39%) as shown in Figure 30. Households use these sources to heat up radiators for about 1-2 hours in the early morning and 1-2 hours in the evening/night (see Figure 31). However, because of poor insulation in most of the surveyed houses, this heat is lost very quickly after the heating is turned off. To compensate, most households light an open fire or a stove in the living room or kitchen during the evening until they retire to sleep. Biomass used for this purpose is often a combination of wood and coal, but it sometimes contains also turf and wood chips or pellets. Figure 32 shows a photo of wood and coal for sale at a local city store. Households that do not have open fires often use electric stoves that they turn on and off continually to regulate the room temperature (Figure 33).

Figure 30: Main heating sources participating households in Ireland

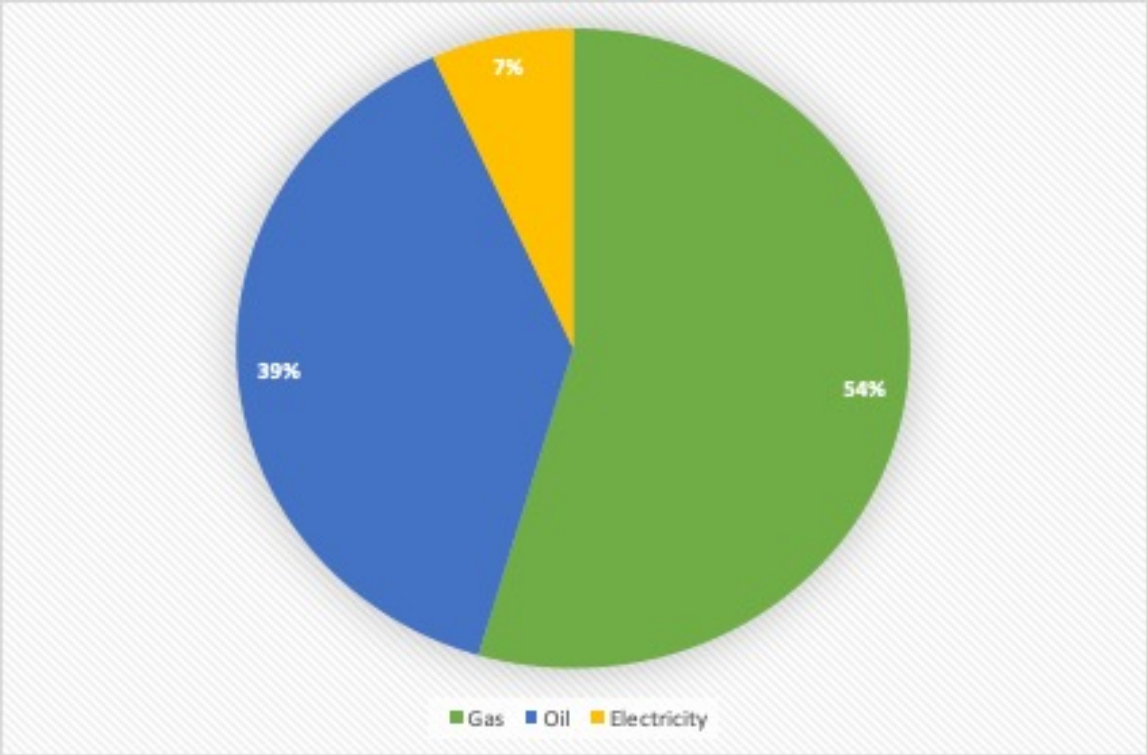


Figure 31: Number of hours that each heating source is used during the day (Ireland)

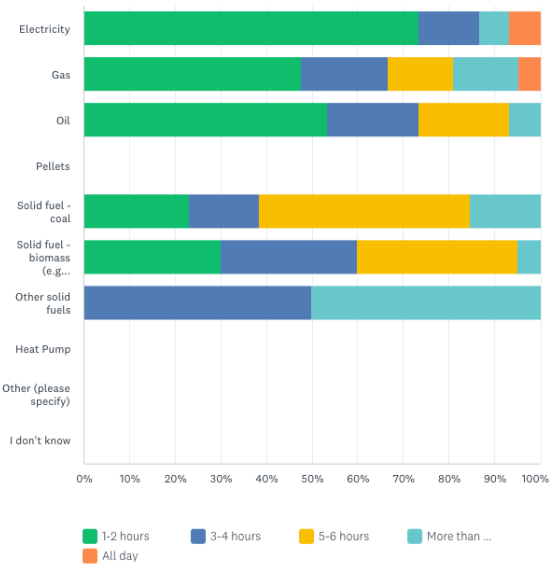
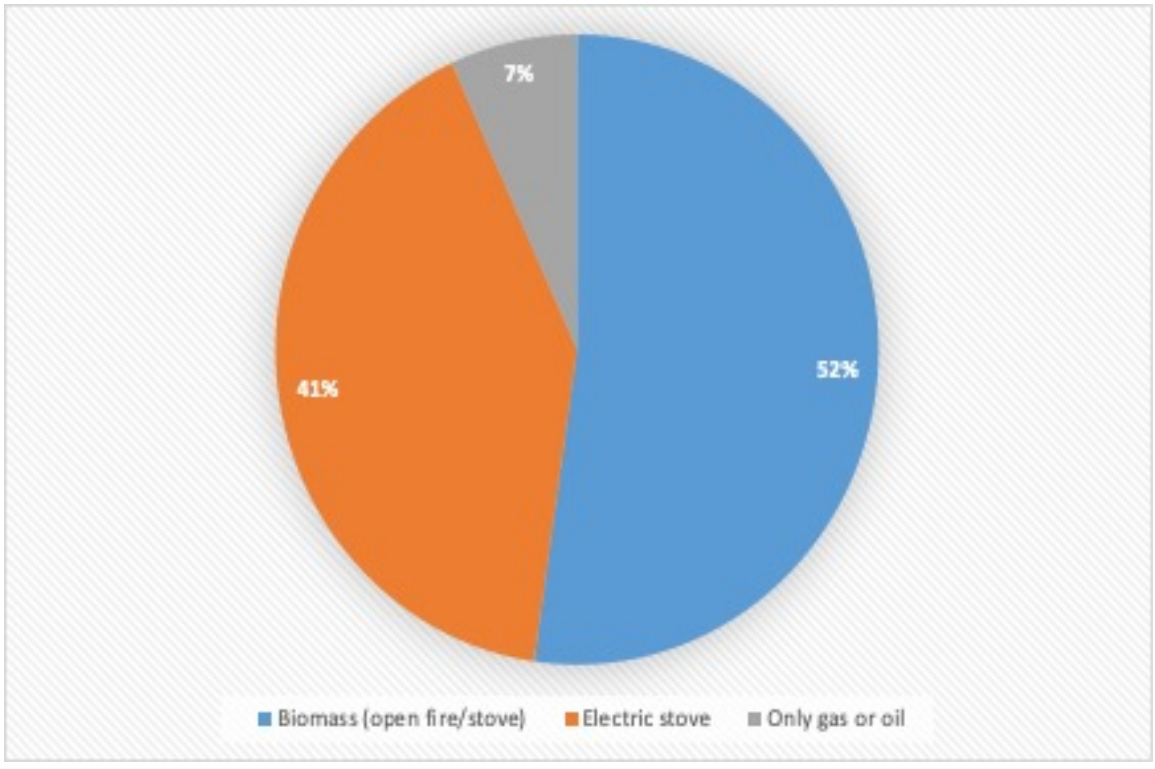


Figure 32: Coal and wood are sold at a local store in Cork City

Figure 33: Secondary heating sources to compensate for heat loss in Ireland



Cost of heating with gas vary between €80 and €382 every two months during the winter, with an average household spending €220. Surveyed households using oil for heating usually fill their tanks one or two times a year, with refills of 500 litres at a time that have a cost that fluctuates between €585 and €840 per fill.

The main challenges experienced by households participating in the project are mould and dampness (Figure 34) in rooms, in addition to wooden and aluminium frames that have been installed more than 100 years ago and generate drafts in the house (Figure 35).

And in Dublin many households are on pre-payment meters, which is a scheme that is usually offered to bill payers with a poor credit. However, this is worrying since the cost per unit through such meters has historically been higher than if paid for by other means (Hills, 2011). In addition, a high percentage of households have never switched suppliers. As a result, Energy Action is helping householders to switch suppliers, which has been appreciated by programme participants.

Figure 34: Examples of mould and dampness in dwellings (Cork City)

Figure 35: Examples of wooden and aluminium windows in dwellings (Cork City)

5.4 Looking forward

Householders participating in the project are requested to gather all their energy bills and receipts from the point of the first household visitation so that these can these collected periodically during the rest of the duration of the project. These contacts will be scheduled at roughly equal intervals over the remaining life of the project.

During these contacts, energy advisor will talk the householders through their experience of the low-cost measures and of implementing changes in their energy-related behaviours – collecting feedback from the participants, providing advice and guidance where possible, and redirecting for support if appropriate. Assistance will be also provided where needed in choosing appliances, reading energy bills, switching energy providers, and accessing grants. In addition to these direct household contact, there will be regular text alerts, email bulletins and social media updates, and incentives such as energy saving appliances will be provided through a lottery to keep people engaged.

The recruitment and data collection process has been an important challenge for the Irish partners. Sanitary measures related to Covid-19 continued until February. Soon after this date and following the increases of prices of oil and gas due to the Russia-Ukraine war, recruitment rates have started to ramp up. However, as we approach the warmer season, recruitment levels have started to stagnate, and therefore new recruitment strategies need to be outlined so that household targets are met before the end of the year.

Another important challenge are existing gaps in the data *e.g.*, many of the householders engaged belong to the group of elderly people living in single-family, owner-occupied houses who often do not have online access to their energy bills[5]. Moreover, many energy suppliers are going out of business, meaning that such information is no longer available. To resolve such issues, the Irish partners are engaging with the distribution system operators to explore means of participants' accessing their consumption data through the DSO systems. In the meantime, energy advisors have had to rely on estimations of energy use where they are data gaps including of course in the case of *ad-hoc* fuels (e.g., litres of oil and bags of coal purchased)

Overall, a number of engaged householders are already starting to communicate decreases in their energy use and improvement in their comfort, which shows that the interventions of small measures along with bespoke energy advice based on behavioural has started to show an impact.

[5] In these cases, where possible energy advisors are working with householders to get them access to this data.

6 The Netherlands

6.1 Country profile and the lived experience

6.1.1 Energy poverty in the Netherlands

In the Netherlands, approximately 550,000 households live in energy poverty (out of a total of 8 million households). They spend more than 10% of their disposable income per month on paying the energy bill or have too little left after paying the necessary expenses to get by. For Eindhoven, it is calculated that approximately 14,000 (out of a total of 122,000) households live in energy poverty. This number puts Eindhoven in fifth place nationwide, with only other big cities such as Amsterdam and Rotterdam with higher numbers of energy poverty. In Eindhoven, approximately 11,500 households are counted as having minimal means. The problem with energy poverty thus goes beyond the households that are known and already receive a form of (financial) support from the municipality (Mulder *et al.* 2021).

Figure 36: Distribution of energy poverty by municipality (left) and district (right) (Mulder et al. 2021 p.7)

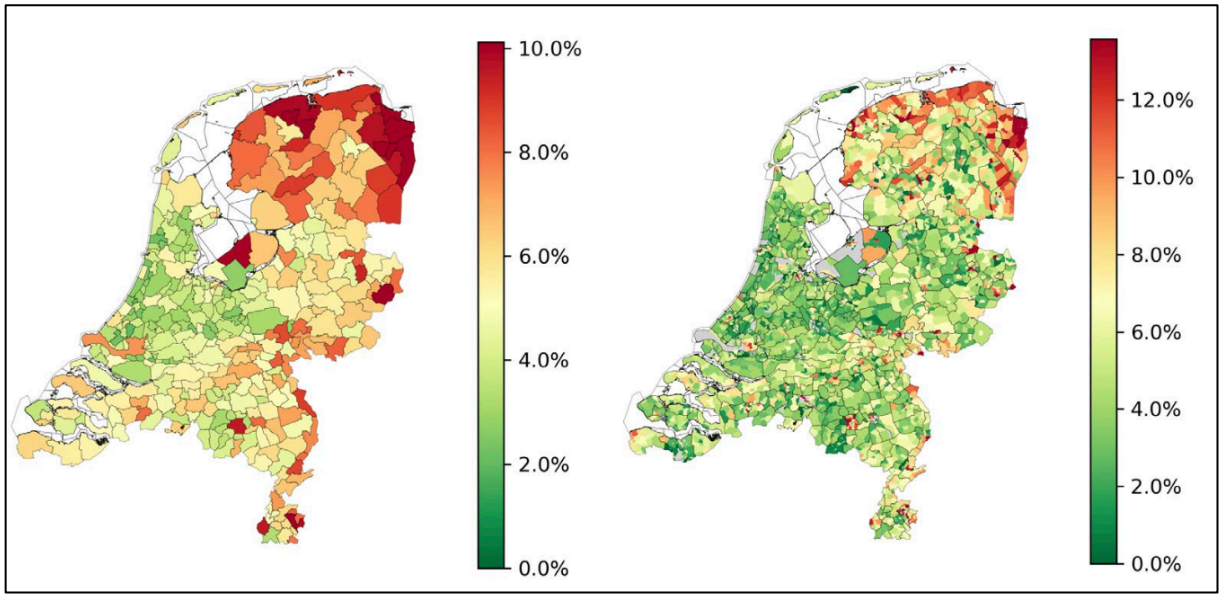
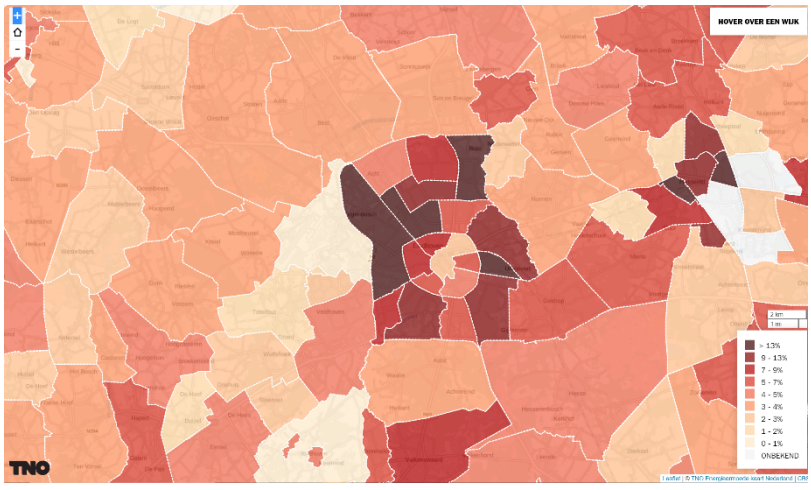


Figure 37: Energy poverty distirbution in Eindhoven (derived from TNO (undated) interactive energy poverty map)



6.1.2 *Energy sources in the Netherlands*

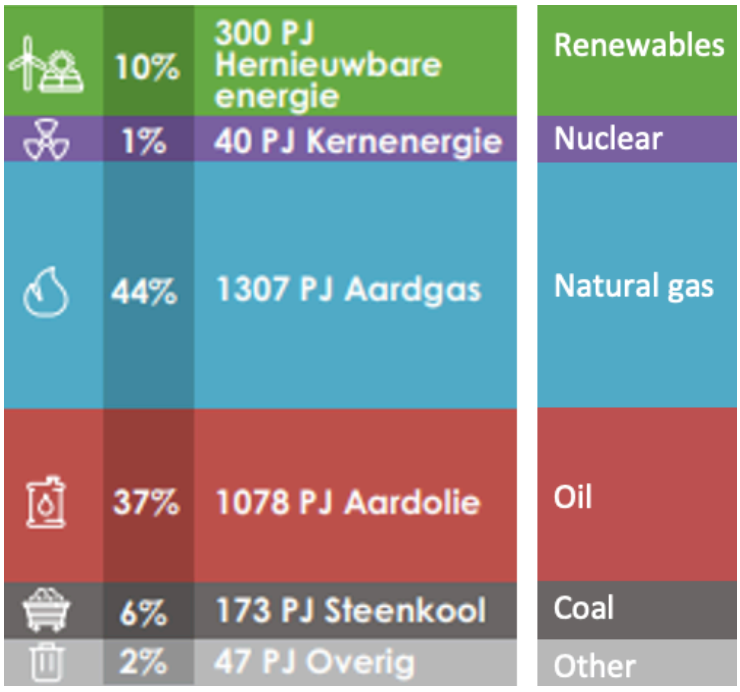
The Netherlands mainly uses natural gas and oil. Only a small part of the energy used comes from other sources such as coal, nuclear energy or sustainably generated energy. In the 1950s, the largest natural gas field in the world was discovered in the north of the country, in the province of Groningen. This led to an extensive network of natural gas pipelines throughout the country. Natural gas also became an important export product for the Netherlands. Private households still use natural gas almost exclusively to heat their houses, 95% of Dutch houses Netherlands are connected to the gas network.

The problem with natural gas in the Netherlands is that its extraction causes earthquakes that cause considerable damage to homes and buildings in the province. That is why the Dutch government has decided to phase out the extraction of natural gas. Less natural gas may be extracted every year and the plan is to completely stop extracting natural gas by 2030. The problem, however, is that the Netherlands is now buying additional natural gas from other countries, especially from Russia. In view of the geopolitical situation, this is not desirable and there is talk of increasing the quota for gas extraction in Groningen after all.

Petroleum is extracted in three places in the Netherlands. However, most of the petroleum used in the Netherlands is imported via the port of Rotterdam. This oil comes mainly from Russia, Norway, Saudi Arabia, and some other small oil-producing countries. The oil goes to oil refineries and is mainly used in industry. Private households do nothing with petroleum.

It goes without saying that the Netherlands is also taking steps towards generating sustainable energy. The focus is on wind and solar energy and energy generated during the processing of biomass. In time, in 2050, the Netherlands will say goodbye to natural gas and all energy used will come from renewable sources. In 2021 12.5% of the total energy consumption was generated sustainably

Figure 38: Energy by source, Netherlands (Adapted from EBN B.V. 2022)



6.1.3 Major energy related challenges

As described above, the extraction of natural gas in the Netherlands has led to earthquakes in the extraction area. To prevent this issue, for the last number of years less gas has been extracted and gas has been imported. The plan is to phase out the extraction of natural gas step-by-step, partly to be less dependent on imported gas. In time, it is planned that the Netherlands will generate all the necessary energy itself via renewable sources. Natural gas is mainly imported from Russia. However, the war in Ukraine has changed the situation and the Netherlands no longer wants (and may not be able) to import natural gas from Russia. However, the Netherlands is highly dependent on natural gas. Major problems and further price increases are expected for the autumn of 2022 and beyond. After all, we are not sure of supplying enough gas and the costs will be enormous.

At present, 12.5% of the energy used in the Netherlands is sustainably generated. The targets are for this to be 49% in 2030 and 100% in 2050. To achieve this, major adjustments are needed to the energy infrastructure. For example, all homes in the Netherlands must be disconnected from natural gas by 2050. These adjustments cost a lot of time and money. In addition, support for this energy transition is not equally high among all Dutch people. The war in Ukraine and rising energy bills have created a new kind of energy consciousness. A recent survey by Het PON & Telos (to be published by July 2022) shows that 57% of the inhabitants of the province of Brabant consider it a problem that the natural gas they use comes from Russia. This was 33% in 2020. The subject of energy poverty is also on the political agendas of municipalities and national politics.

6.2 Number of households recruited, Netherlands (April 2022)

In Eindhoven, the target group within the EnergyMeasures project consists of households with a narrow budget. These are different groups who have difficulty financially to pay for the fixed housing costs and / or who have insufficient budget left for other necessary expenses such as food, clothing, etc. after they have paid their energy bills. There will be a cooperation with various parties and networks and, where possible, we will link up on current processes.

Table 5: Households recruited to date (Eindhoven, April 2022).

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021				25	25
2022	75	100	-	-	175
					200

Table 6: Estimated household engagement numbers adjusted to Covid-19 (Eindhoven Revised targets May 2022).

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021				25	25
2022	75	100	150	150	475
2023	-	-	-	-	-
					500

6.2.1 Approach and recruitment of households

Communication strategy

The Municipality of Eindhoven has taken the lead in the communication strategy. At the start of the project, we have identified three different approaches:

- Conventional media: press releases, newspaper articles in local newspapers (Eindhovens Dagblad or neighbourhood newspaper), newsletters from (neighbourhood) partners, information signs, *etc*.
- Social Media: the websites of the Municipality of the Eindhoven, Energiebox, and the project. At a later stage a Facebook group and possibly also Whatsapp groups, *etc.* will be developed. When appropriate, we will look for cooperation with other partners within and the municipality (*e.g.,* other departments, housing corporations *etc*.).
- Direct personal contact with households and communities: this can mean very targeted door-to-door contact; or approach residents in a targeted manner at certain meetings organised from other routes/trajectories.

We have initiated actions in all three approaches, in order to kickstart the recruitment.

- We have designed (in cooperation with Energiebox) a local identity including flyer, poster, an information package for professionals working in the field and a press kit with several pre-made images for usage on different social media as Facebook, Twitter and Instagram.
- We have had press coverage of the project in the local newspaper and in newsletters.
- We have created a special page on the municipality's page about the project and we have created a special landing page on the Energiebox' website for the project where people can directly apply.
- We have targeted directly via the Voedselbank (the food bank), via the social institutions and network partners, via the social housing corporations, via Energiebox and via different religious and non-religious NGO's active in the city.

Recruitment of households

The Municipality of Eindhoven has initiated various parallel recruitment processes to increase the odds of recruiting enough households (who meet the criteria, which largely consist of social tenants but also possibly include private residents). Due to the possibility of dropout among participants at the start but also during the course (for various reasons), 500 households are being targeted. We have connected the EnergyMeasures project to existing projects and processes as much as possible. As energy poverty is a complex problem, we believe that it also deserves a cross-sectoral approach. The partners who work with the households also know the best way to reach out to the target group and which approaches and methods of communication work best. It has resulted in the following actions:

- Cooperation with Werkplaats Financiën XL. This is an NGO that provides free guidance and financial advice to habitants of Eindhoven.
- Cooperation with WIJEindhoven. This is an NGO that provides social work to all habitants of Eindhoven and they work with around 100,000 clients each year.

- The project is a regular agenda item on the meeting of the energy poverty workgroup between the municipality and the four housing corporations. The housing corporations have shared the project on social media and by flyer with their tenants (40,141 households in total).
- Recruited households in a targeted manner via flyering at the food bank. The alderman of Climate and Energy personally assisted.
- Recruited households by adding the project to a letter sent out to 6,500 households with a minimum income, in cooperation with the Social Domain of the municipality.
- Recruited eligible households through referrals from the regular Energiebox iniative.
- Presented the project to various religious organisations, 25 in total, to share the project with households they work with.
- Presented the project to the NGO Ik Wil, who is active in Woensel West. That is an area with high numbers of energy poverty. Even though the NGO itself does not work with energy related matters, it has contact with households who could be eligible for the project.
- Presented the project to the NGO Sociale Raadslieden, who provide administrative support.
- Presented the project to the NGO Vluchtelingenwerk, who work with refugees.
- Presented the project to the NGO Jonge Moeders, who work with young single mothers.

COVID-19 made it impossible for almost the whole of 2021 to hold in person meetings. That means that all presentations of the project in order to start recruitment have been done digitally. Working directly with the target group has been possible since 15 February 2022, as at that date allowing visitors at home became possible again. The opening up of society in the Spring of 2022, has made a huge impact on the recruitment and engagement numbers.

In Eindhoven, the Municipality of Eindhoven works closely with Energiebox, an NGO that allows energy coaches to visit households for a one-off conversation about energy consumption and provide some small energy savings products. While this initiative is available to all households and is not as intensive an engagement as that envisaged in EnergyMeasures, it is complementary to the work of the project, and as mentioned above has proved a source of referrals. We have leveraged the history and recognition factor of this initiative by positioning the EnergyMeasures project in Eindhoven as 'Energiebox Plus'. The Eindhoven tailored approach is that trained energy coaches enter into a trajectory for a year with a household that is dealing with energy poverty (or that is at risk of getting into trouble). They do not visit just once but keep in touch with the household on a regular basis. If there are any questions about the energy bill or energy consumption, the coach can answer them immediately. But also, if there are other issues within a household (loneliness, debts, problems with raising the children), the energy coach can put the household in touch with the right organizations. The aim is for the household to regain control of its energy bill after a year of supervision, to have more insight into how energy can be saved and, if necessary, to be referred to the right social institution. We hope this will contribute to the resilience of vulnerable households. The goal for Eindhoven is to engage 400 households. By the end of April 2022, we have reached 200 households.

6.2.2 *Characterisation of the dwellings*

If we zoom in on the group of households in Eindhoven that have a higher chance of experiencing energy poverty, we see that these households more often rent through a housing association, they more often live in a house built before 1969 (with an energy label of lower than D) and are most often in the lowest income groups. We also see a higher preponderance of energy poverty amongst households comprising single people or single-parent families.

The three figures below present examples of social housing (unrenovated) in different parts of the city outlining the street layout and exterior structure of the homes. These are typical of the households being recruited in Eindhoven.

Figure 39: Example #1 of social housing (layout & structure) in Eindhoven

Figure 40: Example #2 of social housing (layout & structure) in Eindhoven

Figure 41: Example #3 of social housing (layout & structure) in Eindhoven

The dwellings recruited in these are share a number of characteristics include, *e.g.,* single pane glass windows, lack of ventilation in bathrooms, non-insulated brick walls, old wooden door and window frames, most of the times with wood rot causing drafts in the house (see figures below).

Figure 42: Example of draughty door & window fittings

Figure 43: Example of window used for bathroom venting

6.3 Establishing a baseline

Because 95% of households are connected to the natural gas network, almost all households have to deal with both electricity and gas suppliers. The energy market has been 'released' in the Netherlands. Households can choose from which supplier they purchase their energy. There are different types of contracts, all of which have their own terms and conditions. What every energy supplier in the Netherlands has in common is that they offer their customers online insight into the historical energy consumption of the household. In the Netherlands, you can switch from one energy supplier to another every year (at the end of the year). If a household stays with an energy supplier for a number of years as a customer, it is possible to view historical overviews. In such cases the project will have access to this data through the residents; however, it is not possible for the project to request this data from suppliers. Everyone has the opportunity to log in to the website of their own energy supplier to view

their own Consumption data is available online on an annual, monthly, weekly daily basis in both unit (kWh) and cost (€) terms. Many households will not have created an account to access this data before engaging with the project energy coaches who talk then through the process. To create a baseline, we record the meter readings (in both gas and electricity consumption) at the start of the process. This is our starting point. By doing this again at the end of the process, we can see how much has been used. We can then compare this with old data for a large proportion of households (those who did not switch to another supplier in the past year).

6.3.1 Use of electricity

The average Dutch household is estimated to use on a yearly basis 2,479 kWh of electricity. There is no estimate possible about the costs of this use for the average household as the prices went up enormously in the last months. Currently, contracts for a longer period of time and with fixed prizes are not being offered. In 2021 the average household would pay €1,100 for gas and €430 for electricity. At the time of writing, prices start at €2,300 for gas and €1,330 for electricity and are expected to go further up (source: www.milieucentraal.nl).

6.3.2 Heating

In the Netherlands, approximately 95% of homes are connected to the natural gas network (CBS 2019). A Dutch household consumes about 1,200 m^3 natural gas per year. Most of this consumption, 75%, is used to heat the home. The rest is used for showering/use of hot water (20%) and for cooking (5%). With the envisaged move away from natural gas, the intention homes will be heated electrically – necessitating significant investment is expected from homeowners and housing. This will post a huge challenge for the energy vulnerable who simply do not have the available resources.

Most heating of the home is done in the morning and evening, however the pandemic forced all except essential workers to stay in their home – which also meant heating over the course of the day. As working from home is here to stay for many people, we expect to see more households where the house and / or specific rooms are heated all day long.

6.4 Looking Forward

The participants in the project are asked for the historical overview for every household – many of the times, these statements can be easily downloaded from the energy supplier. Additional to the historical overview, the project works with the Earn-E – a real time meter of the energy consumption. When someone puts the kettle on, for example, the meter starts running and the user can see on his phone how much energy that costs and what the cost is. There is a specific dashboard where the data of all participants with an Earn-E (who have given permission) can be found. So, we could see the group savings in kWh for the participants using the Earn-E. There are 200 of these meters available for participants. The participants will be asked to keep in touch with the energy coaches, either by phone, email, WhatsApp or by in person visits. Depending on their needs, the coaches will provide tips and

advice or help with the installation of small measures. Additionally, the participants are asked to participate in surveys and questionnaires.

Due to the war in Ukraine, the prices for natural gas are rising and likely to continue doing so. It means that currently (May 2022) no fixed price contracts are being offered, with all new contracts variable pricing. Initial calculations indicate that for 60-70% of the households in The Netherlands the energy bill will increase threefold.

Even though energy poverty is a relatively new concept in the Netherlands, stakeholder interviews from activities in work packages one (Breukers *et al.*, 2021) [6] show that there is a growing awareness among social housing corporations and the government of the problems resulting from a combination of inefficient buildings (due to age, overdue maintenance), high energy costs and limited financial resources. While there are several programs and schemes that target vulnerable households and energy efficiency improvements, none specifically target energy poverty.

Being dependent on the social housing association and others (for example when people are under financial supervision) increases the feeling of lack of control in those households. According to the interviews with stakeholder organisations, energy-poor households mainly need information and money. Most households do not know what their options are, what types of subsidies they can apply for and how they can reduce their energy bills (Breukers *et al.*, 2021).

[6] Breukers, S., van Duren, M., Young, J., van de Ven, D., Boekelo, M. (2021). *Citizen views on policy needs for energy poverty alleviation*. EnergyMeasures H2020 Project Deliverable 1.3. https://doi.org/10.5281/zenodo.6869444

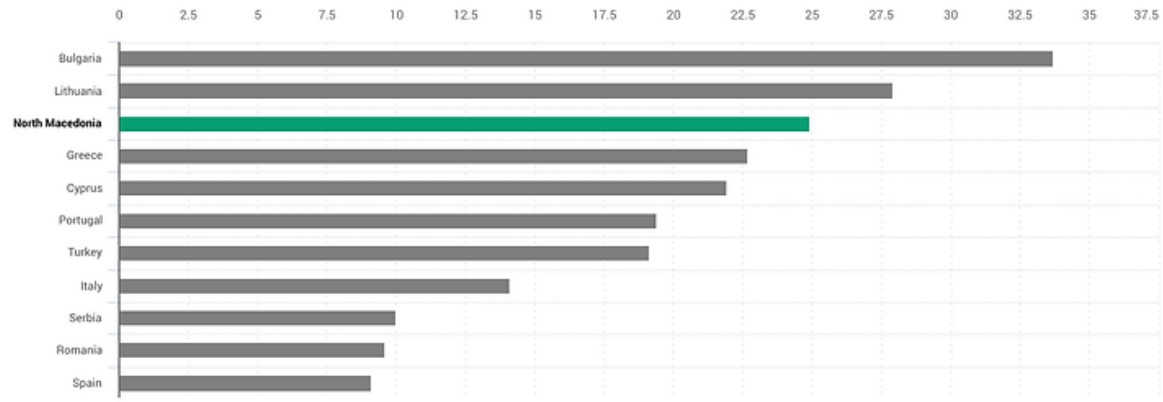
7 North Macedonia

7.1 Country profile and the lived experience

7.1.1 Energy poverty in North Macedonia

The combination of high poverty and unemployment rates; outdated and inefficient heating systems; low energy performance of buildings and appliances; and (relatively) high energy prices means that energy poverty is widespread among North Macedonian households. Energy expenditures take a (increasingly) high share of already low-income levels. It is estimated that 35% of Macedonian households had difficulties in paying their energy bills, while nearly one-quarter of households reported being unable to keep their home adequately warm, one of the highest in Europe as shown in Figure 44 below (Farrugia 2022). Stojilovska *et al.* (2021) observe that the country has '*a weak social protection system with a low net social welfare and strict criteria for social welfare participants*'.

Figure 44: Proportion of the population unable to adequately warm (Eurostat data cited in Farrugia 2022)



For those heating their homes with electricity the most pressing problem is the disconnection from the grid – while others the suffer from include indoor and outdoor air pollution associated with burning solid fuels. Too often, households under-consume energy by reducing heating below comfort levels.

7.1.2 Energy Sources in North Macedonia

According to the Government of North Macedonia 36.5 percent of the energy is used by households, the industrial sector uses 26.6 percent of energy, and the rest is used by other sectors. In North Macedonia main sources of energy are gas, fuel oil, oil, electrical energy, and wood pellets. However, natural gas is not available for the Macedonian residential sector. Six out of ten households consume fuelwood as the primary energy source for heating (State Statistical Office 2015), with the country's forests and woods representing an affordable heating source for many. In North Macedonia, the Austrian owned electricity supply company has a monopoly position Approximately 70% of electricity if sourced from hydropower plants from artificial lakes with the rest is imported from other parts of Europe. A further *c.* 30% of households use electricity for heating in addition to their other needs.

7.1.3 Major Energy-Related Challenges

The reliance on wood for such a large proportion of heating requirements means that North Macedonia's forest ecosystems are heavily degraded, while Macedonian cities are known to be among the most polluted in Europe. Skopje for example has one of the highest PM_{10} concentrations according to the WHO list of 2600 European cities. In parallel, the annual CO_2 during 2000s reached 5.5 tonnes per capita, close to per capita levels of some industrially developed EU countries and higher than all other SEE countries. While the state has a small energy subsidy to combat energy poverty it is not substantial, and the threat of disconnection for the electricity grid is a real worry for many.

7.2 Number of households recruited, North Macedonia (April 2022)

By the end of April 2022, Habidom has reached over 120 households and 80 were eligible to join the project. The project description was sent to around 100 buildings (around 2,000 households) managed by Habidom explaining the goal of the project and requested interesting householders to contact the project. The next step is to telephone calls and door-to-door canvassing of households that Habidom manages in order to increase the number.

Table 7: Households engaged to date (Habidom as of April 2022)

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021			-	30	30
2022	50	-	-	-	50
					80

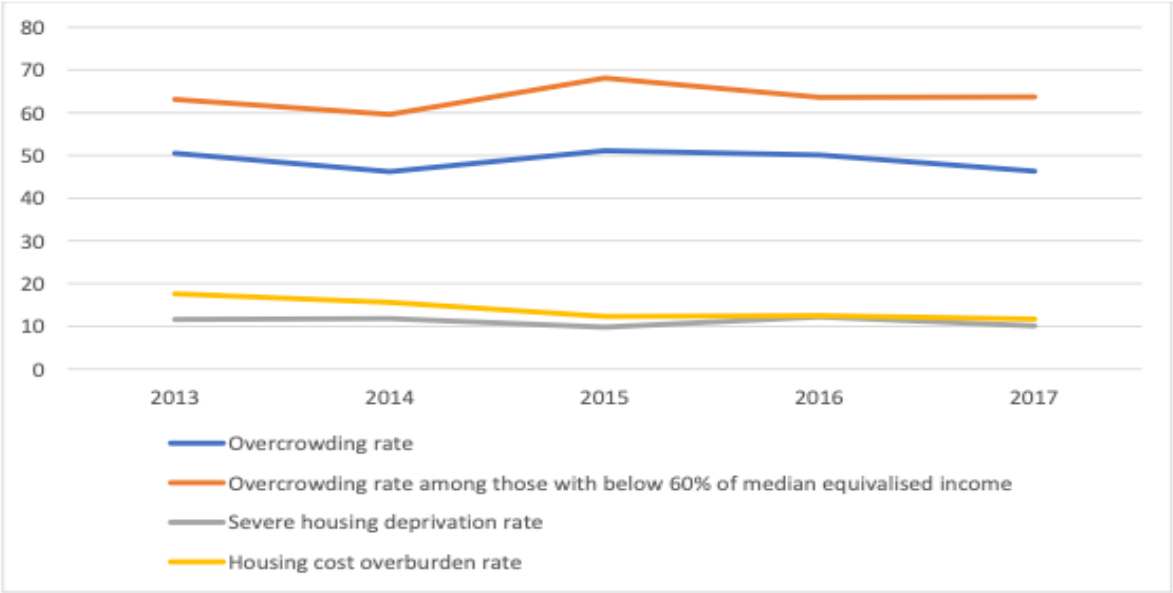
Table 8: Estimated household engagement numbers adjusted to Covid-19 (Habidom revised targets April 2022)

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021				30	30
2022	50	200	200	120	570
2023	0	-	-	-	-
					600

7.2.1 Characterisation of the dwellings

North Macedonia with a population of 2 million, has struggled to make '*significant social and economic progress during the past decades*' due to regional conflicts and its isolation from European integration process (Habitat for Humanity, undated). As a result, the poor quality of housing stock inherited from the communist era has shown little improvement. The economic context with high unemployment, emigration, and internal migration to cities has left many rural areas depopulated with abandoned housing stock, while there is an overcrowding in urban areas (*ibid.*) as illustrated in Figure 45 below.

Figure 45: Housing overcrowing in North Macedonia 2013-17 (Eurostat cited in Gerovska Mitev, 2019)



More than 57% of Macedonian population lives in urban areas, with more than 79% of them living in multi-family apartment buildings. Up to 82% of the entire housing stock in the country was created before 1991[7], most of which was built during the mass-urbanization period (1946-1989), characterised with heavily subsidised energy prices and use of low-cost, poor quality construction technology. Consequently, only 18% of the Macedonian households lived in dwellings with proper thermal insulation. In an apartment or house there can be living one up to three family generations. It is common in North Macedonia for children live together with their parents even when they get married and have their own children. Thermo insulation with Styrofoam is mostly used by buildings and houses. Mostly windows that are used are wooden windows and PVC energy efficient.

7.3 Establishing a baseline

7.3.1 Use of electricity

In North Macedonia, the electricity is supplied only by one supplier and that is EVN, an Austrian company. It has been a monopoly since its independence of the country in the year 1991. Each of the households in North Macedonia receives a monthly invoice from EVN where the cost is written as well as how much kWh is consumed. Once the bill for electricity is received from households, Habidom can go online and get the information from EVN's online platform for the past year.

Once the households provide us with electricity bill, we will be able to see the historical data for the past year (if the household provide us with the bill from July 2022, we can see the history until July 2021). For some of the households that will not be able to provide us with electricity bills, the estimation will be done – similar to someone that lives in the same building.

[7] At the time of the initiation of the activities of Habidom parent company, Habitat for Humanity Macedonia in 2009.

After receiving the electricity bills, a comparison can be done between apartments with the same m^2, the same number of family members and the same type of heating. If there is a significant difference in the electricity bills, advice can be shared with the household that spends more on how to make savings.

Surveyed households in North Macedonia consume between 250 and 450 kWh on average per month. The electrical use of a typical household is 600 kWh monthly during wintertime. The minimum cost paid by surveyed households is 26 Euros each month, and the maximum cost 163 Euros, with an average 65 Euros. Appliances that are used the most and spend a lot of electricity by households are boilers (heating water), air conditioning and stoves.

Raising the cost of electricity on daily basis is the main problem that the households are facing and are therefore trying to avoid using electricity whenever possible. Having only one energy supplier is the other concern that households face. If the cost of electricity rises, the households are obliged to pay it because cannot change suppliers and if not, they will be cut off.

7.3.2 Heating

With natural gas not being available for the Macedonian residential sector, out of the total number of households 61% consume fuelwood as the primary energy source for heating, with 29% using electricity and little over 8% relying on district heating systems. Around 60 % of the households from buildings managed by Habidom are connected to the district heating which is on fuel oil. Usually, the heat is turned on from 6am until 10am and from 5pm until 11pm. The minimum cost paid by surveyed household is €26 per month and the maximum €70. Households pays a fixed cost throughout the year, the cost is per m^2 and while it is not possible to calculate the consumption on an apartment-level basis, we are exploring how better use may be made of the available data.

7.4 Looking Forward

In order to reduce energy bills, Macedonian households often resort to diverse energy saving strategies, including using alternative heating sources (for example solid fuels), increasing energy consumption at night, and decreasing appliance, lighting usage, or the number of heated rooms. Alternatively, households can also invest in improved insulation or purchase more efficient appliances, which, however, may be too expensive for low-income households. These households additionally often have a low level of awareness of appropriate measures for reducing energy consumption.

Once Habidom receives an invoice for electricity from the engaged household, we will have the option online to see how much electricity will be spent in future and it can be compared to the beginning. Constant communication will be held with households in order to see the impact of installing the low-cost measures provided by Habidom. The use of energy in our country is more socially generalised, households use more electricity in periods when it is cheap, in the evening or on Sundays. For example, if possible, larger consumers (water heaters, washing machines and dishwashers, *etc*.) are included in that period.

8 Poland

8.1 Country profile and the lived experience

Energy poverty is a significant problem in Poland. Before the pandemic, it affected 12% of Poland's inhabitants. In 2020, this number increased to 21.4% – aggravated by job losses and falling wages, especially among people with low and middle incomes. In Poland, the share of expenditure on electricity, gas and other fuels as a proportion of total household expenditure is twice as high as the EU average.

The vast majority of people experiencing energy poverty live in single-family houses. In 2016, it was 75.4% of all energy poor, *i.e.,* 3.47 million people. This problem largely affects people living in rural areas and elderly people living alone.

Energy poverty mainly affects the inhabitants of houses built in the years 1946–1960 (51%). The reason may be the low energy efficiency of these buildings, *e.g.*, lack of thermal insulation or draughty windows.

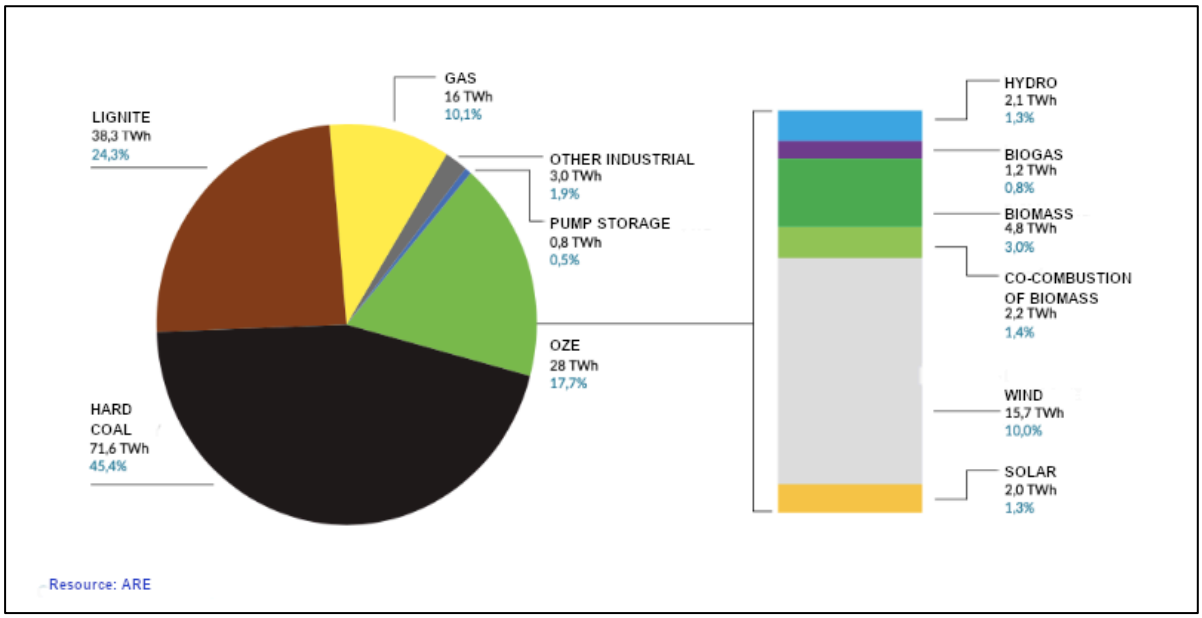
Figure 46: House built before 90s without thermomodernisation (Source: czysteogrzewanie.pl)

8.1.1 Energy Sources in Poland

The main energy source in Poland is coal. In 2020 it was mostly hard coal, with its share being 44.1%. Lignite came second with a share of 24.1 %. The total share of coal in electricity production was therefore 68.2%. Production from renewable energy sources accounted for 17.9 % and since 2014 it has increased by 5.4 percentage points. The most important carriers in the renewable group were wind energy, biomass and biogas. Solar energy had the smallest share, but it was characterised by the highest growth dynamics. In total, domestic electricity production amounted to 158 TWh and

decreased by 3.6% compared to 2019. It was the second consecutive year of decline in domestic production. It was the highest in 2017 and 2018, when it exceeded 170 TWh.

Figure 47: Share of energy sources In Poland (Source: ARE)



Households' energy consumption accounts for approx. 25% of the total final energy consumption in the country. The most important direction of energy use in the household sector is space heating, the share of which amounts to about 63%. Approximately 17% of energy is used for heating water, 11% for lighting and household appliances, and 9% for cooking meals.

According to the latest study by the Central Statistical Office on energy consumption in households, the most frequently used are solid fuels, mainly hard coal and fuel wood. These fuels are mostly used for space heating (45.4% of households). They were used also for water heating (25.6%), and much less for cooking (3.2%). District heat was used in 40.4% of all dwellings, mainly in cities where it was the predominating commodity (58.3%). Moreover 31.5% of households, *i.e.,* 78.2% of all district heating consumers, obtained heated water from the district installation. Natural gas was used in 55.7% of households, but more than half of consumers (51.9%) used it only for cooking, and only 14.0% for space heating. Such a consumption structure was the outcome of a long-lasting practice of installing gas networks in multi-family buildings only for cooking purposes. In those areas of the country which have no access to natural gas, the stationary use of LPG was more common (34.0%), though it was almost exclusively used for cooking (33.9%). Fuel wood was used by 29.9% of households. It was the only renewable energy commodity used by households on a large scale. It was usually burnt in the same boilers and stoves as hard coal, either together with coal or interchangeably. Apart from fuel wood, households also used other types of biomass, though they were far less common than wood. Solar collectors were used by one out of 52 households, and heat pumps by as few as one out of 200. Electricity was commonly used by households, mainly for lighting as well as electrical appliances and electronic devices. The use of electricity for heating purposes was insignificant (5.1%), due to high prices and the availability of cheaper substitutes. Electricity was used for cooking and space heating,

usually on a secondary basis, whereas its use for water heating was common mainly in those areas which did not have access to the heating or gas network.

8.2 Number of households recruited, Poland (April 2022)

The aim for Bielsko-Biala is to engage 400 households. By the end of April 2022, we have reached 250 households and the recruitment is still ongoing.

Table 9: Households engaged to date in Poland (April 2022).

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021			-	-	0
2022	140	115	-	-	255
					255

Table 10: Estimated household engagement numbers adjusted to Covid-19 (PNEC Revised targets April 2022).

Total of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021			-	-	0
2022	140	145	115	0	400
2023	0[8]	-	-	-	-
					400

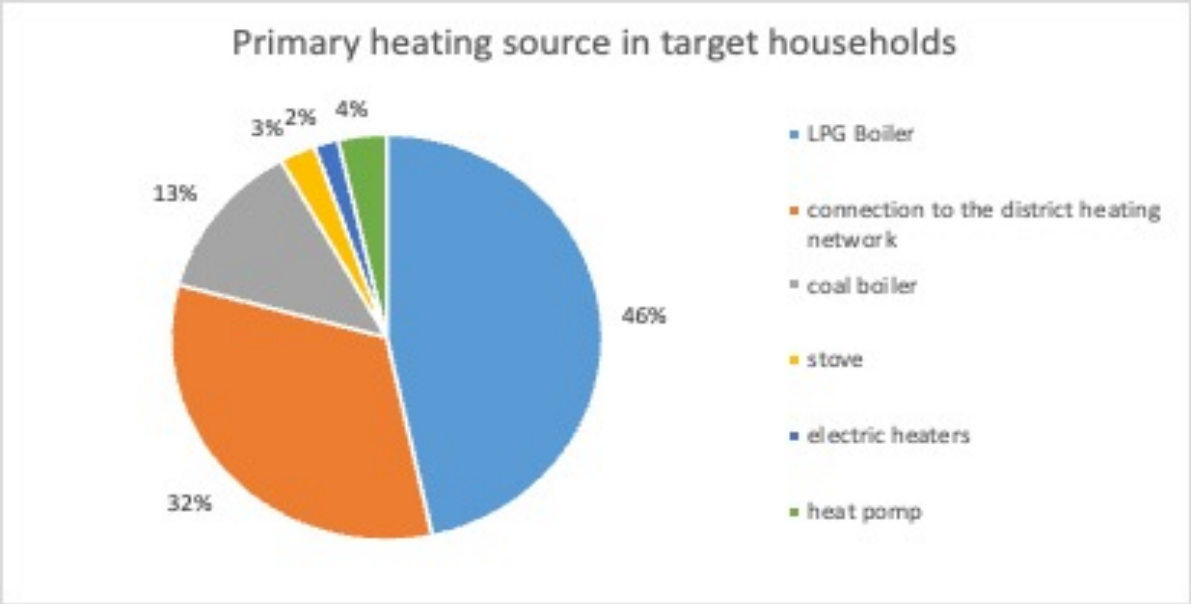
Due to the pandemic and the extensive 'lock-downs' and social restrictions imposed in Poland, it has not been possible to start engagement as it was originally planned. The dissemination was rescheduled and started at the end of 2021, when the circumstances has finally let us meet with respondents in person. The household recruitment and engagements were conducted in the city with the help of local administration, as well as local, public and social institutions. Further difficulties arose when the war in Ukraine began in the mid of February 2022. This resulted in a reduced involvement of local institutions in activities aimed at the residents due to the new challenges related to the emergence of immigrants, what caused next changes in the engagement plan.

8.2.1 Characterisation of the dwellings

The situation in Bielsko-Biała looks a bit different from the national picture, as the city started to work on energy efficiency already in the 90s. That caused a decrease in the consumption of coal. It is related, inter alia, with a change in the method of heating new facilities to gas, district heat and electricity, as well as to the application of high standards of energy efficiency of newly constructed facilities. We can see that progress also in the share distribution of heating sources in the target group in the project as shown in Figure 48.

[8] The target is to have the full complement of households recruited by month 24, with provision made for potential household dropouts with a small level of recruitment after month 24.

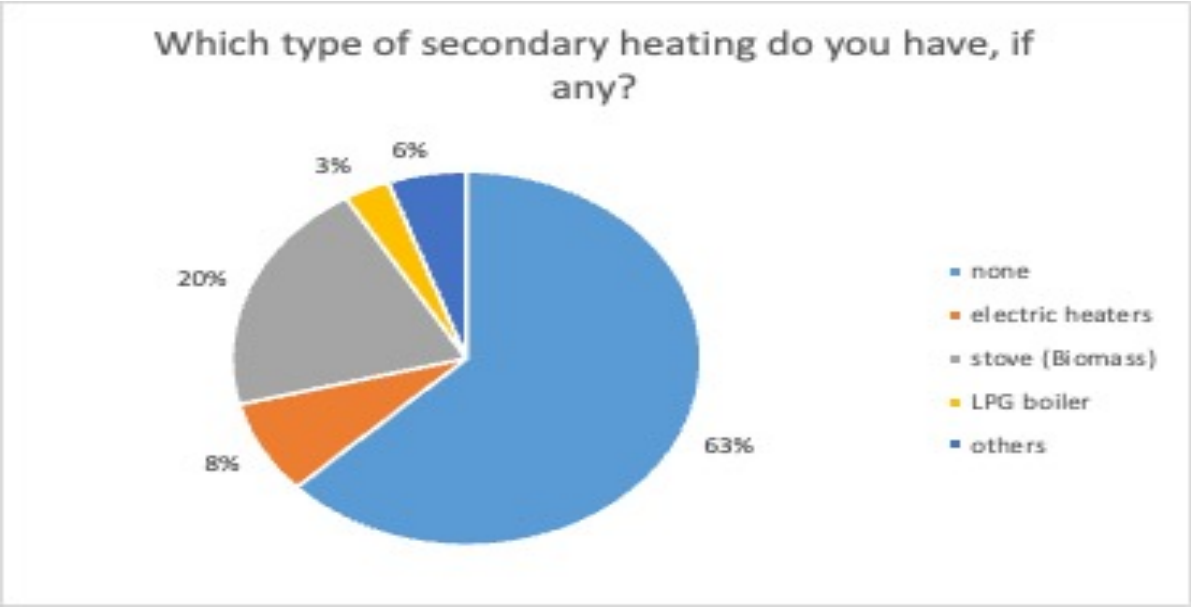
Figure 48: Share of primary heating source in interviewed households in Bielsko-Biała (April 2022)



Nearly half of households have an LPG boiler as the main heating source and one-third has a connection to a district heating network. Other sources aren't really popular in the households engaged. The large number using gas sources (the heating network also needs gas) may cause difficulties with payments for citizens in the close future, as the gas resources, supplies and especially prices are related to the situation in Ukraine.

Among the interviewed group, there are 43% of households which use additional heating source, see Figure 49 for details of secondary heating. The most popular option is to have a stove, which can be used occasionally. Some people (6%) use electric heaters (especially plug-in heaters). Free-standing cast iron stoves and even ovens were mentioned as others.

Figure 49: Secondary heating source in interviewed households in Bielsko-Biała (April 2022)

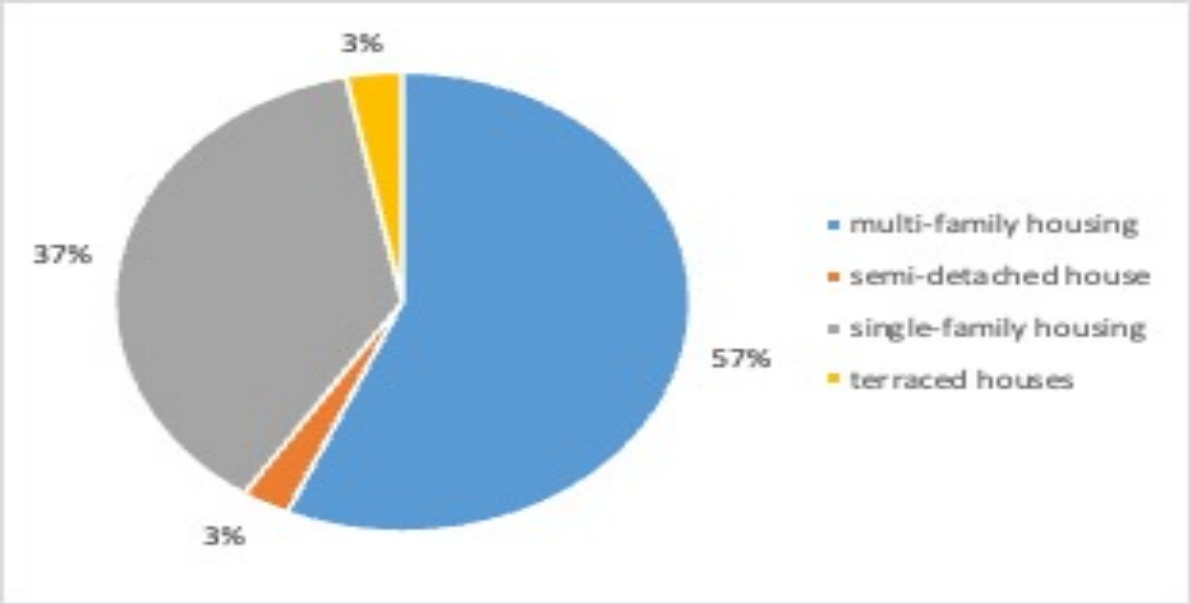


Thinking about energy poverty we need to consider also the general household situation. The age of buildings and type of property influence modernisation possibilities and necessity. To receive wider perspective, it is not only important to have knowledge about the heating source but also about the general challenges residents deal with every day in the buildings. There are approximately 73,000 households in Bielsko-Biala, which gives 430.9 flats per 1000 citizens (GUS, 2020). The average number of people in a household is 2.32. The average usable floor area is 69.8 m^2. Settlements vary greatly in terms of surface area and population density. Buildings from the post-war years have a normative standard, imposed on the construction industry during the socialist years. Objects vary from 5 to 11 storeys and were predominately built in large-panel technology. Single-family housing is varied, usually of a low architectural standard. The city area is divided into 30 housing estates, which constitute auxiliary units of the commune.

Figure 50: The different types of buildings in Bielsko-Biala

The housing stock is characterised by unfavourable age and technological structure - buildings built until 1945 dominate constituting over 73% of the total number of buildings. This age profile implies substantial renovation and modernization needs, (and not unrelatedly) significant maintenance costs. The municipality manages around 1,400 buildings across the city, of which only about 6% were built after 1970. The historic substance of Bielsko-Biala is primarily the Old Town and dispersed historic objects. Currently, the designated contractual boundaries of the Old Town cover the area of about 10 ha. The physical state of many buildings in that part of the city is very bad and they require major repairs.

Figure 51: The type of buildings inhabited by respondents



The respondents live in all types of housing. There is representative group of single-family buildings (37%) and a bit bigger group of multi-family housing (57%).

8.3 Establishing a baseline

The important part of the analysis is receiving data and making comparisons of energy use of different households. The district system operator and the main energy supplier in Bielsko-Biala is Tauron. Since 2007 inhabitants of Poland have a possibility to freely change the electricity supplier to a new, sometimes cheaper one. However, it is not a popular solution as it is (perceived to be) much easier to have a comprehensive agreement (electricity sales agreement + electricity supply agreement signed with one company that is both the DSO and the supplier). As receiving data directly from the company was impossible, the monitoring of energy invoices or expenses on energy is done together with participants. We record the information about energy consumption at the beginning – during the first meeting with the household. There is a possibility to give information about used energy for 2021 in kWh or, if the data are not available or the source of energy is different (*e.g.,* coal, oil) by sharing information about the expenses on energy. Then the converter to kWh – the set of conversion factors – is established and used to make the data comparable.

The aim is to gather energy bills and after a year of observation have more insight into how energy is used and how it can be conserved. We will compare baseline data with the future ones, monitoring the people who agree on sharing their data next year. All of them receive compact instruction how to regularly control their bills, so it should be possible to receive complex information. People consent to being contacted again for the purpose of collecting their energy-related data. It is assumed that about 80% of participants will provide the correct, binding information, but it will only be known after the data has been collected for some time. This process gives insight into the direction for improvement. It needs to be highlighted, however, that although energy savings are expected, the cost savings not necessarily due to rapidly increasing energy prices.

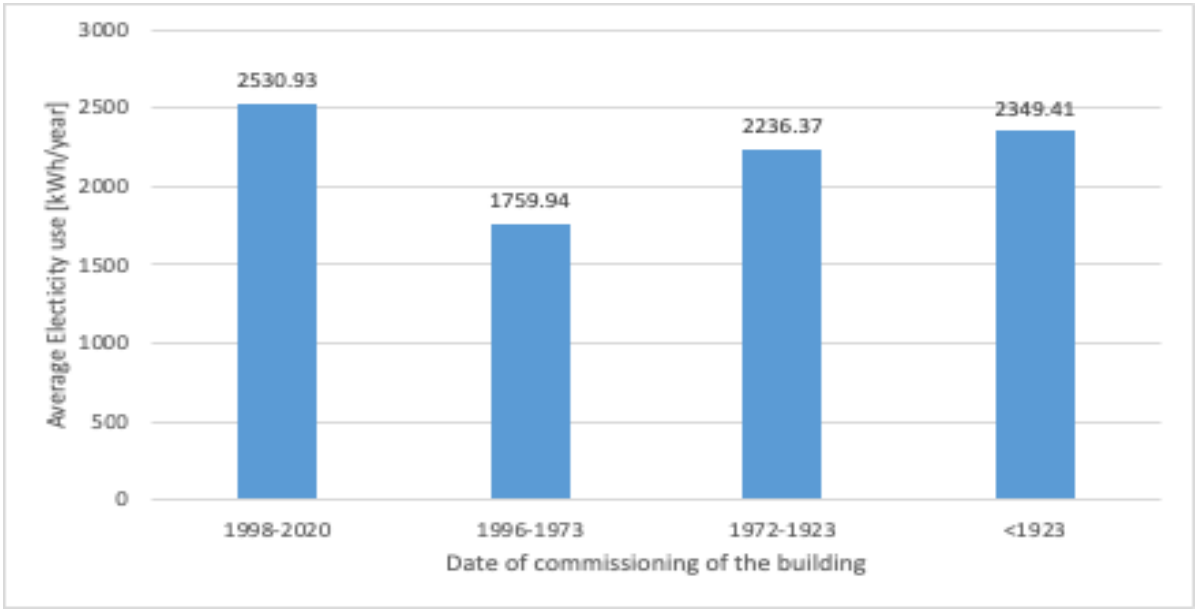
Electricity consumption for those households who joined to the project before April 2022 is presented as Table 11 below. Data in the table were calculated based on the electricity use declared by respondents and using average electricity price for Poland. The average price was determined as the mean of the tariffs: G11 – fixed electricity price for the whole day, G12 – electricity price differing depending on the hours of the day, and G12w – extended G12 covering different electricity prices on weekends and holidays.

Table 11: Statistical data concerning electricity use in interviewed households (based on data till April 2022)

Statistical data	Quantity [kWh/year]	Cost [PLN]
Minimum	112.00	175.00
Maximum	11,665.00	19,441.67
Average	1,999.59	3,635.61
Median	1,601.00	2,910.91

Figure 52 below shows a correlation between the age of buildings that the respondents live in and the electricity consumption. It can be assumed that the high electricity consumption in newer buildings is related with the use of larger number of electrical appliances, including house equipment, heat pumps, etc. The second highest electricity consumption has been recorded for buildings constructed before 1923 and can be mainly associated with the outdated and inefficient electricity installations and equipment.

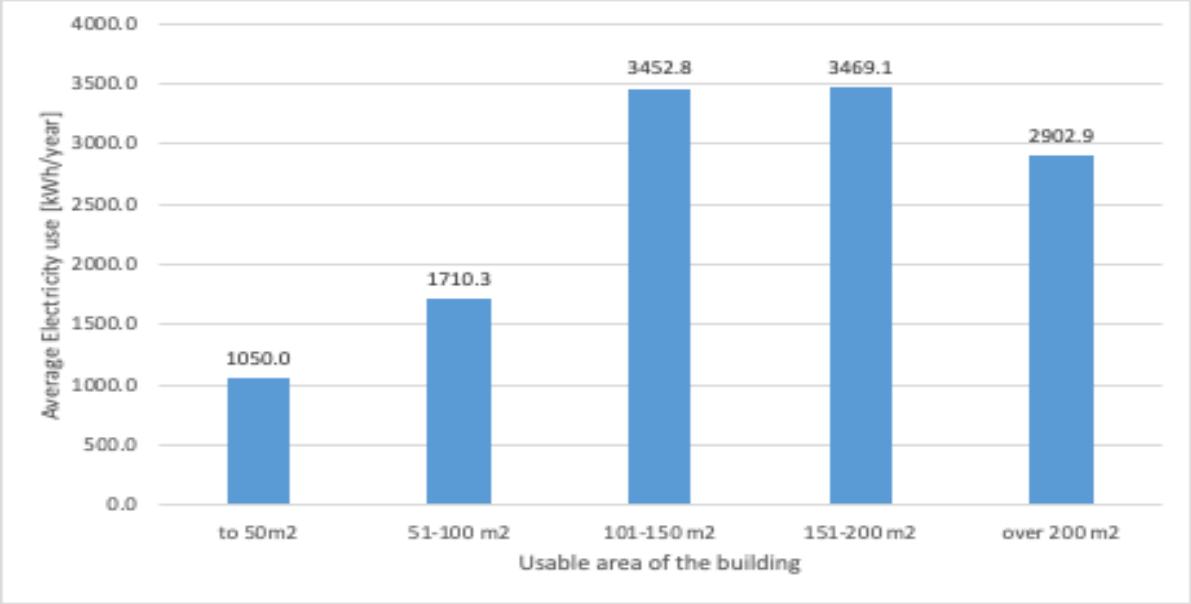
Figure 52: Correlation between the age of the buildings and the electricity consumption



There is a direct link between the usable area of the building and electricity demand as shown in Figure 53 below. The smaller value for buildings over 200 m^2 may result from the same number of high-

consumption rooms and equipment than in smaller buildings. This way the impact of those on the final energy use is more or less equal in both cases and hence the change in electricity use is small.

Figure 53: Correlation between the size of the buildings and the electricity consumption



The main challenge concerning electricity use highlighted by the respondent is their lack of knowledge of the possible incentives and subsidies supporting reduction of electricity consumption. The respondents also underlined that the electricity bills are unclear for them and thus they cannot verify them and determine in which areas they can reduce their electricity use properly.

8.3.1 Heating

Table 12 contains aggregated data showing heat consumption of households who joined the EnergyMeasures project. The overall heat consumption was calculated as the sum of district heating, coal, biomass and gas consumption, depending on the declared heating sources (see Figure 48 and Figure 49 on page 56).

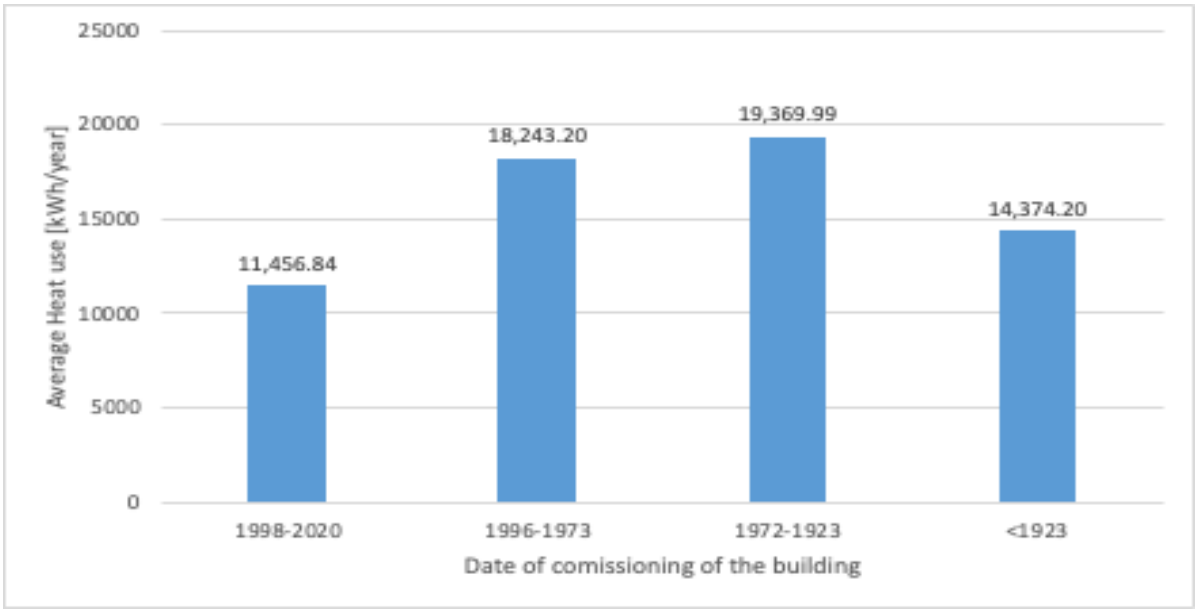
Table 12: Statistical measures for heat use (Polish households)

Statistical data	Quantity [kWh/year]	Cost [PLN]
Minimum	400.00	80.00
Maximum	121,850.00	32,735.00
Average	15,824.08	3,624.11
Median	15,000.00	3,344.14

Figure 54 below shows that the heat consumption in older building is generally higher compared to those commissioned later. The lowest use was noted for the buildings commissioned within the last

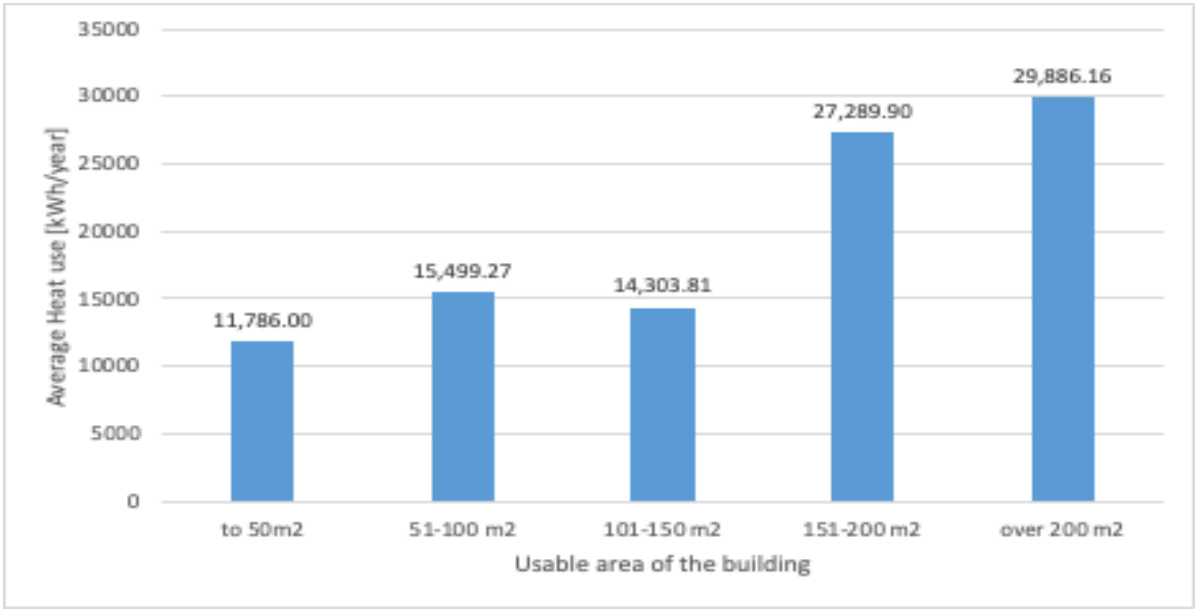
25 years. The highest use was noted for buildings commissioned 50 to 100 years ago and this might be due to the lack of proper insulation or listing those building as of historical value (their renovation requires special permissions).

Figure 54: Average heat consumption in the buildings according to building's age



When it comes to heat consumption, the bigger usable areas the building has, the higher the consumption as illustrated by Figure 55.

Figure 55: Average heat consumption in buildings according to the building's size



The main challenge highlighted by respondents was the will to use modern heating technologies, such as heat pumps, as well as to do the thermomodernisation but this requires significant amounts of money. The respondents mentioned that they need information about local and state incentives and subsidies related to the mentioned improvements.

8.4 Looking forward

The energy data collection from a household is made firstly by receiving data from the year before joining the project (baseline data) and secondly by monitoring the energy use within the year after the first house visit*, i.e.,* for the period between April 2022 and April 2023 (future data). All information is collected in a dedicated excel sheet and an electronic system.

To sum up, Polish strategy is to collect the following energy data:

1. **Baseline** = Historical data from yearly statements (April 2021-April 2022)
2. **Current** = Meter readings at the first house visit
3. **Future** = yearly statements on energy use at third contact, shared via telephone/email (period April 2022-April 2023)

During the second household visit, the household receives a full package of personalised information to make changes in energy behaviours and consumption. Householders are requested to gather their energy bills and receipts from the point of the first household visit so that these can be collected periodically during the rest of the project duration and summed up at the end of the project cycle.

The reliable way of data analysis will be to also take into consideration the tips given by the energy advisors to participants and to analyse what savings their implementation brings. Such analysis could provide the information about real effects of the project.

The volatile economic situation in the country causes unpredictability of energy prices. First, Covid caused a greater demand for energy in households, due to remote work and stopping the economy and companies for the long period. Then, the war in Ukraine caused unpredictable jumps in energy prices, as well as increased number of inhabitants (arrival of immigrants). That affects consumption and prices. To make a realistic assessment of energy savings, it is necessary to focus on reducing consumption in kWh, rather than trying to reduce bills and expanses. Thanks to this, it will be possible to evaluate the effects of undertaken actions.

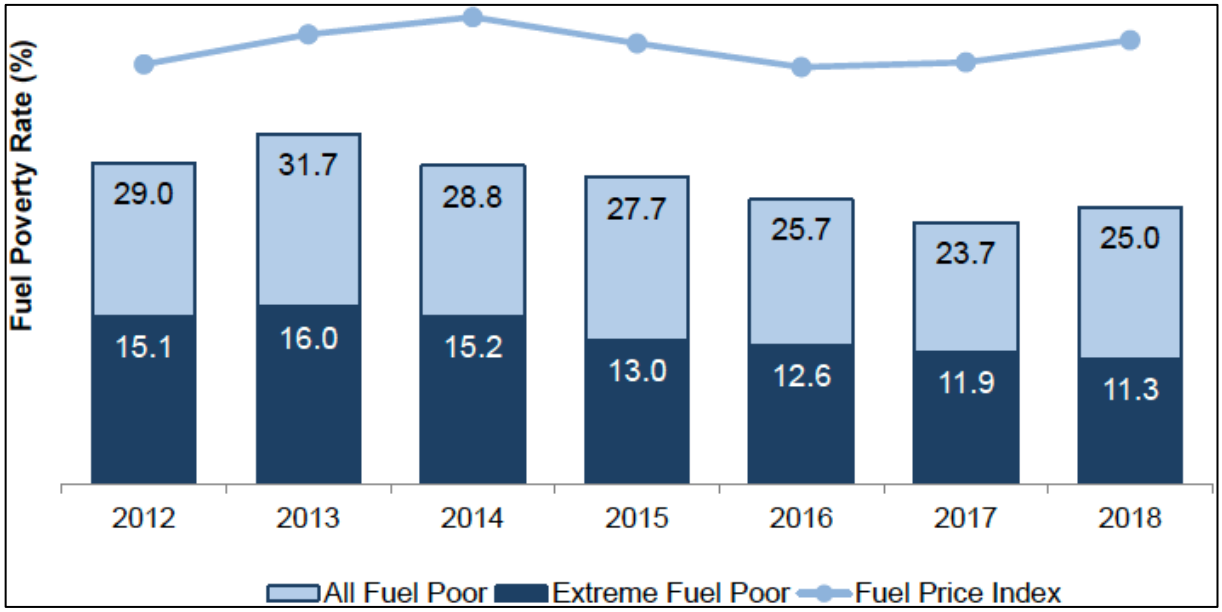
9 United Kingdom (Scotland)

9.1 Country profile and the lived experience

9.1.1 Energy poverty in Scotland

The Scottish House condition survey Key Findings 2018 report (2020) showed the fluctuation of energy (fuel) poverty levels in Scotland, as can be seen below.

Figure 56: Scottish house condition survey: 2018 key findings (Scottish Government, 2020)



The numbers for 2019 came in slightly lower overall, at an estimated 24.6%. Extreme fuel poverty increased to 12.4%. However, the more important development for remote rural (and island) Scotland saw fuel poverty levels increase from 33% (already significantly higher than cities and large towns) to 43%, with extreme fuel poverty rising from 23% to 33%. There are no Western Isles[9] only figures available as no survey is done islands wide each year.

Post 2019, data collection methods changed to reflect 'The Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act 2019'. This Act established the following fuel poverty targets for 2040:

- no more than 5% of households in Scotland are in fuel poverty.
- no more than 1% of households in Scotland are in extreme fuel poverty.
- the median fuel poverty gap of households in Scotland in fuel poverty is no more than GBP £250 adjusted to take account of changes in the value of money.

However, due to the nature of the Scottish House Condition Survey, *i.e.,* door to door review of house types and households, because of Covid it was deemed impossible to conduct such an exercise.

[9] The Western Isles (Scots Gaelic: *Na h-Eileanan Siar*) also known as The Outer Hebrides is an island chain off the west coast of mainland Scotland

9.1.2 *Energy sources in Scotland*

Energy efficiency, the impact of the economic cycles, prevalent energy price cost increases and weather patterns have all played a role in reducing overall energy consumption by over 24,000 GWh from 2005 to 2020.Provisional figures for 2020 show Scotland's final energy consumption was 14.4% below the 2005-07 baseline, a record low, and represents a 0.1% decrease in total energy consumption between 2019 and 2020. Scotland has met its energy consumption target (Scottish Government, undated). Energy consumption in the domestic sector is 44.2 TWh. This is a decrease of 16.1% from 2005-07, which may reflect improvements in energy efficiency in the domestic building stock in this time (Scottish Government, undated).

Figure 57: Scottish Energy consumption 2020 compared to 2005/07

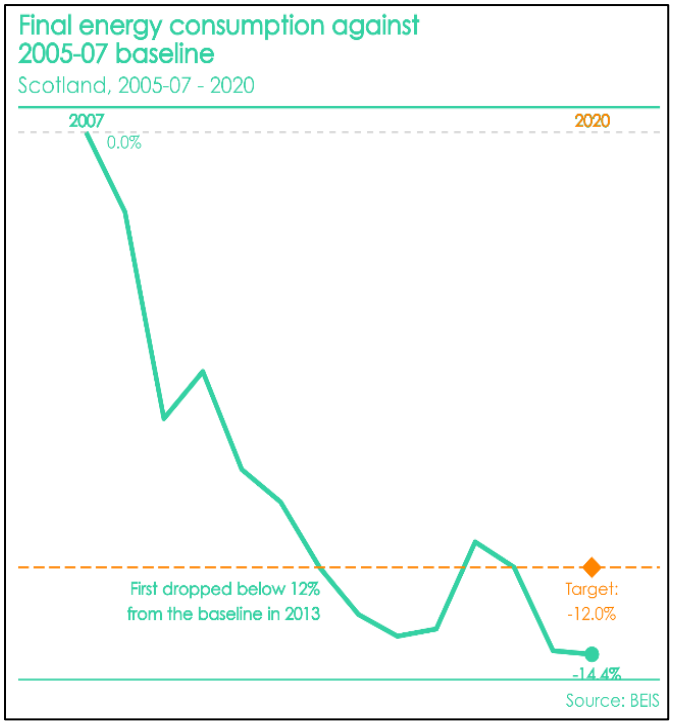


Figure 58: Total Installed capacity renewable electricity in Scotland (data from UK National Archives 2011; UK Government 2022)

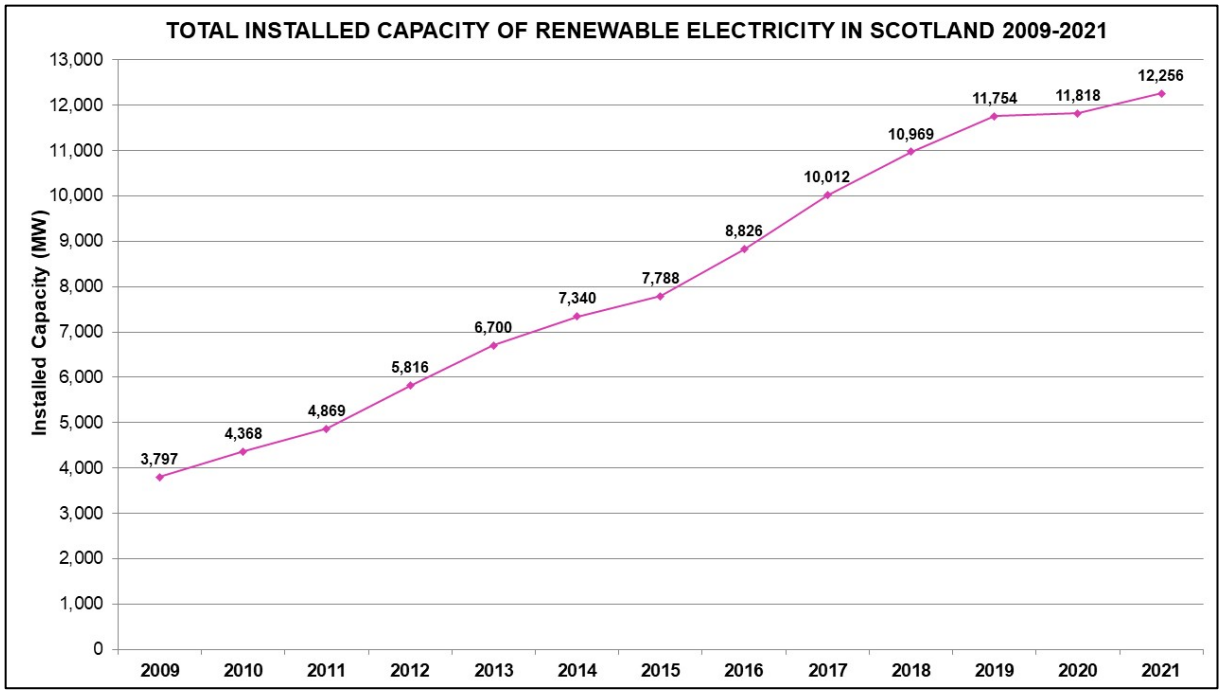
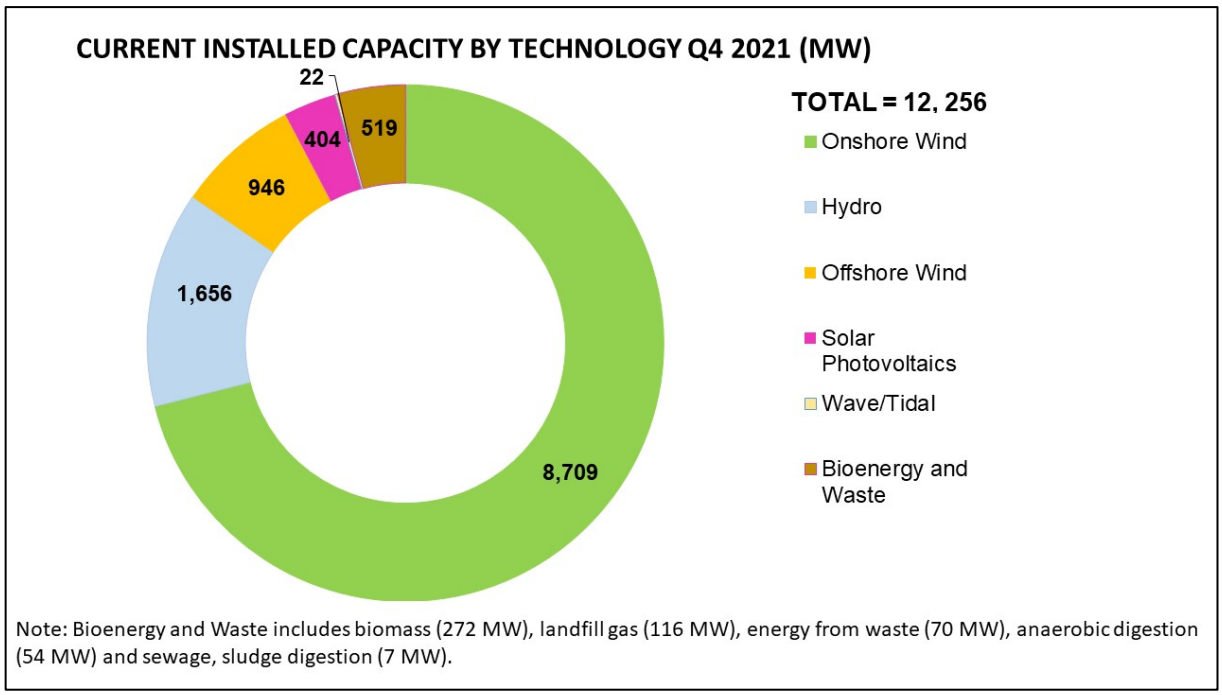


Figure 59: Current installed renewable capacity, Scotland (Source: BEIS Energy Trends)



This chart is to show how much onshore wind generation has expanded in Scotland. This is particularly so in remote rural areas, which despite large areas of community owned wind generation, still suffers highest levels of fuel poverty in Scotland, indeed has the highest unit rate for electricity (due to transmission costs of returning energy from the grid). This will be picked on in the next section, as the project works in such an area of high generation with highest levels of fuel poverty.

9.2 Number of households recruited, Scotland (April 2022)

The primary focus of engagement in the Outer Hebrides of Scotland is private owner-occupiers suffering from energy poverty, living in remote communities on the islands, with a focus on elderly. Demographics are a key factor in the choice of group to support in the Outer Hebrides.

Table 13: Households recruited to date (Scotland as of May 2022)

Total Number of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021	148	49	64	120	381
2022	48	14	0	0	62
2023	0	0	0	0	0
					443

Table 14: Estimated household engagement numbers adjusted to Covid-19

Total number of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2021	148	49	64	120	381
2022	45	30	30	14	119

Total number of households	**Q1**	**Q2**	**Q3**	**Q4**	**Total**
2023	0[3]	0	0	0	0
					500

Tighean Innse Gall recruitment strategy is focused on these two themes:

1. Public awareness.
2. Agency involvement.

Public awareness – newspapers: due to the demographics of the Outer Hebrides, marketing activities to raise public awareness utilise traditional media as well as using social media. The 14 inhabited islands are well served by local newspapers which have a relatively small but dedicated readership. These 14 islands cover over 3000 km^2 and newspapers range from weekly to monthly titles, with some representing village or set of villages in scope, others island wide. There are at least 8 newspapers printed. There is no newspaper which covers all islands. TIG is placing adverts alongside editorial, for example with one-page adverts alongside a page of text question and answer sessions with project officers. Adverts and editorial content will be tailored towards each readership highlighting case studies in the community.

Public awareness – social media: social media often reflects local print media, with pages for villages / islands / communities that are read and contributed to keenly by the public. TIG are placing adverts in such media, with links for the public to contact officers directly. News stories linked to case studies will be placed as successes are generated and citizens agree to material being published. This will be developed further as the project goes on.

Public awareness – radio: there are 3 local radio stations (2 of which are mostly pre-recorded) and TIG will develop adverts which highlight the project. The BBC also hosts a Gaelic radio station, and it is hoped this will give airtime to our project as we develop 'hooks' for them to broadcast. One of our project officers is bilingual and will act as the 'voice' of EnergyMeasures on this medium.

*Public awareness – word of mouth: a*s successes of the project develop, and where people are made aware of our support, we know that word of mouth will generate referrals. Word of mouth is an essential component of awareness raising, and we hope to develop key messages for the public which will develop traction and 'cut through'. This will be developed by the team.

*Agency involvement – Gluasad Còmhla: a*s referred to previously, Gluasad Còmhla (Moving Together) served as the vehicle for multiple agencies to align services for those who have medical (including physical and mental health) conditions which are exacerbated by fuel poverty. These agencies include Western Isles National Health Service, Western Isles Association for Mental Health, Western Isles Citizens Advice Service, The Shed (works with people with drug and alcohol addiction issues) and The

[3] The target is to have the full complement of households recruited by month 24, with provision made for potential household dropouts with a small level of recruitment after month 24.

Foyer which works with vulnerable young people. In addition to these, the Financial Inclusion Team of Comhairle nan Eilean Siar and numerous local community-based organisations are working to promote the services of EnergyMeasures throughout the islands and to make electronic referrals to our team.

Recent examples of community engagement activities leading to recruitment of households:

- Community group meetings – Harris coffee morning, Breasclete and Carloway Community Association drop-in sessions.
- Leaflet drop – for community groups at Western Isles food bank so that recipients of food parcels could also gain information about the project.
- Library services - Climate Corner, community drop in for people looking to reduce their climate impact.
- Online briefings for agencies - Social Security Scotland officers were briefed about the project and how they could make referrals to us from their client base.
- Third Sector / Advice Services – Western Isles Citizens Advice Services.

Impact of the Covid-19 pandemic had on recruitment activities

The principal impact of Covid-19 has been restrictions on home visits, and in particular for vulnerable people anxious about visits in their homes. In essence this means we have delivered two projects, firstly virtual with reliance on use of internet and telephone, now followed up with a second round or 'actual' visits.

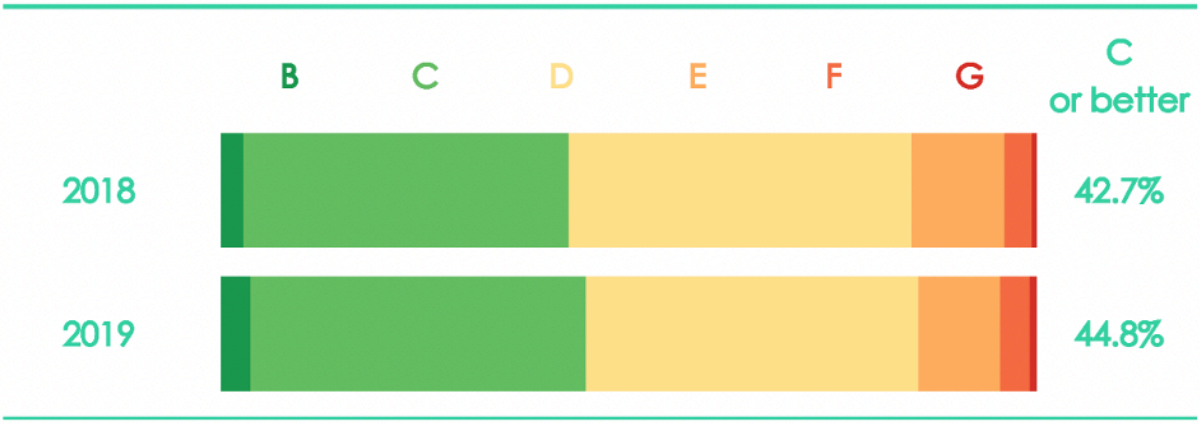
During lockdown we found that householders were paying more attention and interest in energy use in their homes. With more time spent at home and energy bills increasing, there was a rise in enquiries and smart survey sign ups.

9.2.1 Characterisation of the dwellings

9.2.1.1 Scotland

As one can see from Figure 54 below energy efficiency at a national level in Scotland is improving, but nonetheless is mostly stagnant at an inefficient majority. The Energy Efficient Scotland: Routemap (Scottish Government 2018) sets an ambition for 'every Scottish home to achieve at least a band C in its Energy Performance Certificate (EPC) by 2040 (where technically feasible and cost effective). Linking into the Fuel Poverty Strategy (Scottish Government 2021), where this suggests fuel poverty is suffered by female households, 'more likely to be a female headed household' (51% vs 35%) this is why in the Outer Hebrides we chose to focus on women led households, where efficiency in homes is worse than Scotland as a whole, with more than 80% below EPC band C. The Scottish government are likely to propose legislation to phase out installation of new or replacement fossil fuel boilers not on mains gas from 2025 and those on mains gas from 2030 (Maby & Sunderland, 2022). Warmer Homes Scotland (delivery agency for energy efficiency measures Scotland wide) have already been stopped from installing replacement oil boilers with government funding.

Figure 60: Housing Stock Distribution by EPC Band, Scotland 2018-19 (Scotish Government)



Space heating in Scotland is split (as a majority) between electricity and gas in the central belt (Glasgow through to Edinburgh, where the majority of Scots live) and electricity and oil in rural areas. House types in Scotland can be categorised into the following groups: detached; semi-detached; terraced; flat, maisonette or apartment. Primary heating is met through these common energy vectors, however as one moves from cities into rural areas is usually supplemented by a secondary heating source, almost always biomass or solid fuel (wood, coal, or peat).

9.2.1.2 Western Isles

Within Na h-Eileanan Siar (Western Isles Council area) detached homes are often (almost always) heated by a main system supported by a secondary system. The main heating systems are oil (*c.* 62%) and electric storage heaters (*c.* 20%) (data from Home Energy Scotland). Approximately 6% come from solid fuels (coal, wood and peat). A small number of homes use biomass wood pellets, but these are difficult to source and often rely on large deliveries from the mainland. Few trees grow in the islands and as such local supply is almost impossible. It is noticeable that people are now burning pallets they source literally from skips and the street/behind business premises.

Secondary heating typically takes the form of multifuel stoves (or open fires) and moveable electric panel heaters. Historically, many homes heated by electric storage heaters were supplied energy via Scottish Hydro, with bursts of 'top up' energy throughout the day and night. These heaters are wired into a dynamic dual billing system, with the heating on one meter (at a reduced rate) and appliances *etc*. on a second one. A secondary heating system would be billed via the second meter (at a tariff of one-third to one-half above the heating rate). Which means for those unable to utilise storage heaters efficiently and correctly, they would plug in a second heater at the higher rate. In effect they wouldn't benefit from cheaper heating systems, and then use a higher billed heater to 'plug the gap'.

Some 85% of homes across the Western Isles have poor energy performance (EPC ratings D to G). This, coupled with long winters, poor Atlantic coast weather and low incomes in the islands, creates the 'perfect energy storm'. This explains the high levels of energy poverty (43%) and extreme energy poverty (26%) to be found on the islands. Given recent price rises of 54% in energy bills in Scotland, it is of no surprise that these figures are out of date and will be higher.

9.2.1.3 Construction Types

Stornoway, the main town in the Western Isles has the largest number of post 1930 buildings in the Outer Hebrides, hence a large proportion of these 44% cavity construction homes will be built there. Although we have not turned down households in Stornoway from the project, our focus is on detached homes and subsequently most of our caseload is outwith the town. This means that more of our properties will be non-cavity and more likely to be stone, solid brick or poured concrete. Our project focus has been on detached properties, and these will be broken down into when built / wall type. Essentially the older built the less likely to be insulated, hence high numbers with low insulation but a reasonably high number with insulation that will have been built more recently.

Figure 61: Common house types in the Outer Hebrides

Detached old stone House, approx. 1825

Traditional 1920s stone croft house

Croft house Poured concrete, *c.* 1930s

Semi-detached 1950s brick cavity house

Detached block cavity house, *c.* 1960s

Detached timber frame bungalow, 1990s

9.2.1.4 Heating types

Primary Heating Types: Storage heaters are the most common form of electrical heating systems in the islands. Most households who use this type had systems installed 15-25 years ago). It is controlled by input and output dials which we have found to be often faulty, missing or that the households themselves do not understand how to use them to get the best out of them.

The next most common heating system is an oil boiler, which may be internal or external, such boilers are used to heat water which is circulated in radiators around the property. Many properties in the Western Isles have inefficient old boilers over 30 years old. Other common fuels used to heat radiators include LPG, biomass or solid fuels such as coal or peat. Solid fuels can also be burned in an open fire with back-boiler. Reflective panels as shown in Figure 63 can be fitted to the back of the radiator to conserve heat.

Secondary heating systems are usually a multifuel stove or electric panel or resistance heater. Multifuel stoves are usually 3-5 kw in output and are used to heat the main living room. Older households who do not have a stove may use an open fire. Open fires are not usually used in bedrooms anymore, and we have installed chimney balloons in unused fireplaces to block them. The multifuel stove can burn wood, coal or peat and can have its efficiency boosted to heat other rooms with a stove fan placed on top and directed towards open doors to direct heat towards other rooms.

Peat was once the main fuel used in homes across the Outer Hebrides. Peat cutting remains an important part of island life for many, who still gather with family & friends out in the peatlands for the labour-intensive cutting and gathering. The soft peat is cut into blocks in the springtime and left to dry out for 2 weeks and then lifted and stacked for winter.

Panel or resistance heaters are the next largest form of secondary heating in the islands. Figure 63 shows an electric resistance heater which is fairly common, *i.e.,* directional with two heat settings, 400w or 800w. This one is used to heat a living room in a home without a radiator or working stove in it. Set at the highest setting, this heater costs €1.28 for 4 hours at current Scotland prices. Given the heating season is from mid-September to mid-May this can cost around €250 - 300 a year.

Figure 63: resistance heater

Figure 63: Reflective panel fitting

9.3 Establishing a baseline

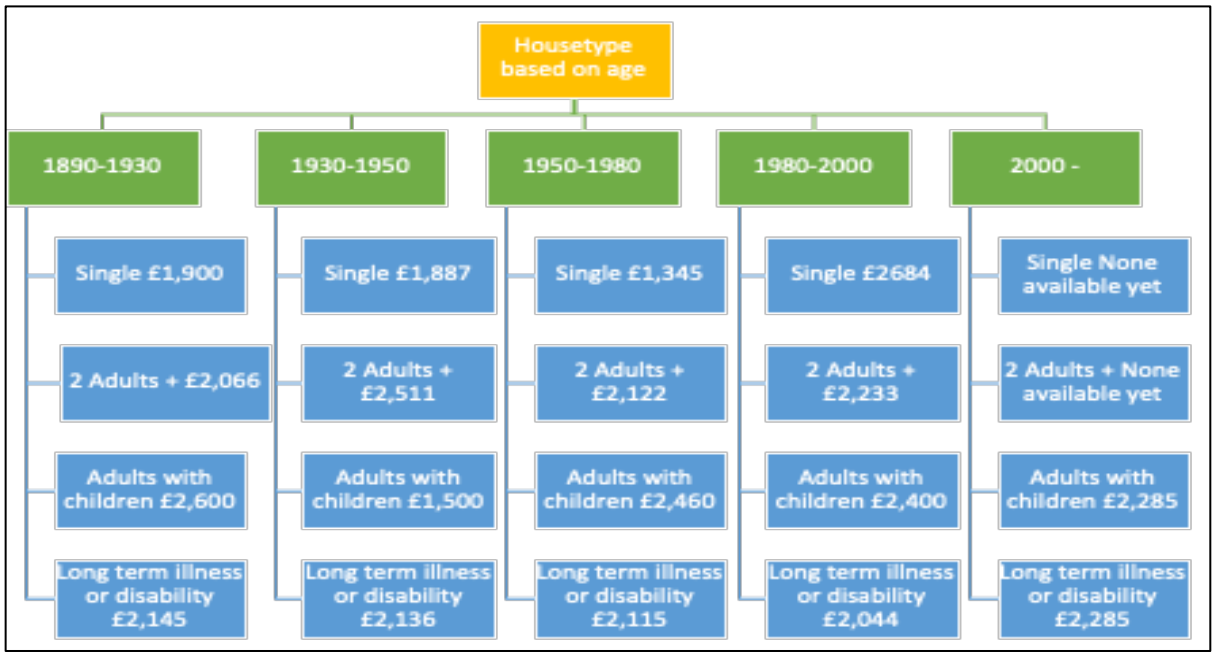
We have historic data given by roughly 10% of households which includes overall expenditure on energy (annually) total kWh used. However, historical data is limited, principally due to energy companies leaving the market and incomplete records of households.

We have also collected some information which details energy expenditure as recalled by households *e.g.,* "my direct debit is £100 per month" or "I put £30 a week on my card". Where we have it, in some cases it's 6 months but mostly it's annual. We started household visits later in the project, due to covid. As we visit more households, we expect to unearth more previous data. These contacts will be scheduled at roughly equal intervals over the remaining life of the project (six, twelve, and if the time periods allow eighteen months after the first household visitation). We will then review actual energy use data and compare and contrast with previous usage. We will also test anticipated energy savings of measures and behaviour change against actual usage. For example, we assume kWh reduction of 495 by installing LED lighting and for a 2-person household reducing shower usage time to 4 minutes each, saving 450 kWh. Did they make those savings? We have asked participants in the project to provide the following information. House type (when constructed; wall type, i.e., solid wall, stone, kit house, brick *etc*.; levels of insulation); Household type: numbers of adults; numbers of children; long term illness or disabilities

9.3.1.1 Use of electricity

Surveyed households in Scotland consume between 1,500 kWh and 17,000 kWh per annum. The average electricity use of a typical household is 6,676 kWh per annum. At the time of writing, the minimum cost of electricity (unit cost, plus standing charge and VAT) for all surveyed households was £424 per annum, and the maximum price paid was £6,000, with an average of £2,039.

Figure 64: Energy expenditure – electricity heated homes with appliance use - by house type (ages).



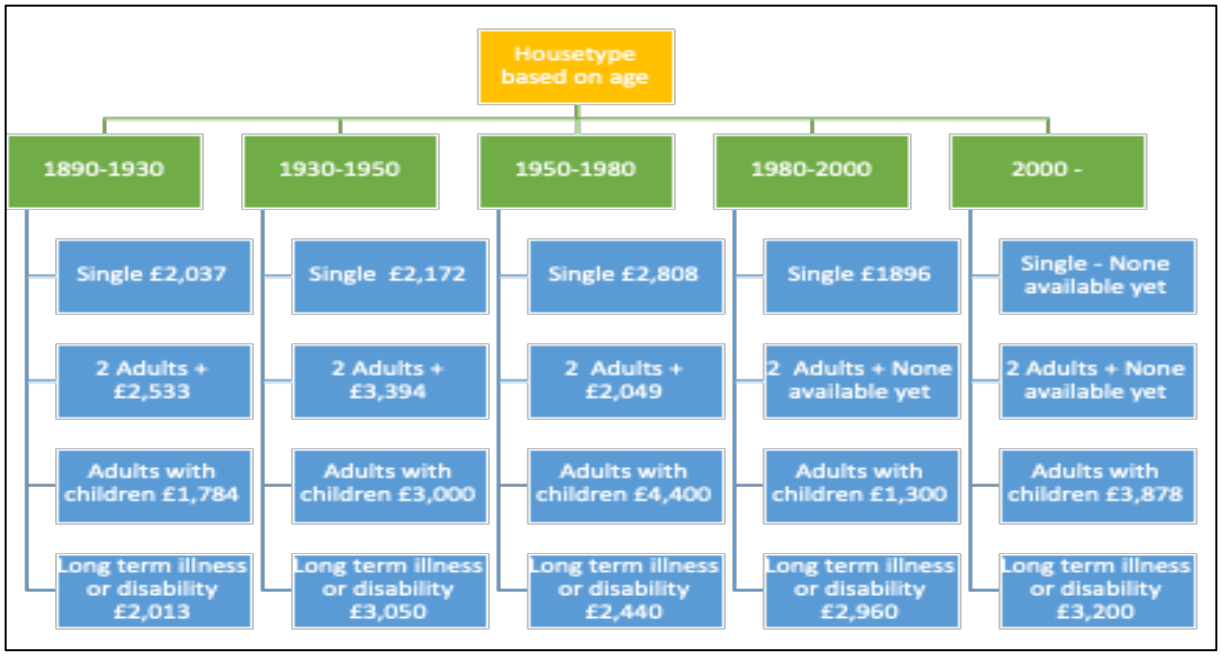
9.3.1.2 (Oil) Heating

Survey respondents reported a minimum of 600 litres of domestic oil usage per annum, a maximum of 4300 litres, with an average of 1,946 litres.

At the time of writing, the minimum cost of domestic oil expenditure for all surveyed households was £600, the maximum amount paid was £5,000, with an average expenditure of £1,306.

Please note these figures do not reflect the rise in oil prices following the disruptions caused by the Russian invasion of Ukraine. The cost of domestic oil has doubled since March 2022.

Figure 65: Energy expenditure – oil heated homes with appliance use - by house type (ages)



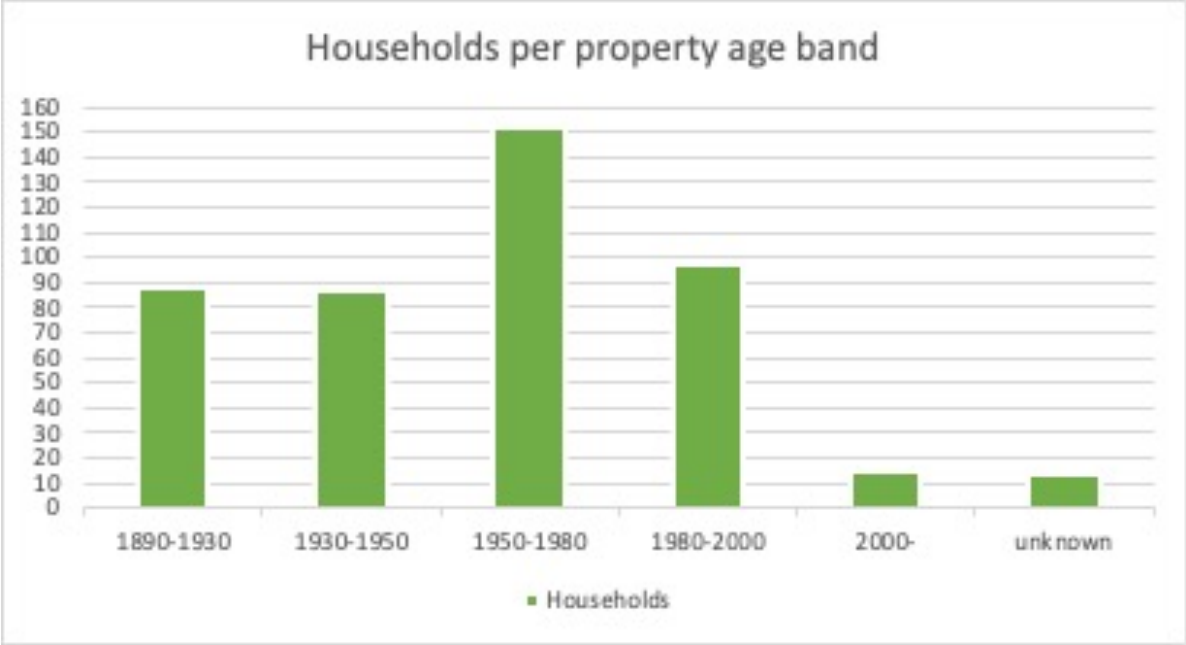
9.4 Looking Forward

When we made/make initial contact with households we asked/ask for (a) a current meter reading (b) annual energy use broken down into kWh, (c) oil and (d) any other form of energy use. When we visit, we ask for copies of statements if available and we take a current meter reading. We also conduct periodic requests for new meter readings or current expenditure.

From the data, we have received so far (all households engaged with) we have endeavoured to show average energy use for house types, with households from information available. The ages in the graph below reflect different generations of build types in the islands over the years. The attributes below this, *i.e.,* single, 2 adults, adults with children (could be one adult with a child), and long-term illness or disability reflect the average household types in the islands. Of course, this is unscientific as we cannot regulate who joins the project (unless we retract the decision to help those wider than the initial single pensioner household with a preference for women). We have demonstrated two primary energy use charts, the first using oil as a heating source and the latter electricity, as total energy costs, which includes electricity use on appliances in oil-fuelled homes. The rationale for this is to demonstrate total

potential behavioural change opportunities. We have also demonstrated the numbers of house type ages in the chart immediately below.

Figure 66: Age of dwellings Scotland



We will aim to fill gaps as the project goes on and we gain more information. We will gain this information by seeking meter readings / details of oil tank fills / purchase of coal / use of peat from a stack, throughout the project.

Similarly, it is too soon to breakdown expenditure on secondary heating costs, simply because we need to visit more homes and gain additional data due to household uncertainty as to how much fuel they are using. We hope that over time we will refine data collection practise and display.

We have chosen the age of the house in bands to reflect on the build type of that generation, *i.e.*, houses built in 1890 to 1930 were built from stone, 1930s to 1950s poured concrete and cavity, 1950s to 1980s block and brick cavity, 1980s to 2000s cavity and timber frame, from 2000 almost all are timber frame construction (fully insulated at build).

We have found that at present there are significant gaps in data which we will aim to fill in the coming months. Energy use is high, due to long winters and weather patterns *i.e.,* storms as well as poor efficiency and low incomes in the islands. We believe that the interventions of small measures along with bespoke energy advice based on behavioural change supported by an energy plan raise the level of understanding around energy use and will have an impact on alleviating fuel poverty. Moreover, public education on energy use and potential for efficiency will help create a climate of understanding and initiate further action, such as larger energy efficiency measures or shifts in heating systems. Finally, informed and educated energy citizens is imperative to tackling fuel poverty and reducing energy consumption. To achieve this, a 'hook' of small measures and bespoke advice is essential, and we have found that with this positive approach far more citizens wish to engage and ultimately benefit.

10 Concluding remarks

This aim of this document was to describe the approach(es) being taken to describe the initial baseline against which so-called 'energy savings'; changes in electrical energy demand, thermal energy demand and reductions of people living in energy poverty will be measured throughout the project. The deliverable comprises a brief overview for each country of the most important energy sources and energy-related challenges, the number of households recruited, characteristics of dwellings, and information about energy use, household composition, and plans to gather future energy data for the remaining time of the project.

While a common approach has a lot of advantages – the local specificities in each country means that the approach to data collection must be tailored to circumstances. For some countries the task is relativity straightforward (*e.g.,* with widespread use of centralised electricity and gas grids and access to invoicing data), for others it is more complex and time-consuming (*e.g.,* energy companies ging out of business, widespread use *of ad hoc* fuels, *etc*.).

While the timing of the household recruitment means it was not possible to yet calculate energy savings the establishment of good baseline data and access to future data is of vital importance. This data collection is very much an ongoing task, for example in Ireland, where a good deal of billing information has been sourced directly and indirectly from householders – work is underway to devise an arrangement for access to billing data through the DSO – which would greatly improve the quality of the data. Over the coming months a good deal of effort will be expended in arranging for data access, improving data quality, and analysing the impacts of the householder interventions.

Each of the country reports first presented an overview describing the prevalence of energy poverty in their country, the major sources of energy and the main energy-related challenges at the national level. Next, the number of households recruited by the end of April 2022 was detailed and information of the characteristics of dwellings provided. Thirdly the work towards establishing a baseline was described and the mechanism for obtaining the historical data explained. Depending on the specific progress with engagement in each country, in cases where sufficient quality data was collected and analysed a summary was presented. The final part of the country reports outlined the strategy for energy data collection during the duration of the household's time within the project for each country, along with any lessons learnt to date.

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