UsersTCP

Hard-to-Reach Energy Users

Subtask 2: Case Study Analysis

PORTUGAL

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Preface

This report was developed under the 'Users Technology Collaboration Programme (TCP) by the International Energy Agency (IEA) Task on Hard-to-Reach (HTR) Energy Users'. The Task aims to provide country participants with the opportunity to share and exchange successful approaches identifying and better engaging HTR energy users. Under the Task, HTR energy users are broadly defined as *'any energy user from the residential and non-residential sectors, who uses any type of energy or fuel, and who is typically either hard-to-reach physically, underserved, or hard to engage or motivate in behaviour change, energy efficiency and demand-side interventions*'.

Outcomes from the Task indicate that HTR energy users involve, for example, renters and landlords; low- and high-income households; the MUSH (municipalities, universities, schools, and hospitals) sector; small to medium enterprises / businesses (SMEs / SMBs); and people exposed to intersecting and compounding vulnerabilities based on factors such as age, race, gender, minority status, geographic, linguistic, technological or social isolation.

The case studies presented in this report aim to offer insights into programmes that aim to better engage HTR energy users in Portugal. Particular attention is given to design, implementation and behaviour change aspects. Other country case studies developed under the Task also include: Aotearoa New Zealand, Canada, Italy, the Netherlands, Sweden, the UK and the U.S.

We would like to thank all participating countries, their authors, and the interviewees who provided insights into their programmes targeting the HTR. I would like to particularly like to thank our National Experts and any national experts who undertook peer reviews.

All case studies can be found on the project's website.

Dr Sea Rotmann
Task Leader
Users TCP by IEA Task on HTR Energy Users
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Country background: Portugal

Portugal is located in the Iberian Peninsula, in the southwest region of Europe. Historically, Portugal has suffered from a high external energy dependency of around 90%, as no fossil fuel production occurs in the country. However, the last decades saw a sudden increase in endogenous energy supply, mainly due to the investment in renewable energy sources, which brought down energy dependency to 72% in 2019. From 2005 to 2014, primary energy consumption registered a downward trend of around 2.3% per year due to the combined effects of the economic crisis, technological evolution, and modest energy efficiency policies. From 2015 to 2019, energy use increased almost 5%, signalling the slight rebound and stabilisation that followed the country's economic recovery (DGEG, 2020).

In 2019, transportation accounted for 36% of Portugal's final energy consumption, the country's most significant energy-consuming sector. The building sector represented 31% of energy use (17% from households and 14% from services). Finally, industry accounted for 29% of energy consumption (DGEG, 2020). Although no official data is available regarding Small and Medium Enterprises (SMEs), estimates indicate that industrial SMEs may represent 9% of national gross energy consumption, while service sector SMEs may account for 15% of total electricity consumption (Sequeira, 2016; Reuter *et al.*, 2021).

The Covid-19 pandemic crisis has had a tremendous impact on Portugal's everyday life and economic activities, leading to temporary shifts in energy consumption patterns. The national GDP is estimated to have fallen 7.6% on a year-on-year basis (INE, 2021). In 2020, primary energy consumption decreased 8.5% from 2019 levels (DGEG, 2021). For example, with the country on full lockdown in April 2020, compared with April 2019, private vehicles' fuel consumption was halved, while services and residential electricity use was reduced by 43% and increased by 31%, respectively (Portuguese Energy Observatory, 2020). Data from April 2021 suggests a tentative return to pre-pandemic normality regarding energy consumption patterns (Portuguese Energy Observatory, 2021a).

Portuguese buildings generally have low energy performance with a high incidence of problems, such as lack of thermal comfort, indoor air pollution, leakages, and humidity (Gouveia and Palma, 2019). Around two-thirds of the building stock predates energy performance regulations, and, according to the Portuguese long-term building renovation strategy, virtually 100% of existing buildings will need to be renovated by 2050 (Portuguese Government, 2021a). However, currently, energy renovation rates remain very low, with deep renovation estimated to occur in only around 0.01% of buildings annually, far below the values expected in the *European Renovation Wave* (INE, 2020; European Commission, 2020a). In addition, Portuguese buildings' energy use will likely be impacted by a changing climate, and Portugal has been pointed out as one of the European countries most vulnerable to climate change (EEA, 2017; Figueiredo *et al.*, 2020).

Regarding residential buildings, energy use in Portuguese households is the second-lowest per capita in the European Union (EU) (Eurostat, 2020). Although climate, culture and other country-specific factors play a role, research has uncovered systemic energy performance gaps and underconsumption in the Portuguese residential sector (Palma *et al.*, 2019; Horta *et*

al., 2019). In addition, based on the energy performance certificates available, around 70% of Portugal's close to 6 million dwellings are inefficient compared to current standards (C class or lower; Portuguese Energy Observatory, 2021b). Electricity is the primary energy source in households, followed by biomass, respectively 43% and 29% of consumption (DGEG, 2020). Main energy end-uses include cooking (39%), water heating (24%), space heating (22%), and electric appliances (11%; INE and DGEG, 2011). Energy-saving potential for Portugal's residential sector has been estimated at 50% of current consumption (Melo *et al.*, 2019).

Regarding non-residential buildings, public or private, data is still scarce in Portugal. Compared with the residential sector, the energy performance certificates available present a slightly improved picture, with around 43% of certified services buildings with a B-class or above (Portuguese Energy Observatory, 2021c). Electricity is the largest energy source for services, accounting for over 60% of consumption (DGEG, 2020). Non-residential buildings include a wide array of activities which further constrains in-depth analysis.

Portugal is committed to the global challenge of climate change, being a signatory of the Paris Agreement and following the directives emanated at EU level. The *Carbon Neutrality Roadmap 2050* charts the long path towards full decarbonisation by 2050 (Portuguese Government, 2019). Buildings, end-users, and citizens are essential for the energy transition, and the roadmap sets urban renovation, energy efficiency, renewables integration, and energy poverty mitigation as key priorities. Furthermore, the *National Energy and Climate Plan 2030* is the main policy instrument for the current decade and establishes the measures needed to keep the country in line with its long-term goals (Portuguese Government, 2020). Key targets for 2030 include a 45-55% reduction in greenhouse gas emissions from 2005 levels, a 47% share of renewable sources in final energy use and a 35% reduction in primary energy use.

Energy poverty in Portugal

Energy poverty is a multidimensional, severe societal problem in Portugal that negatively impacts public health and well-being, as well as the pursuit of overarching social, environmental, and economic goals (Portuguese Government, 2021b). It can be defined as *the inability or difficulty to maintain an adequate level of essential household energy services and has some of its root causes in a combination of factors as low incomes, poor buildings energy performance and high energy prices, among others* (adapted from Portuguese Government, 2021b). EU-SILC proxy indicators illustrating the situation in the country report:

i) 18.9% of households are unable to keep their home adequately warm (4th highest in the EU and well above the average of 6.9% in 2019),
ii) 35.7% of the population live in houses not comfortable cooled in summer (2nd highest and above the EU average of 20.9% in 2012), and
iii) 24.4% of the population live in dwellings with the presence of leak, damp or rot (2nd highest and above the EU average of 12.7% in 2019; Eurostat, 2021a; Eurostat, 2021b; Eurostat, 2021c).

According to the index developed by OPENEX (2019), Portugal is the fourth-worst EU country regarding domestic energy poverty. Gouveia *et al.* (2019) has explored the phenomenon for all its civil parish regions, both for winter and summer.

Electricity prices for Portuguese households in the second half of 2020 are in line with the EU average, whereas natural gas prices are above; however, purchasing power in Portugal is significatively lower than in other Member States with comparable energy prices (Eurostat, 2021d; Eurostat, 2021e; Eurostat, 2021f). The country's Gini coefficient reveals significant income disparities, and 16.2% of citizens are at risk of poverty (INE and PORDATA, 2021a). The recently released national *Energy Poverty Mitigation Draft Strategy for 2021 to 2050*, currently awaiting its final version, estimates that around 7% of the population may suffer from severe energy poverty, with up to 22% suffering from moderate energy poverty (Portuguese Government, 2021b). Covid-19 may have exacerbated existing social inequalities, possibly increasing energy poverty vulnerability in Portugal (Horta and Schmidt, 2021).

Portuguese hard-to-reach energy users

Until recently, scientific knowledge on energy poverty and vulnerable energy users was scarce in Portugal. In the past few years, however, these topics have received more attention from researchers, practitioners, and policymakers (*e.g.,* Gouveia and Seixas, 2016; Simões *et al*., 2016; Gouveia, 2017; Gouveia *et al*., 2018; Horta and Sousa, 2018; Gouveia *et al*., 2019; Horta *et al*., 2019; and Portuguese Government, 2021b). In contrast, the concept of hard-to-reach (HTR) energy users is novel in Portugal, with virtually no research conducted explicitly under this umbrella. Nevertheless, HTR energy users, as broadly defined by Ambrose *et al.* (2019a) and extensively reviewed by Rotmann *et al.* (2021a), may represent a large and growing percentage of the Portuguese population and their participation in a citizen-centred, local-scale, sustainable and inclusive energy transition is crucial to achieve the twin goals of decarbonisation and energy poverty alleviation.

Despite their importance to overall societal aims, engaging with HTR energy users has been slow due to numerous and wide-ranging barriers (Backlund *et al.*, 2012; Ambrose *et al.*, 2019a). These include key challenges such as split incentives, insufficient knowledge, high transaction costs, market fragmentation, shortage of finance, lack of information, competing priorities, and mistrust of energy providers ((Schleich and Gruber, 2008; Labanca *et al.*, 2015). To better target the HTR, the first step should be to identify and characterise this remarkably heterogeneous group of residential and non-residential energy users in the specific Portuguese context. It is essential to understand their unique perspectives regarding behavioural change, energy efficiency, building renovation, renewable energy, demand flexibility, and the gaps and barriers that hinder their involvement in the energy transition. This is a prerequisite for developing tailor-made and context-specific measures that effectively target HTR energy users from the national to the local scale. The following analysis presents a first exploratory attempt at identifying and estimating some Portuguese audiences, who might potentially be HTR energy users, in the residential and non-residential buildings sector.

Residential sector

HTR households can be considered as those facing a wide range of vulnerabilities and whose circumstances or characteristics present severe barriers to engage in energy issues (Ambrose *et al.*, 2019a). Considering the Portuguese population of 10.3 million people, corresponding to around 4.1 million families, a few national-scale socio-economic indicators can be used to explore this concept (INE and PORDATA, 2020). These tentative proxy indicators are shown individually in Table 1, although, in the real world, vulnerabilities can often be hidden or add up, and regional differences should also be accounted for. The rationale is explained below.

Table 1 – Indicators relevant for the identification and characterisation of HTR households.

Indicator	Number of families	Share of families (%)	Number of people	Share of population (%)	Reference year, source
Natural gas social tariff recipients	55 281	1.3	-	-	2021 (DGEG and Portuguese Government, 2021)
Total electricity social tariff recipients:	797 337	19.2	-	-	
- Due to income	398 364	9.6	-	-	2020 (Portuguese Government, 2021b)
- Due to social assistance	203 539	4.9	-	-	
- Due to income plus social assistance	150 001	3.6	-	-	
Family income < 5 000 €	677 673	12.5*	-	-	2019 (AT/MF and PORDATA, 2021)
Family income level 5 001 - 10 000 €	1 446 100	26.7*	-	-	
Family income level 10 001 - 19 000 €	1 625 421	30.5*	-	-	
Family income level 50 001 - 250 001 €	309 435	5.7*	-	-	
Family income level > 250 001 €	4 180	0.1*	-	-	
Population at risk of poverty (income below 6 480 € after social transfers)	-	-	1 666 381	16.2	2019 (INE and PORDATA, 2021a)
Population with severe housing deprivation conditions	-	-	473 170	4.6	2020 (INE and PORDATA, 2021b)
Elderly (>65 years old) living alone	-	-	513 200	5.0	2019 (INE and PORDATA, 2020)
Families with representative > 65 years old	1 445 000	34.8	-	-	
Families with representative < 34 years old	368 900	8.9	-	-	
Single-parent families	470 654	11.3	-	-	2020 (INE and PORDATA, 2021c)
Single-parent families led by women	398 572	9.6	-	-	
Migrant population with legal status	-	-	604 140	5.9	2019 (INE *et al.*, 2020)
Unemployed population	-	-	350 900	6.8**	2020 (INE and PORDATA 2021d)
Population with social pension of old age or disability below minimum wage	-	-	1 614 171	18.1***	2019 (ISS/MTSSS and PORDATA, 2020)
Families with children receiving social assistance	820 330	19.8	-	-	2020 (II/MTSSS & PORDATA, 2021)
Adult population without formal education	-	-	478 300	5.6***	2020 (INE and PORDATA, 2021e)
Adult population with education below the 12th grade (current mandatory minimum)	-	-	4 894 200	55.0***	
Families living in rented dwellings	1 067 841	25.7	-	-	2011 (INE and PORDATA, 2015)
Families in informal dwellings	6 612	0.2	-	-	
Families living in social housing	112 188	2.7	-	-	2015 (INE, 2016)
Population living in settlements with fewer than 2 000 inhabitants	-	-	4 124 307	40.1	2011 (INE and PORDATA, 2018)
Population living in settlements with fewer than 10 000 inhabitants	-	-	6 055 272	58.9	

Notes: *Considering a total number of 5 408 288 fiscal families (AT/MF and PORDATA, 2021); **Official unemployment rate in 2020 (INE and PORDATA, 2021d); ***Considering adult population of 8 898 924 people (INE and PORDATA, 2020).

The selected indicators, based on Ambrose *et al.* (2019b), Ashby *et al.* (2020), and Rotmann *et al.* (2021a), among other relevant literature (*e.g.,* Gouveia *et al*., 2019), showcase a wide array of population profiles that may be associated with potential situations of vulnerability and HTR energy users. For example, the *Energy Social Tariff* is a social support scheme to increase vulnerable consumers' access to essential energy services (Martins *et al.*, 2019). It is currently given to around 19% of Portuguese families, which can be considered HTR due to their low income and/or need for social assistance.

Using only lower gross incomes as a generic metric, it is noteworthy that around 70% of Portuguese fiscal families are in the bottom four tax levels, substantially below family average net income of €34,000 per year (INE and PORDATA, 2021a). These families' engagement in energy issues is hindered by their lack of investment capability. Around 16.2% of the population is still at risk of poverty, and, according to the draft of the *National Energy Poverty Strategy*, up to 29% of people may suffer from energy poverty (Portuguese Government, 2021b). In contrast, the top three tax levels (high-income) only account for 5.8% of families.

Age can be an important factor in the households' capability to participate in energy issues. In Portugal, there is a high share of families whose head of household is above 65 years old and, according to some research (*e.g.,* Abreu *et al.*, 2020*)*, less prone to invest in improving energy performance. On the other hand, younger and more recent families can experience a shortage of funds, lack of knowledge and conflicting life priorities, even if they seem more inclined to act, particularly, to improve their children' comfort and health (Mahapatra *et al*., 2019). These two situations can account for almost half of Portuguese families. Moreover, elderly people living alone are particularly vulnerable to energy poverty issues (Ambrose *et al*., 2019b).

Context-specific characteristics such as single-parent families and migrant status may be associated with an HTR condition, with strong links to broader gender and ethnic inequalities (Feenstra and Clancy, 2020; Churchill and Smyth, 2020). Other vulnerabilities such as unemployment, child-related social support, and dependence on very low income from pensions due to old age, disabilities, or illness can also hinder households' ability to engage in energy issues. In addition, higher education levels are widely considered an enabler of engagement (Hall *et al.,* 2021). However, in Portugal, more than half of the adult population has an education level below the 12th grade (current mandatory minimum).

Although the share of the population living in rented dwellings, social housing, and informal settlements in Portugal is low compared to other EU countries, these can be particularly HTR regarding energy issues. While the share of rented dwellings sits at 26%, it reaches 40% for population below 60% of median equivalised income (Eurostat, 2021g). People living in rented houses can be quite heterogeneous – e.g., with varying levels of income, types of contracts (or lack thereof), and rental durations, including specific subgroups such as dislocated students. They may experience split incentives where neither the renter nor the landlord invests in energy performance (Bouzarovski *et al.*, 2020). Social housing, governed by a single organisation, could present a different situation altogether, with an easier-to-reach profile if sufficient funds were to be allocated (European Commission, 2020a). Finally, informal settlers, illegal migrants, and stigmatised and criminalised people (e.g., the homeless) are also mentioned as HTR by Rotmann *et al.* (2021a); these are hard to account for in Portugal.

Around 90% of Portuguese residential buildings are designed to accommodate only one or two families (INE, 2012). However, 46% of citizens currently live in apartments, while 54% live in single-family houses (Eurostat and PORDATA, 2020). The adoption of building renovation and renewable energy measures can be complex in multi-family buildings where decisions and investment need to be approved by multiple house owners (Eisermann *et al.*, 2019).

Almost 60% of Portuguese citizens live in less-densely populated settlements, such as suburbs and rural areas, which could make them HTR due to geographical isolation and lack of available services, as also reported by Ashby *et al.* (2020), and due to the use of unregulated and unreported energy carriers. In Portugal, around half of the population aged between 16 and 74 years old has below-basic digital skills, women being five percentage points behind men, which can hinder their participation in an increasingly digital energy system (Eurostat, 2021h). The *Portuguese Energy Services Regulator* (ERSE, 2020) ranked residential energy literacy levels at 43 out of 100 points, highlighting higher values among male consumers between 36 and 55 years old, with at least ten years of education, who are responsible for managing their family's energy bills.

In summary, the Portuguese residential sector showcases a wide range of structural socio-economic vulnerabilities, low education levels, dependence on social assistance, gender and ethnic inequalities, low housing quality, and widespread energy poverty. The lower-income factor alone may deem two in every three households as HTR with traditional energy policies and measures; other vulnerabilities and circumstances will significantly add to this problem.

Non-residential sector

SMEs are defined by the European Commission (2020b) as enterprises with less than 250 employees and an annual turnover of less than 50 million euro. These enterprises are described as HTR energy users by Ashby *et al.* (2020) and Rotmann *et al.* (2021a); however, research on their role in the energy transition is still scarce. Large companies, energy-intensive industries and the public sector should theoretically be easier to reach by traditional energy policies since they have facilitated access to finance and expertise, their number is small, and organisational structures are well-defined (Schlomann and Schleich, 2015). Considering the universe of 1.3 million enterprises in Portugal, SMEs account for a staggering 99.9% of enterprises, employ 77% of private-sector workers, and generate 56% of business revenues (INE and PORDATA, 2021f). Table 2 presents further details on Portuguese SMEs.

Table 2 – Portuguese SMEs according to their number of employees.

Type of enterprise	Number	Share of total enterprises (%)	Reference year, source
Micro enterprises (less than 10 employees)	1 281 857	96.0	2019 (INE and PORDATA, 2021f)
Small enterprises (10-49 employees)	44 492	3.3	
Medium enterprises (50-249 employees)	7 300	0.5	
Total SME (less than 250 employees)	1 333 649	99.9	

Portuguese SMEs can be disaggregated by economic activity, as shown in Figure 1. Significant shares of these activities, e.g., retail, food services, education, and health, take place either in commercial, mixed-use or residential buildings. The *Portuguese Energy Services Regulator* (ERSE, 2020) ranked businesses' energy literacy levels at 50 out of 100 points, slightly above the score for households, highlighting that it was higher among enterprises with over 10 employees and higher revenues. Considering the share of micro-enterprises, at least 96% of Portuguese business might be deemed HTR energy users. Their engagement in energy issues through traditional policies and measures is seriously hindered by a wide range of barriers and vulnerabilities, such as lack of knowledge and shortage of funds, as described in Portugal by Brazão and Melo (2012) for industrial SMEs and Sequeira and Joanaz de Melo (2020) for service sector SMEs.

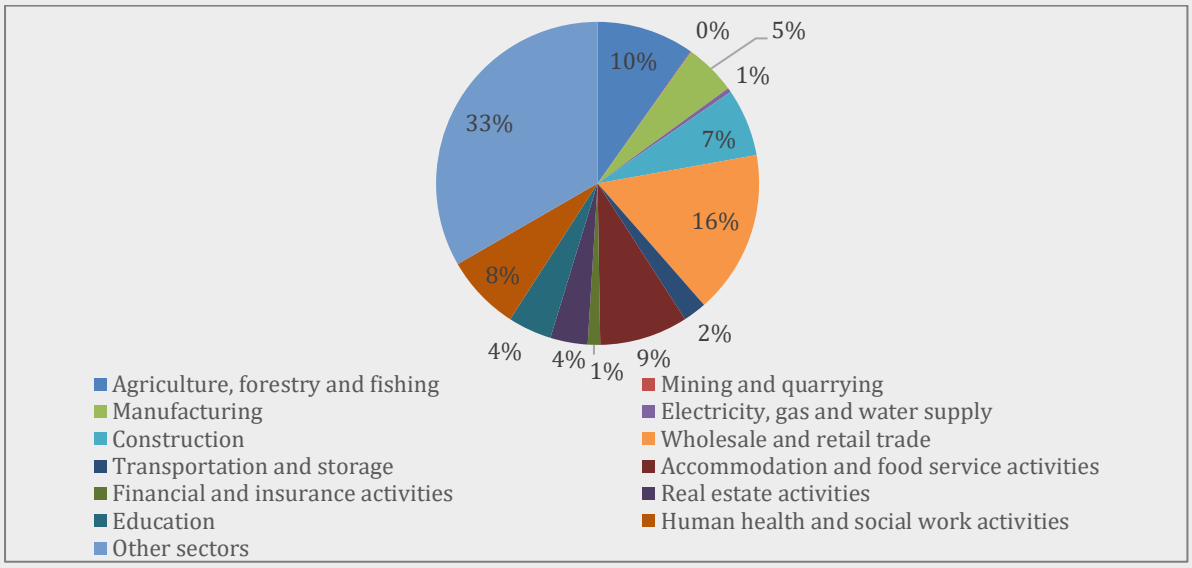


Figure 1: Share of SMEs according to economic activity in 2019 (INE and PORDATA, 2021f).

Targeting and engaging the hard-to-reach

Whilst stressing the importance of increasing energy efficiency in buildings, the Portuguese *Carbon Neutrality Roadmap* and the *Long-Term Strategy for Buildings Renovation* acknowledge the need for addressing energy poverty, i.e., vulnerable HTR energy users, but do not advance any specific measures for their identification, targeting and support. The *National Energy and Climate Plan 2030* paved the way for the development of a *National Energy Poverty Strategy*. In the draft version of this instrument, the Portuguese Government (2021b) foresees energy efficiency vouchers (*Vouchers Eficiência* programme) for energy-poor households, and support of renewable energy communities in vulnerable neighbourhoods. The concrete implementation of these measures and their impact on the HTR remains unknown since no ex-ante evaluation was performed. However, most current energy policies for the residential sector have been developed at a strategic level, with instruments, in general, lacking sufficient tailoring to deliver the expected results (Gouveia and Palma, 2021a).

In Portugal, currently implemented policy measures aimed directly at supporting vulnerable households are the automatic social tariffs, reduction of VAT taxes on energy prices and delay of energy disconnections (Gouveia and Palma, 2021b). During the Covid-19 pandemic, disconnections were suspended. A small, extraordinary aid was attributed to residential energy bills, and SMEs were supported at national and municipality levels (*e.g.,* government-backed lay-off schemes, loans and grants; Hesselman *et al.*, 2020).

A few financing schemes have focused on residential energy efficiency improvements, ranging from soft loans (e.g., *Casa Eficiente 2020* programme) to grants (e.g., Edifícios Mais Sustentáveis programme). While grants have shown considerably more success than loans, neither is aimed at HTR energy users. Most Portuguese financing schemes to date involve a high degree of bureaucracy and require available own funds and know-how, thus catering to the needs of only easier-to-reach households. On the other hand, HTR energy users benefit from programmes that, while not aiming directly at energy performance, promote interventions in vulnerable households, precarious buildings, disadvantaged communities, and social housing (e.g., *1º Direito* and *Reabilitar para Arrendar*). The *PPEC programme* (*Efficiency Promotion Plan in Electricity Consumers*) supports the implementation of energy efficiency measures in end-users through tangible and intangible interventions; a few have focused on HTR energy users, including small businesses and households (DGEG and ERSE, 2016).

Beyond the scarce governmental interventions, a few non-governmental organisations, cooperatives, and research centres have implemented projects affecting HTR energy users. The social organisation *Just a Change* mobilises volunteers for the rehabilitation of precarious poverty-stricken houses, with a track record of 262 renovated dwellings and 4,600 beneficiaries (Just a Change, 2020). The renewable energy cooperative *Coopérnico* invests in decentralised photovoltaic projects and, while the cooperative members can be regarded as educated and medium/high-income, it aims to expand its activities towards the vulnerable and the energy-poor through new initiatives (e.g., European project *POWERPOOR;* (Coopérnico, 2020). Furthermore, *CENSE FCT-NOVA*, jointly with *Coopérnico* and *Just a Change*, co-branded the *ENERGY ACTION* Project, where energy efficiency tips were disseminated on social media (Gouveia and Palma, 2021b). In 2020, *CENSE FCT-NOVA*, during a European project co-funded by the *EIT Climate-KIC*, developed the *Green Menu* (*Menu de Renovação Verde*[1]) – a digital one-stop-shop for residential buildings renovation.

Several Portuguese entities working on energy topics (*CENSE FCT-NOVA, DECO, RNAE, Lisboa E-Nova, AdePorto, ADENE, ERSE, INESC TEC, DGC, DGEG*, and *S. Energia*) took part in supporting the *Energy Efficiency Roadshow* initiative from the European Commission held in Lisbon and Porto in 2018. This roadshow featured an interactive exhibition with tips on saving energy, with over 4,000 visitors in Portugal (Gouveia and Palma, 2021b). In 2020, in the scope of the European project *STEP*, the *Portuguese Association for Consumer Protection* (DECO) created an office to provide personalised advice on energy management. *FCT-NOVA* is part of the *EPAH – EU Energy Poverty Advisory Hub* (2021-2024) coordination team – aiming to provide technical assistance to European municipalities implementing sustainable solutions to alleviate energy poverty. Several Portuguese researchers are also integrated in the activities of the *EU COST ACTION – ENGAGER* on Energy Poverty (2017-2022).

[1] www.menurenovacaoverde.pt

As the HTR concept, applied to energy users, is relatively novel in Portugal, policies, projects, and measures have not explicitly focused on this topic. Nevertheless, most of the examples synthesised above present relevant experiences to the broader context of Portuguese HTR energy users. The two case studies analysed in the next section, following the methodological approach defined by Karlin *et al.* (2021), were chosen due to their particular focus on targeting and engaging with HTR audiences, their innovative nature in Portugal, and their scope on the residential (Case Study 1) and non-residential (Case Study 2) sectors, as requested by Rotmann *et al.* (2021b). The first case study presents an energy poverty vulnerability index, developed by Gouveia *et al.* (2019), which enabled the nationwide mapping of household vulnerabilities. In the *LIGAR - Energy Efficiency for All* project, the index was used to identify critical regions, and vulnerable energy users were engaged through household interviews (Horta *et al*., 2019). The second case study *Energy Efficiency in Telheiras' Traditional Commerce* showcases a neighbourhood-scale project aimed at energy efficiency improvement in traditional commerce and services SMEs, combining energy audits, surveys, and community engagement (Sequeira and Joanaz de Melo, 2020).

Methodology

The overall methodology followed the co-designed CSA methodology and template (Rotmann *et al*., 2021). Our HTR Task follows a recently-developed research framework by See Change Institute, called 'The ABCDE Building Blocks of Behaviour Change' (BBoBC; Karlin *et al.*, 2021). The ABCDE Building Blocks framework serves as a systemised and data-driven approach to designing, implementing, and evaluating behaviour change interventions, including for those aimed at HTR audiences. These Building Blocks include (see Fig. 1 in Karlin *et al.*, 2021):

- **A**udience: the pilot or programme's intended participants
- **B**ehaviour: the specific behaviour the programme intends participants to change
- **C**ontent: the programme strategy and approach
- **D**elivery: the mechanism and timing of the intervention (e.g. delivery may happen through door-to-door interactions or social media, etc.)
- **E**valuation: the way in which programme success is measured or otherwise assessed

Throughout the development of these case studies, it became clear that some of the building blocks applied more readily to these programme examples than others, as discussed in more detail in the General Discussion section of this document. As will become apparent in each case study, Content and Delivery are often closely linked. Given that certain content lends itself more readily to specific delivery channels, it can be a bit tricky to untangle which was content and which was delivery. The other building blocks, for the most part, proved more straightforward to apply to these concrete programme examples.

Methods of Data Collection for each CSA

The methodology to develop the case studies is simple, and is composed of the following elements (from Mundaca, 2021).

First, the case studies were chosen based on the outcomes of previous activities undertaken by the Users TCP HTR Task. As indicated in the previous section, these activities aimed to identify and characterise HTR audiences in participating countries. To that end, a variety of data sources were used, including an international survey, interviews with experts and practitioners, and a literature review (for details, see Ashby *et al.*, 2020a and b; Rotmann *et al*., 2020). We then reached out to our funders and other stakeholders to identify the most appropriate CSAs for Portugal.

From an analytical point of view, the approach adopted the BBoBC framework developed (for details see Karlin *et al*., 2021; and Rotmann *et al.*, 2021). Data gathering was guided by an interview protocol that addressed each building block, and the set of questions can be found in Rotmann *et al*. (2021).

Interviews (~60 minutes) supported data collection and provided a deeper understanding of the chosen cases. These were conducted by the author of this report and the following people were interviewed:

- Dr. Ana Horta, Senior Researcher at ICS
- João Joanaz de Melo, Environmental Engineering Professor at FCT-NOVA
- Luís Keel Pereira, Coordinator of the Local Partnership of Telheiras

Finally, the case studies were supported by a review of official documentation and related journal publications. This phase also included the analysis of information found on the websites of the four initiatives, and multiple (*ex-post*) evaluation reports and papers.

Portuguese Case Study – Residential

Background

The project *LIGAR - Energy Efficiency for All* was promoted by the *National Energy Agency of Portugal* (ADENE) and counted with the participation of entities with diverse backgrounds: *CENSE FCT-NOVA*, *Institute for Social Sciences* of the University of Lisbon (ICS), *Sair da Casca* (consultancy company in sustainability and social responsibility), and *CDI Portugal* (non-governmental organisation for inclusion and innovation). *LIGAR* was funded in the scope of the *PPEC Programme* and approved by the *Portuguese Energy Services Regulator*. The project adopted an inclusive approach for implementing consumer engagement actions to increase energy efficiency in vulnerable homes and reduce energy poverty. An interview was conducted with Dr. Ana Horta, senior researcher at ICS and a specialist in social studies on energy poverty, aiming to deepen the configuration and analysis of this case-study.

In the first phase of the project, *CENSE* developed a multidimensional high-resolution *Energy Poverty Vulnerability Index* (EPVI) to assess energy poverty vulnerability in all 3,092 Portuguese civil parishes (local administrative units smaller than municipality), aiming to identify and map hotspots of vulnerability in winter and summer (Gouveia *et al*., 2018; Gouveia *et al*., 2019). The index combines the calculation of an energy performance gap (difference between theoretical and actual energy consumption) by Palma *et al*. (2019), using data on construction characteristics of buildings, climate variables, heating and cooling technologies, and official energy consumption statistics for the residential sector; with the adaptive capacity of the population, using socio-economic indicators, into a value of vulnerability ranging from 1 (least vulnerability) to 20 (maximum vulnerability). The average weights of the different indicators for computing the adaptive capacity were selected according to the feedback provided by 13 experts of the consortium. The selected socioeconomic indicators were the following: population with 4 or fewer years of age, population with 65 or more years of age, average monthly income, dwelling owned by the occupant, population with a university degree, unemployment rate, and building state of conservation.

The EPVI results were analysed together with complementary regional indicators such as the share of social housing, informal dwellings, and social tariff recipients typically associated with the concept of HTR energy users. As a result, a shortlist of 168 priority regions was picked. Of this bunch, ten regions from mainland Portugal were selected for the next phase of the project, according to their higher vulnerability levels in summer and winter, territorial typology (rural/urban), size of the population, and easiness in accessibility and communication with local authorities, which were regarded as important intermediaries to engage with the population. The EPVI mapping and the ten selected regions are displayed in Figure 2.

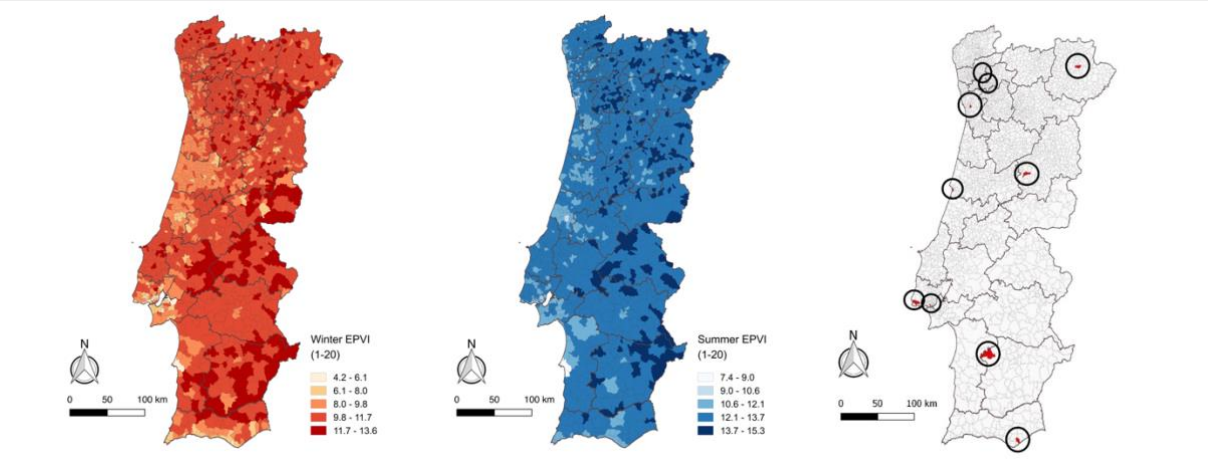


Figure 2: Winter EPVI map (left), Summer EPVI map (centre) and the ten selected regions for intervention (right) (Gouveia *et al.*, 2019; Horta *et al.*, 2019)

Audience

In the second phase of the project, *ICS* devised a methodology to qualitatively study the population, or audience, of the selected regions in what pertains to the circumstances conducive to a situation of energy poverty and its impact on well-being and daily life. The goal was to identify opportunities for interventions and to develop energy poverty alleviation strategies. The method consisted of household interviews – a total of 100 were conducted, distributed by the 10 selected regions from north to south Portugal (10 in each region) to represent the diversity of realities in the national territory.

The interview script integrated common theoretical approaches in sociologic research, like practice theory, to capture the complexity of social dynamics and practices regarding elements such as the use of energy technologies, competencies, and meanings. The interviews touched on the following dimensions: dwelling characterisation, renovation works, conservation state, satisfaction about the dwelling, notion of comfort, evaluation of thermal comfort, practices to cope with the cold and the heat, domestic equipment, energy consumption, energy savings, family budget, impact of the economic crisis, energy supply contracts, access to information, daily habits, and household composition.

> *"It was important not to mention that we were analysing 'energy poverty' but rather studying domestic energy consumption and energy efficiency, as not to put a negative charge on the interviews, which were inevitably a moment of intrusion and tension. The interviewees did not directly benefit from the interview, so it would have been beneficial to provide a compensation for participants, to increase participation rate and motivation. However, this was not possible due to project budget limitations"*
> **Dr. Ana Horta, Senior Researcher at ICS (quote translated by the authors).**

With the help of the local authorities, the interviewees were selected according to different profiles of households, dwelling typologies and neighbourhood characteristics to have a diversified sample and capture vulnerable households (Horta and Sousa, 2018). Single-parent

families with low income or unemployed, young families with 2+ children (up to 4 years old), big families (with 3+ dependent children), and elderly couples or single persons with low pensions were among the selected in the interviews' sample. Interviewees also included people residing in single-family and multi-family buildings, rented and owned dwellings, rural and urban settings, and different types of neighbourhoods (requalified and non-requalified). The differences in gender, age and income were carefully considered in the sample.

> *"The intermediaries between the project and the vulnerable population were social workers from the local authorities (civil parishes), with whom the population had already a previous connection and an ongoing trusted relationship. This was key to reach and engage these vulnerable groups, who frequently shy away from this kind of interaction."* **Dr. Ana Horta, Senior Researcher at ICS (quote translated by the authors).**

Interviews were primarily conducted in person, with minor exceptions, via computer or telephone. A total of 134 participants were interviewed (as some of the interviews included more than one member of the same family), and their demographic indicators are depicted in Figure 3. A literature review process prior to the qualitative analysis highlighted the difficulty of interviewees of these selected profiles in guaranteeing an adequate level of essential energy services in their home due to lack of financial resources, low education levels, and low energy performance of their dwellings, among other reasons.

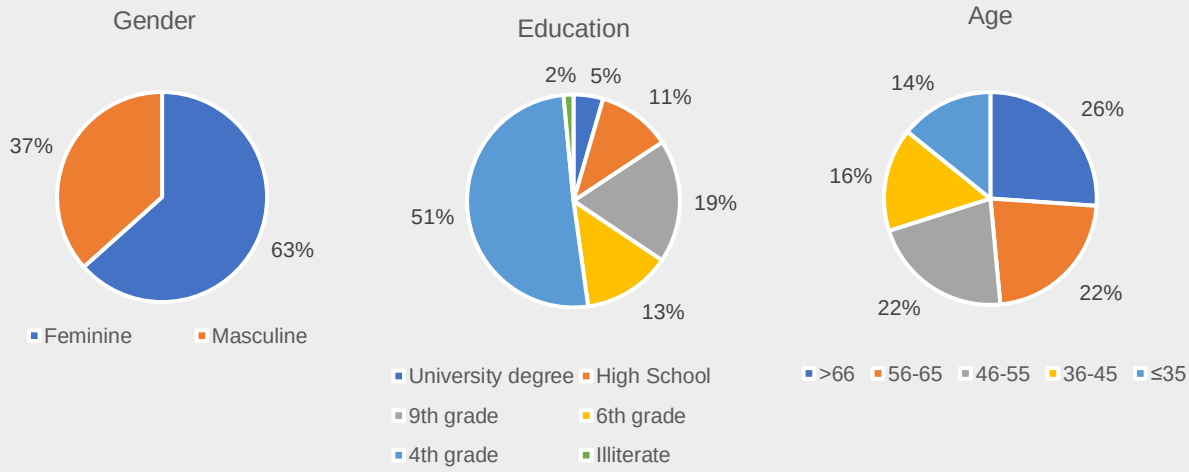


Figure 3: Sociodemographic characterisation of the audience (adapted from Horta and Sousa, 2018)

Behaviours

Results show that more than half of households (56%) report living in a home that is either too cold in the winter or too hot in the summer, and only 16% have thermal comfort in both seasons (Horta *et al*., 2019). The reasons behind these reports are the low quality of dwellings, with frequent air and water leakages and humidity and mould, but more importantly, the high cost of energy when compared with the lower income levels. Several interviewees claim that their

dwelling needs renovation, although the lack of financial resources and/or their tenant status makes the process more difficult.

In the winter, these vulnerable households adopt basic daily practices such as using more clothing, blankets and covers and going to sleep earlier instead of using heating appliances (Horta *et al*., 2019). In the summer, they opt to open the windows and doors to cool their home. Households show a lack of knowledge regarding the energy consumption of domestic appliances and measures to reduce it. Appliances are generally old, and consumers are unaware of the energy label when purchasing them, paying more attention to their price. New appliances can also be problematic, as people have difficult working with them. It can result in misuse, with unnecessary increase in energy consumption or no use at all, potentially creating stress and discomfort. Some people also have personal preferences regarding certain appliances, even if they are not the best option economically and for their comfort. In general, these groups are very resistant to change. There is evidence of a cultural normalisation of feeling cold, especially in regions with a milder climate, translating in habituation and desensitisation to cold temperatures inside homes (Horta *et al*., 2019).

> *"The essential interventions, such as building renovations and equipment replacement, involve significant investment that people often cannot afford. People instinctively adopt some energy-saving behaviours, except for the frequent use of old freezers and refrigerators, where they store large amounts of food bought on discount in the supermarket, aiming to save money on food but ending up spending more on energy. Stand-by consumptions are often disregarded. There is an opportunity for savings by adjusting energy contracts."*, **Dr. Ana Horta, Senior Researcher at ICS (quote translated by the authors).**

> *"People with low education levels have more difficulty dealing with their vulnerable situation, asking for help, or finding ways to solve their problems. The feeling of shame, which is transversal to all the analysed profiles, is also a major factor behind the condition of hard-to-reach, since it prevents people from speaking out about their problems",* **Dr. Ana Horta, Senior Researcher at ICS (quote translated by the authors).**

Several opportunities of interventions surfaced at the end of this phase:

i) increasing public awareness for the severity of energy poverty in Portugal,
ii) calling for local and national decision-makers to address regulation and monitoring of domestic energy prices, residential buildings' energy performance, and construction norms,
iii) breaking unhelpful social constructs regarding thermal (dis)comfort,
iv) raising awareness of authorities regarding the state of social housing,
v) providing information to prevent inadequacy between energy supply contracts and consumers' needs, and
vi) increasing awareness and knowledge about the efficient use of appliances and domestic equipment.

> *"There is a generalised lack of trust when it comes to government support. People are not used to it and do not expect authorities to provide help and promote collective well-being. They are suspicious of bureaucracy. Many have trouble reading and writing and do not know what interventions they need. Often their homes need deep retrofit, which cannot be fully covered by current programmes. There are also significant levels of informal economy and people are afraid to get caught if they apply for support instruments",* **Dr. Ana Horta, Senior Researcher at ICS (quote translated by the authors).**

Content

In the third and last phase of the project, drawing on the knowledge obtained in the previous stage, *ADENE, Sair da Casca* and *CDI Portugal* developed various initiatives to engage the local community and tackle the identified causes of vulnerability. The first one was the development of an energy efficiency manual (ADENE, 2019) for local agents and the wider population, addressing all the areas about which a lack of information was identified. An ideation contest was also implemented in the selected regions, aiming to promote innovative ideas to stimulate awareness and involvement of local agents for energy efficiency whilst guaranteeing execution and continuity.

Finally, energy brigades were organised, where local groups personally supported vulnerable households to use energy more efficiently. These brigades involved training sessions for local agents at first and then visits of these agents to local households, for diagnosis of housing conditions and equipment, observation of behaviours and understanding of choices, identification of less-efficient practices and appliances, support the interpretation of energy bills and contracts, and advise and educate on better daily practices.

> *"Support can be most effective when provided by a trained multidisciplinary team, equipped with both technical and interpersonal skills, with frequent visits to vulnerable homes, before, during and after a particular intervention. It would be beneficial to have a local example in each civil parish of a dwelling in which successful interventions were performed, to increase confidence and adhesion to support actions",* **Dr. Ana Horta, Senior Researcher at ICS (quote translated by the authors).**

Delivery

In the final phase of the project, delivery was executed through the form of energy efficiency materials provision, event organisation and home visits by the project's partners. Material provision and event communication was mostly done through the website of the project. Home visits were organised with local authorities' intermediaries, so that people would feel more comfortable and trusting of the team visiting their homes. Arguably, the ideation contests had no impact since there were no project proposals from contestants, which denounces problems in the strategy execution. The energy efficiency manual is available to the public and local agents, intending to support energy users. The impact of this strategy is somewhat connected with the willingness of the local authorities and citizens themselves to engage with it. The energy brigades are based on a more proactive form of delivery, as agents contacted the

consumers and visited them in their homes, potentially increasing the impact of the intervention.

Evaluation

The specific impact of implemented measures was not monitored after the project ended. The real effect of these measures has not been evaluated in the long term, as it is difficult to measure due to its subjective and intangible nature and since they relate to a complex multi-faceted issue as energy poverty. The number of areas targeted (10), number of vulnerable households interviewed (100), and number of interventions (500) were the key indicators to evaluate the performance of the project after its end date.

Discussion

This project had a comprehensive approach, from mapping and pinpointing vulnerable regions to identifying and engaging households, and implementing solutions, using different quantitative and qualitative methods in each phase. It involved a wide array of collaborators with diverse backgrounds and expertise, and it targeted different profiles of HTR energy users across the country. While complex, the second and third phases of the project could be replicated in other regions to reach more vulnerable HTR energy users in Portugal. These can be regarded as the main positive takeaways from this project. On the other hand, implemented initiatives had limited impact, as they only focused on information and awareness, leaving out physical and financial interventions, which play a significant part in improving energy performance and reducing energy poverty in HTR energy users. Moreover, the project did not have any follow-up nor were its impacts evaluated at short- or long-term, which makes it difficult to evaluate the effectiveness of the implemented solutions in helping the targeted vulnerable consumers.

Portuguese Case Study – Non-Residential

Background

The core tasks of the project *Energy Efficiency in Telheiras' Traditional Commerce* were conducted in the scope of a master's thesis work in Environmental Engineering at FCT-NOVA (Sequeira, 2016). Two interviews were performed to deepen this case study analysis: João Joanaz de Melo – Environmental Engineering Professor at FCT-NOVA, energy efficiency expert, and academic supervisor of the project –, and Luís Keel Pereira – Coordinator of the Local Partnership of Telheiras and community representative for the project.

The reasoning behind the project was that, despite their acknowledged importance in overall energy consumption and urban sustainability, services and commerce sector SMEs had been little studied and reported in the literature. The lack of policy measures, projects, and actions, as well as scarce and disconnected approaches between researchers, citizens, businesses, and authorities, have undermined the sector's involvement in the energy transition. A literature review conducted before the study revealed the wide-ranging and severe barriers that SMEs face when acting on their energy performance, placing them within the HTR framework.

> "*To achieve the* European Green Deal *targets and to have a less intensive energy system, we need to reach everybody. We know that SMEs represent something like half of the energy consumption in industry and services in Portugal, but the sector has been absolutely neglected in public policy."* **João Joanaz de Melo, Environmental Engineering Professor at FCT-NOVA.**

In this context, the project's key goals were to explore the energy-saving potential in the small business service sector and understand the drivers and barriers influencing energy-related behaviours and decisions. Chosen methods took a sequential approach from the mapping and characterisation of target users to the performance of energy audits and surveys and to the provision of direct counselling to project participants and the community (Sequeira and Joanaz de Melo, 2020). The selection of the Telheiras neighbourhood in Lisbon instead of random businesses across the city resulted from:

i) the recognition that a community-based approach would facilitate personal relations with the participants (word-of-mouth playing an essential role in small businesses),
ii) the simpler logistics of conducting fieldwork in a single neighbourhood compared with larger areas, and
iii) the pre-existing solid connections with community associations and other local stakeholders that could support communication and engagement with local businesses and reinforce project outcomes in the long-term.

A shared aim between the project managers and the Local Partnership of Telheiras, which gathers several associations and informal groups active in the neighbourhood, was to go beyond the academic work and generate impact in business and community awareness of energy issues.

> "*As the* Local Partnership of Telheiras, *we try to involve all groups of our community in everything we do. And local commerce is one of the most difficult groups to engage because they have limited time and are mostly focused on keeping their business running. It made a lot of sense to support this project because we were already trying to develop some ideas on promoting sustainability, and we always try that these initiatives also contribute to foster community building*." **Luís Keel Pereira, Coordinator of the Local Partnership of Telheiras.**

Audience

The target audience was defined as small businesses of the services and commerce sector that operate mainly at the neighbourhood scale in Telheiras. Six groups of activities were analysed: general retail, refrigerated retail, food services (restaurants, bakeries, coffee shops), health and beauty (hair salons and small medical clinics), associations (sports, arts and social associations), and print shops (Sequeira, 2016). Offices and 'others' were excluded from the scope of the study: offices because they have been the object of other studies and the 'others' group because they were too diverse for a meaningful analysis. At the time, the HTR formulation was not an explicit motivation for selecting the target audience. Nevertheless, the project's participants, and SMEs in general, can be regarded as HTR energy users due to a combination of factors such as lack of awareness, insufficient knowledge, low priority attributed to energy management, split incentives, mistrust, and shortage of funds (Sequeira and Joanaz de Melo, 2020; Rotmann *et al.*, 2021a).

> "*We really wanted to match the theoretical framework that we already had on energy efficiency measures with actually speaking to the people that are going to implement them. We are talking about small private businesses, that in business terms are often marginal, and that are highly sensitive to crisis, lack specialised and knowledgeable personnel, and often have a short-term view, so it takes more work or more convincing to have these managers look at something like energy efficiency*." **João Joanaz de Melo, Environmental Engineering Professor at FCT-NOVA.**

The first step was an inventory and mapping of all commerce and service enterprises in Telheiras (Figure 4). A total of 160 service establishments were inventoried in the neighbourhood, of which 148 were small businesses. According to the criteria described above, where large businesses and offices were excluded, 107 establishments became the study universe. Efforts were made to contact the business managers, with success in around 80 cases, and all were offered the opportunity to participate in the project; 47 accepted and thus became the sample. Of these, 13 cases were selected for standard energy audits based on diversity, representativeness, and availability of information, and the other 34 cases were subject to more straightforward walk-through audits (Sequeira and Joanaz de Melo, 2020). Inventoried data focused mainly on businesses' characteristics, and no demographic and psychographic information was collected on the businesses' owners and/or managers.

Figure 4: Location of Telheiras and small businesses in project scope (Sequeira and Joanaz de Melo, 2020)

Behaviours

Targeted energy behaviours included optimisation of management practices (e.g., turning off lighting and appliances when not in use, proper maintenance, and efficient use of air conditioning units), upgrade and equipment replacement (e.g. LED lighting, efficient refrigerators, and solar thermal systems), and renovation of building components (e.g. replacement of windows, and façade insulation). Overall energy-saving potential for each establishment was estimated using case-appropriate measures from this set (Sequeira, 2016).

Content

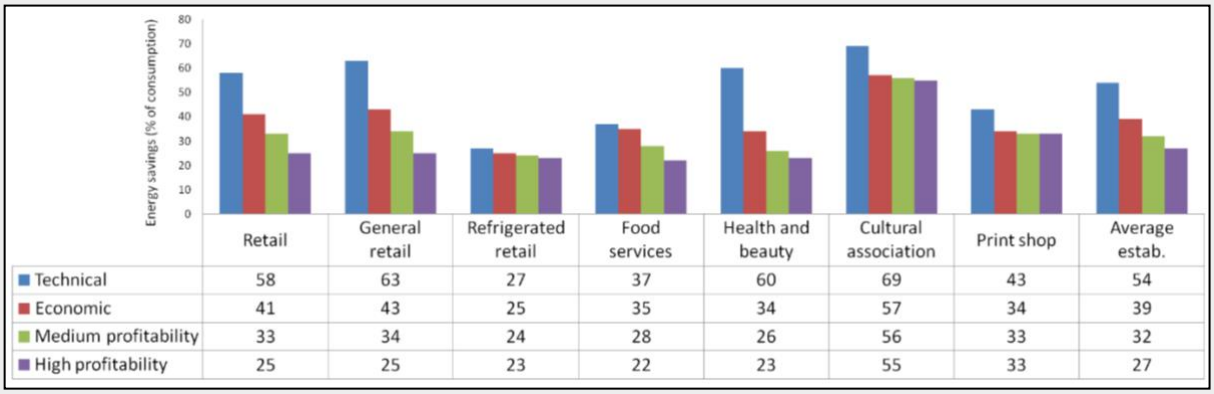
In the second phase of the project, a systematic, adaptable, practical, and flexible energy audit program was piloted in Telheiras. Standard energy audits were used to identify energy consumption patterns, applicable measures and costs, and overall saving potential. All energy-consuming equipment was visually inspected and divided into the following end-uses: lighting, cooking, refrigeration, hygiene and cleaning, office equipment, water heating, heating ventilation and air conditioning (HVAC), and activity-specific uses (Sequeira and Joanaz de Melo, 2020). Walk-through energy audits included only the characterisation of the establishment; data from both audit approaches was crossed and compared. Besides the energy audits, participants were also surveyed to better understand their businesses' characteristics (e.g., establishment area, number of employees, working hours, and number of clients), energy behaviours, drivers, and barriers towards energy efficiency. Energy audit

reports were produced for each establishment that received a standard audit, with comprehensible detailed information on energy consumption patterns and energy-saving measures (Sequeira, 2016).

Key results from this phase included:

i) most energy-intensive categories were refrigerated retail and food services and the less intensive was general retail,
ii) small business services in the case study were, on average, less energy-intensive than the Portuguese service sector, but more intensive than the residential sector,
iii) HVAC, lighting, and office equipment were relevant end-uses for all businesses, while refrigeration and water heating seemed to be specific to certain activities,
iv) cost-effective energy efficiency measures were most significantly available in refrigeration, lighting, and HVAC, and
v) energy-saving potential is very relevant, but variation between individual cases is considerable (Sequeira and Joanaz de Melo, 2020).

Figure 5 showcases the energy-saving potential for the small business activities, according to payback time (*i.e.*, high profitability is under 3 years, medium profitability is under 6 years, economic is under 15 years, and technical has no restrains).



	Retail	General retail	Refrigerated retail	Food services	Health and beauty	Cultural association	Print shop	Average estab.
Technical	58	63	27	37	60	69	43	54
Economic	41	43	25	35	34	57	34	39
Medium profitability	33	34	24	28	26	56	33	32
High profitability	25	25	23	22	23	55	33	27

Figure 5: Energy saving potential in the case-study's services activities (Sequeira and Joanaz de Melo, 2020)

Delivery

Small businesses in Telheiras neighbourhood were directly engaged, with a door-to-door, face-to-face individual approach. In this first contact, the project's scope (i.e., not-for-profit and straightforward academic work), goals (i.e., inform on energy use and reduce bills) and tasks (i.e., conduct energy audits and surveys) were explained in detail, aiming to generate trust between auditors and auditees. After the first successful audits, word-of-mouth also played a role in attracting participants since local business managers talk to each other and quickly understood the potential benefits of conducting a free energy audit.

> *"So, once it was known that this project was underway, it was easier for the next business managers to accept that this was a good thing and not an underhand scheme to get them to pay something. After some initial wariness, because people*

> *did not know what this was about, most were conquered by the idea. So, it's both a matter of reaching the people and showing them that we really have something to offer. We are offering an opportunity. We are offering better knowledge. And people react very well to that. And it works better if we treat the issue as a community."* **João Joanaz de Melo, Environmental Engineering Professor at FCT-NOVA.**

The *Local Partnership of Telheiras* played an important role as a trusted intermediary between the project and the community. This was accomplished in four ways:

i) an initial interview about the project that was widely shared in local media and social networks (Viver Telheiras, 2015),
ii) an explanatory email about the project with an appeal for participation that was sent to all businesses of Telheiras,
iii) three energy-saving workshops for businesses and households organised during local events (in 2016, 2017, and 2019), and
iv) a follow-up interview summarising the project's key outcomes aimed at the local community (Viver Telheiras, 2020).

> *"I think there are different ways of approaching people that can work. One of them is to provide celebration spaces that bring people together, not only for the celebration itself but also to get people engaged with relevant topics for the community. For example, we can have a music festival in our neighbourhood, where people come for the music and to have a drink, and we take the opportunity to convey information about sustainability issues, in this case energy, and on how they can get involved. The important thing is to build relationships, to build trust, and to build a community."* **Luís Keel Pereira, Coordinator of the Local Partnership of Telheiras.**

In the third and final phase of the project, energy audit reports were provided to the respective small businesses (Sequeira, 2016). These were accompanied by informal counselling sessions, where the main results from the energy audits and the recommended measures were explained in detail, and the auditees feedback was received. Participants often showed surprise when confronted with their energy consumption patterns and the financial costs of inefficient practices. Critical drivers for energy-saving identified in the survey were the desire to cut operational costs and the presence of managers sensitive to energy issues (Sequeira and Joanaz de Melo, 2020). Around one-third of businesses had already taken small steps to reduce their energy consumption – e.g., installing movement sensors for lighting in bathrooms and avoiding the use of heating and cooling equipment, the latter frequently in lieu of thermal comfort. These quick wins were a particular concern for more energy-intensive and/or less financially stable businesses, even though client satisfaction remained the priority.

During the counselling sessions, several barriers surfaced that were faced by small businesses (Sequeira and Joanaz de Melo, 2020). Shortage of funds and lack of access to finance were important obstacles for the non-adoption of expensive measures with longer payback times. However, it became clear that other barriers were responsible for the non-adoption of a significant share of low-cost measures with shorter payback times. The project partially addressed the lack of awareness and insufficient knowledge barriers, but as energy

illiteracy is widespread in the Portuguese population, these remain important structural factors that make investment decisions difficult. On the other hand, barriers such as low priority/time for energy management (in micro and small businesses, often only one person makes all decisions), and distrust of profit-oriented energy services providers were not explicitly addressed by the project. Split incentives between building owners and business managers were also uncovered as an important barrier for this type of SMEs since 85% of services activities in the case study take place in rented spaces (usually the ground floor of residential buildings).

Evaluation

The core fieldwork of this project was performed for a master's thesis and, thus, within a short, limited timeframe (Sequeira, 2016). Unfortunately, no formal evaluation of the project's real long-term impacts on energy behaviours in Telheiras was conducted. Informal conversations with some business managers and local stakeholders indicated that at least a few of the more accessible and lower-cost measures were adopted and that the project contributed to an increased awareness of energy issues in the community. The repetition of the small businesses inventory, one year after the initial one, revealed a high turnover rate among the 107 establishments of the study universe (9 of these closed while 8 new opened), which could also difficult any monitoring strategy of long-term results. Impacts of the project can be quantitively measured by the number of neighbourhoods (1), and types of SMEs (6) studied, as well as by the number of establishments audited (47), energy audit reports delivered (13), and community energy-saving workshops performed (3).

> *"I think the methodology became quite robust by the end of the fieldwork. What we really need now is to scale up and to understand what kind of tools and organisational setting we need to go to the next level in terms of number of participants and impact. When we scale up things from a pilot, several aspects may work differently.*" João **Joanaz de Melo, Environmental Engineering Professor at FCT-NOVA.**

Discussion

Developed at the neighbourhood-scale, the project advanced a comprehensive approach, including an inventory of target users, engagement, performance of energy audits, and provision of energy advice. It gathered useful information on energy consumption patterns and saving opportunities for different profiles of understudied HTR energy users of the SME sector while fine-tuning and piloting methodologies to reach them. The local community was involved in the project from the kick-start, which positively contributed to its execution. From the end of the project to this date, the *Local Partnership of Telheiras* is continuing to push forward energy issues as a key area for the neighbourhood's long-term social and environmental sustainability. These can be regarded as the main positive takeaways from this project.

> "*The fact that we could support this project opened up some doors because it brought people together that have an interest in the energy area. Currently, we are opening working groups to address different initiatives in sustainability, and one of them will be on energy. The idea is to have a sort of energy community in our neighbourhood that will produce renewable energy locally and improve energy efficiency. We get a*

> *lot of inspiration from other projects in Portugal and internationally, and we are really looking forward to establish this energy community*." **Luís Keel Pereira, Coordinator of the Local Partnership of Telheiras.**

On the other hand, the project was developed in a limited timeframe and geographical scope, while mainly focusing on tailored energy counselling rather than on actual financial support and physical interventions. The project's effectiveness in changing energy behaviours was hindered by these constraints. Although it is labour-intensive and requires context-adapted solutions and communication strategies, the energy audit programme could be replicated in other neighbourhoods and scaled to larger areas to reach more HTR energy users.

General Discussion

Lessons and recommendations

The *ABCDE Building Blocks of Behaviour Change framework* by Karlin *et al.* (2021) proved useful for the case studies' analysis as it allowed a fresh, holistic, and critical perspective on the selected projects. This fostered the identification of successes, shortcomings, lessons learned, and recommendations.

Both projects were well-grounded on their motivation and goals, specifically looking at different profiles of HTR energy users. The initial phases involved the mapping of the target audience, either at a national scale through a multidimensional index, or at a local scale through an inventory. Regarding behaviours, the projects strongly focused on improving energy efficiency and increasing awareness around energy poverty. A common positive point was the involvement of trusted intermediaries that facilitated the communication between the project team, the target audience, and the broader community. While the methods were different (one focusing on regional quantitative assessment coupled with qualitative interviews, and the other using quantitative energy audits coupled with qualitative surveys), both examples successfully took advantage of proximity approaches to engage and advise HTR energy users. Although evaluation and monitoring were lacking, which appears to be a frequent flaw in this type of project, the case studies did contribute towards increasing awareness of energy issues in targeted energy users and their respective communities, creating a strong backbone for follow-up activities and further research.

Besides the limited evaluation process, the projects shared other common shortcomings. In the first place, the approach mostly focused on the proactive engagement of HTR energy users and on providing tailored advice on energy behaviours. Notwithstanding the importance of energy literacy, one factor that would improve projects' results would be to offer attractive incentives and continued support, thus, leveraging the actual adoption of measures. In addition, both case studies were limited in geography, time, and number of participants. Even if parts of the work could be replicated and scaled up to reach a larger number of HTR energy users, this would entail more resources, different challenges, and a new level of complexity.

From the Portuguese case studies analysis, the following recommendations can be drawn regarding projects that intend to successfully engage with HTR energy users: a) define and map your target audience early, b) clearly describe the energy behaviours that you would like to be changed, c) build strong ties with trusted intermediaries, such as local authorities and associations, and try to involve the whole community, d) prioritise door-to-door and face-to-face approaches when conducting project activities, and e) establish early-on a quantitative and systematic monitoring and evaluation strategy for your project.

Future research

The case study analysis presented allowed a first exploratory look at HTR energy users in the Portuguese context. Although still superficial and requiring further research, it suggests that HTR energy users may represent a highly significant number of businesses and families in

Portugal, whose participation in energy issues is severely constrained by a wide range of vulnerabilities, circumstances and/or characteristics. Nevertheless, effectively engaging this heterogeneous audience is vital to foster a sustainable, inclusive, and just energy transition. Future work on HTR energy users in Portugal should attempt to answer the following research questions:

i) Why should we specifically target HTR energy users?
ii) Who should be regarded as HTR energy users and why?
iii) What behaviours or interventions we want HTR energy users to change/adopt?
iv) Who is targeting the HTR and why?
v) How to successfully engage with HTR energy users and prove that it worked?

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