SOCIALWATT

CONNECTING

OBLIGATED PARTIES

TO ADOPT INNOVATIVE SCHEMES TOWARDS

ENERGY POVERTY ALLEVIATION

D2.1

Evaluation of schemes to tackle energy poverty

October 2020

The SocialWatt project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 845905

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PREFACE

SocialWatt will develop and provide utilities and energy suppliers with appropriate tools for effectively engaging with their customers and working together towards alleviating energy poverty.
SocialWatt will also enable obligated parties under Article 7 of the Energy Efficiency Directive across Europe to develop, adopt, test and spread innovative energy poverty schemes.

SocialWatt will contribute to the following three main pillars:

1. Supporting utilities and energy suppliers to contribute to the fight against energy poverty through the use of decision-support tools.
2. Bridging the gap between energy companies and social services by promoting collaboration and implementing knowledge transfer and capacity building activities that focus on the development of schemes that invest in renewable energy sources/energy efficiency and alleviate energy poverty.
3. Implementing and replicating innovative schemes to alleviate energy poverty.

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CONSORTIUM

ICCS	INSTITUTE OF COMMUNICATION & COMPUTER SYSTEMS	EL
IEECP	INSTITUTE FOR EUROPEAN ENERGY AND CLIMATE POLICY STICHTING	NL
RAP	REGULATORY ASSISTANCE PROJECT	BE
E7	E7 ENERGIE MARKT ANALYSE	AT
ISPE DC	ISPE PROIECTARE SI CONSULTANTA S.A.	RO
EDF	ELECTRICITE DE FRANCE	FR
NATURGY	NATURGY ENERGY GROUP S.A.	ES
ESB	ELECTRICITY SUPPLY BOARD	IE
PPC	PUBLIC POWER CORPORATION S.A.	EL
CEZ VANZARE	CEZ VANZARE S.A.	RO
FORTUM	SIA FORTUM JELGAVA	LV
HEP ESCO	HEP - ESCO DOO ZA VODENJE I FINANCIRANJE PROJEKATA ENERGETSKE UCINKOVITOSTI	HR
EVISO	EVISO SRL	IT
CARITAS AUSTRIA	OSTERREICHISCHE CARITASZENTRALE	AT

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CONNECTING OBLIGATED PARTIES TO ADOPT INNOVATIVE SCHEMES TOWARDS ENERGY POVERTY ALLEVIATION

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1 INTRODUCTION

1.1 SOCIALWATT PROJECT

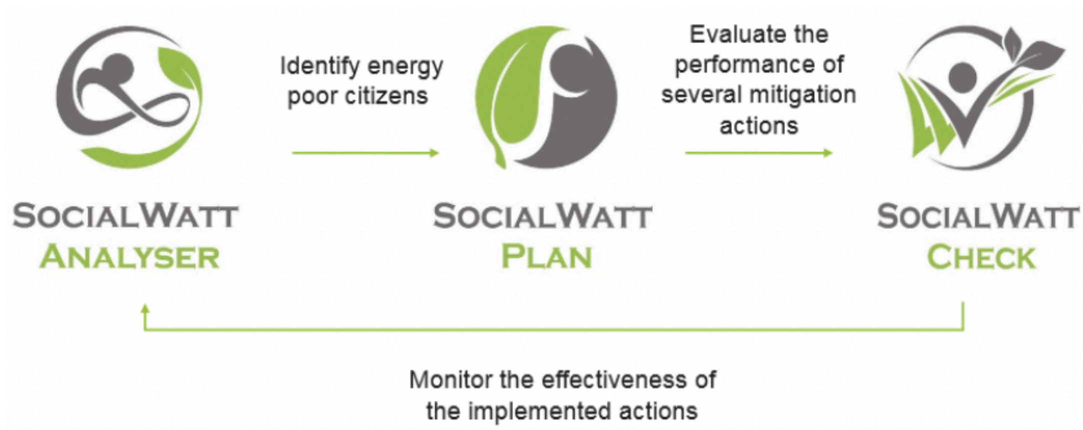
SocialWatt, a project funded by the EU's Horizon 2020 Research and Innovation Programme, aims to enable energy suppliers and utilities to develop, adopt, implement and spread innovative energy poverty schemes across Europe. More specifically, the project aims to enable energy suppliers and utilities to build their capacity and use tools developed within the framework of the project to effectively engage with their customers and implement schemes that alleviate energy poverty.

Three different decision-support tools are being developed and tested as part of the project to support utilities to alleviate energy poverty:

- SocialWatt Analyser for identifying energy poor households among clients, based on utilities' real energy consumption and cost data as well as other readily available data;
- SocialWatt Plan for evaluating the performance of several actions/schemes and selecting the optimal ones (in terms of cost and risk) to implement, in order to elaborate energy poverty action plans; and
- SocialWatt Check for monitoring and assessing the effectiveness of schemes implemented.

The SocialWatt tools are a set of user-friendly decision-support tools, with intelligible features to ensure ease of use. The three tools are designed to be used jointly to support utilities efforts to alleviate energy poverty in an integrated way. They can also be used independently to meet specific needs. Figure 1 illustrates the interaction of the tools.

Figure 1: The SocialWatt tools



The SocialWatt tools have been developed following a long process. Model requirements and specifications were developed, the tools were tested by developers and users, and subsequently the tools were improved to meet users' needs and offer the necessary flexibility.[1]

[1] More details on the process and methodology employed are available in the report developed on the SocialWatt decision-support tools (forthcoming).

The SocialWatt tools are in compliance with the General Data Protection Regulation 2016/679 (GDPR), as they were developed and tested using anonymised data, respecting data ownership, privacy and security. In addition to this, SocialWatt Analyser is developed as a desktop application: each user downloads and uses it locally, so any personal data and information imported and analysed are not shared with any other organisation or stored in any open database or repository.

The eight SocialWatt utility partners have used the SocialWatt Analyser and Plan tools to support their analysis of energy poverty within their customer bases and assess the suitability of schemes and finance mechanisms to alleviate energy poverty. As part of this process the SocialWatt tools have been further refined and improved, in response to the utility partner needs and experiences. The results produced by the tools are presented for each partner in this report. These results will help inform the utilities' development of their energy poverty action plans which will guide their energy poverty alleviation work for the duration of the project and beyond.

This chapter provides an overview of the SocialWatt Analyser and Plan tools and presents a discussion of the experience of utilities in using the tools. The subsequent eight chapters contain the utility partners' analysis of energy poverty and assessment of schemes to alleviate it, performed using the tools. Finally, key lessons learnt on the assessment of energy poverty and the role that calculation tools can play are presented.

1.2 SocialWatt Analyser and Plan tools

1.2.1 SocialWatt Analyser

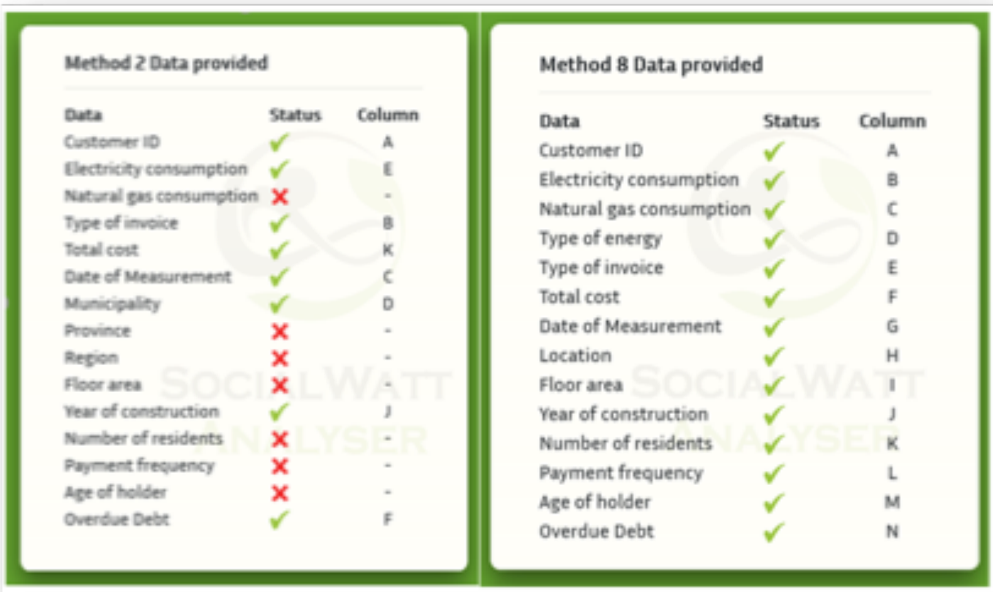
The aim of SocialWatt Analyser is to help utilities identify energy-poor households among their clients. It is designed to help users to more effectively target consumers in energy poverty. It is a user-friendly tool that can also be used by people with limited expertise and technical skills. The development of the tool has considered three major implementation pillars:

- To provide in-depth information about energy-poor households at national, regional and municipal level;
- To enable utilities to identify energy-poor households using i) customer data collected and held internally, in particular energy consumption and costs at a household level, and ii) diversified layers of information, such as climate data (e.g. climatic zones) socioeconomic data (e.g. income), other customer data (e.g. type of buildings), and comfort levels (energy needs); and
- To allow customisations, in terms of different input methods, data types and structures, and consequently to support utilities (even those with limited expertise) to identify energy-poor households. Functions for configuring the tool and appropriately adjusting its settings are built in; for example, the tool enables users to select different energy poverty indicators and to import income data.

The tool allows the user to import customer data from a range of fields commonly held by utilities (Figure 2) as well as external data on average income at a national or subnational level, and average national energy use as required by the energy poverty indicators.

The minimum data required for the SocialWatt Analyser are energy consumption (electricity and/or natural gas), energy costs (€), date of measurement and customer location, and income per capita at municipal, regional or county level from external data.

Figure 2 Example of data input types per data process method in SocialWatt Analyser



Method 2 Data provided

Data	Status	Column
Customer ID	✓	A
Electricity consumption	✓	E
Natural gas consumption	✗	-
Type of invoice	✓	B
Total cost	✓	K
Date of Measurement	✓	C
Municipality	✓	D
Province	✗	-
Region	✗	-
Floor area	✗	-
Year of construction	✓	J
Number of residents	✗	-
Payment frequency	✗	-
Age of holder	✗	-
Overdue Debt	✓	F

Method 8 Data provided

Data	Status	Column
Customer ID	✓	A
Electricity consumption	✓	B
Natural gas consumption	✓	C
Type of energy	✓	D
Type of invoice	✓	E
Total cost	✓	F
Date of Measurement	✓	G
Location	✓	H
Floor area	✓	I
Year of construction	✓	J
Number of residents	✓	K
Payment frequency	✓	L
Age of holder	✓	M
Overdue Debt	✓	N

The Social Watt Analyser tool allows users to choose between six energy poverty indicators with which to assess energy poverty in their customer dataset:

- 10% approach: A household is classified as energy poor if it spends more than 10% of its income on energy to maintain an adequate level of thermal comfort.[2]
- Low income high costs (LIHC): A household is classified as energy poor if its actual energy costs are above average (national median level) and its residual income (i.e., energy costs subtracted from income) is below the official poverty line.
- High share of energy expenditure in income (2M): A household is classified as energy poor if its share of energy expenditure in income is more than twice the national median share.
- Low absolute energy expenditure (M/2): A household is classified as energy poor if its absolute energy expenditure is below half the national median.
- Arrears on utility bills: A household is classified as energy poor if it has arrears on utility bills.
- SocialWatt indicator: A household is classified as energy poor if its actual energy consumption (e.g. electricity, natural gas, etc.) is lower than the theoretically

[2] In the SocialWatt Analyser tool the 10% indicator studies energy expenditure compared to income. The original 10% indicator introduced in the UK compared a household's calculated energy expenditure needed to achieve a prescribed level of thermal comfort and compared this to its income. Given that the purpose of SocialWatt is to make best use of the data that utilities uniquely hold to assess energy poverty, the Analyser tool uses actual energy expenditure rather than need.

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required level for maintaining thermal comfort (heating/cooling/ventilation). If consumption is not lower than the theoretically required level, the ratio between energy cost and income is taken into consideration.

The indicators chosen are three of the four Energy Poverty Observatory primary indicators: high share of energy expenditure in income (2M), low absolute energy expenditure (M/2), arrears on utility bills.[3] Two further indicators have been chosen as they are in use by Member States – 10% approach and low income high cost (LIHC). Finally, the SocialWatt project has developed its own indicator. Utility users are able to select just one indicator or a combination of indicators and overlay and compare results. The ability to use multiple indicators is important in the measurement and targeting of energy poverty as no single indicator of energy poverty is perfect and suitable for all contexts.[4]

1.2.2 SocialWatt Plan

SocialWatt Plan enables the evaluation of different energy poverty schemes. The tool provides utilities with a set of optimal portfolios, comprising different combinations of conventional and innovative schemes to alleviate energy poverty, along with a budget allocation for each scheme and the expected number of energy-poor households to be involved.

The optimisation includes a set of predefined targets and constraints, which can be customised by the user to enable the tool to propose an appropriate selection of the schemes. These include:

- Maximum utility budget per year (2021-2030)
- Energy savings target in kilowatt hours (kWh)
- Number of energy-poor households to engage
- Share of total interventions in old/new buildings
- Share of total energy savings in old/new buildings
- Share of small/large-scale interventions
- Minimum and maximum renewable energy production

The different portfolios are then evaluated against the objective of minimising both investment costs and associated risks from the utility's perspective, by considering the cost-effectiveness and associated risks per action.

Energy poverty schemes

Within the framework of SocialWatt, different policies to mitigate energy poverty were

[3] The Energy Poverty Observatory is an initiative set up by the European Commission to help Member States in their efforts to combat energy poverty. It exists to improve the measuring, monitoring and sharing of knowledge and best practice on energy poverty. Its fourth primary indicator, which is not used in the SocialWatt Analyser tool, is the 'inability to keep adequately warm'. This indicator was not selected as data are not available to utilities to quantify it.

[4] For a discussion of the datasets and indicators available to measure energy poverty see Sunderland et al., 2019, *Report on the status quo of energy poverty and its mitigation in the EU*, https://socialwatt.eu/sites/default/files/2020-01/D1.1%20Status%20Quo%20of%20Energy%20Poverty.pdf

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reviewed, as well as numerous schemes, initiatives and good practices focusing on alleviating energy poverty.[5] Emphasis has been placed on programmes and schemes delivered by or in partnership with an energy supplier. Good practices were categorised under four broad types of support provided to energy-poor, low-income or vulnerable households:

- Bill support and disconnection prevention;
- Energy-saving and energy bill advice (with low-cost measures);
- Low-cost energy-saving measures; and
- Energy efficiency and renewable energy measures.

Overall, 42 schemes that have been or are being implemented to tackle energy poverty were further analysed, with the aim to identify appropriate and innovative schemes to incorporate in the SocialWatt tools for tackling energy poverty. Numerous stakeholders have also been actively engaged to help shape new schemes that may have a considerable economic and social impact on energy poverty.[6]

Overall, 10 schemes are incorporated in SocialWatt Plan (Table 1), with each of the schemes bundling a number of individual energy poverty alleviation actions.

Table 1: Schemes incorporated in SocialWatt Plan

Scheme	Actions
Greening Home	Insulation – exterior walls, roof Windows – double-glazed windows
Renovate your Home	Low-budget renovations (e.g. leaking roofs, plumbing insulation, air leakages, etc.) Efficient lighting
White Appliances	Washing machine Kitchen Fridge
Smarter Home	Smart thermostats
Information and Communication	Energy advice and leaflets
Fighting the Cold	Energy-efficient air conditioning Boilers – diesel Heat pumps Boilers – gas
RES4ALL	Solar thermal panels Boilers – biomass Solar PV
Helping Hand	Customer charge bonus

[5] Sunderland et al., 2019
[6] Osso et al., 2020, *Brief on actions and schemes to consider for tackling energy poverty*, https://socialwatt.eu/sites/default/files/2020- 04/D1.2%20Brief%20on%20actions%20and%20schemes%20.pdf

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Scheme	Actions
eVouchers	Bonus tickets Standby killers installation
Protection Hand	Prohibiting disconnection based on weather Prohibiting disconnection based on customers' needs Prepaid amount of energy

The tool then provides the user with a full breakdown of all possible combinations of schemes and actions that would deliver against their requirements, including two optimal portfolios – one risk-driven portfolio and one cost-driven.

Financial mechanisms

The SocialWatt Plan tool also considers different financial mechanisms. The table below presents the financial mechanisms that were incorporated in the tool, along with the associated risks and the likely percentage contribution of utilities in terms of investment.

Table 2: Financial mechanisms incorporated in SocialWatt Plan

Financial mechanism	Description	% contribution of utility	Risks
Utility	The utility covers the full amount of the necessary investment for the implementation of the scheme	100%	Payback period – high upfront cost
Partial/scalable funding by utility	The utility covers a percentage of the investment necessary for energy interventions (under scalable funding this varies for different groups of citizens, e.g., higher subsidy for energy-poor households), while the customer is responsible for the residual amount	50-80%	Payback period – high upfront cost
On-bill financing	The utility incurs the cost of energy interventions, which is then repaid on the utility bill	60-100%[7]	Long payback period – high upfront cost
On-bill repayment	The customer repays the investment through a charge on their monthly utility bill, but the upfront capital is provided by a third party	5-30%	Implementation complexity

[7] 60%-100% utility contribution refers to the initial utility investment, however, this investment is expected to be returned to the utility.

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Financial mechanism	Description	% contribution of utility	Risks
Revolving loan fund	The utility sets up a pool of capital to provide loans to finance energy interventions/the purchase of energy-efficient products, which is self-replenishing, utilising interest and principal payments on old loans to issue financing for new interventions	30-100%	Payback period – high upfront cost – implementation complexity
Financial Incentive	The utility provides incentives to customers to implement energy efficiency interventions, e.g., reduced energy prices/tariffs, rebates, monetary contributions	10-30%	Payback period
Partnership with the public sector	The utility collaborates with national/regional/local authorities to offer financial incentives and support for the implementation of energy efficiency interventions	50-100%	Bureaucracy
Green loans	The utility, in collaboration with financial institutions/banks, offer customers low/no interest loans to finance energy efficiency interventions/the purchase of energy-efficient products (may also involve public authorities as loan guarantors)	20-50%	Payback period
Collaboration with the private sector	The utility, in collaboration with enterprises from the private sector, offers discounts for purchasing energy-efficient products/services or leasing energy-efficient products	10-30%	Payback period
Collaboration with third parties	A third party or energy service company (ESCO) finances energy efficiency interventions and uses cost savings to repay the costs of investment	5-30%	Implementation complexity
Crowdfunding	The customers of the utility are encouraged to donate an amount through their utility bill, in order to fund energy efficiency interventions or help reduce the tariffs of energy-poor customers	5-30%	Implementation complexity

In conclusion, the final output of the SocialWatt Plan tool is a set of optimal portfolios (in terms of minimising costs and risks), including different combinations of schemes and their respective actions, which meet a set of targets and constraints. For each scheme, the cost,

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associated risk, number of energy-poor households to be involved/number of interventions to be implemented, and the total energy savings are estimated.[8]

1.3 SUMMARY OF LEARNING

1.3.1 DEFINITION OF ENERGY POVERTY, CUSTOMER DATA AND THE SOCIALWATT ANALYSER TOOL.

SocialWatt Analyser has enabled SocialWatt utility partners to analyse their customer data in order to identify levels of energy poverty within their customer base and which households are likely to be suffering energy poverty. It has also enabled the partners to test the suitability and sensitivity of the different commonly used indicators of energy poverty for their context. SocialWatt partners have also used the tool to identify geographical regions that are likely to have a higher concentration of energy-poor households in order to focus area-based schemes.

The process of using the SocialWatt Analyser tool has contributed to significant learning that is useful to other utilities tackling energy poverty both within the framework of the SocialWatt project and beyond.

One significant contextual challenge faced by SocialWatt partners is in countries where there is no definition of energy poverty or where there are ongoing governmental processes to define energy poverty. In these situations, the SocialWatt partner is moving ahead of the government in seeking to measure energy poverty. This creates an uncertain situation for the utility as it selects indicators that may prove to be different from the national definition and priorities that will be set. This is particularly relevant for utilities that are closely aligned with the government, or state owned, which cannot use eligibility criteria that are not state approved. In these situations, policies have relied on the definition of "vulnerable customers" to define and assess eligibility for support.

Despite the fact that the SocialWatt tools are designed to be GDPR compliant, many of the SocialWatt utility partners experienced issues with access to customer data and ability to import data into the tools. Internal and external data protection rules, as well as checks and balances needed to be carefully navigated. In some cases, the sharing of data between groups or divisions within complex corporate structures proved impossible. Therefore, although utility-held energy consumption data is of significant value in assessing energy poverty, there are significant challenges in its use.

Utilities also had issues with obtaining permissions to download applications. This is due to tight controls on IT system security within organisations that hold sensitive personal data, provide an essential service and must ensure integrity of systems.

Overall, the data held by each of the utilities varies, with the main limitations as follows:

- Household-level income data are unavailable to utilities;
- Data on individual dwellings (e.g., year of construction and floor area) and household composition (e.g., number of residents and customer age) are also largely missing;

[8] More information on the development and inputs into the SocialWatt Analyser and Plan tools is available in the SocialWatt decision-support tools report (forthcoming).

- Nationally available data, in particular national median energy expenditure, are missing or available in a format inconsistent with the indicator;
- Where utility businesses supply only one energy carrier (e.g., electricity) or individual customers only purchase either electricity or gas from the utility, the data on the other carrier – and therefore a full picture of energy use – is not available.

Data availability limited the accuracy of the analysis in some areas, for some indicators more than others, as outlined in the next section of this chapter.

1.3.2 Indicators of energy poverty

The testing and comparison of the six energy poverty indicators chosen for the SocialWatt Analyser tool has produced insights and lessons on their usefulness and their limitations. Below each indicator and the data sources it relies on are described and key learnings are summarised.

High share of energy expenditure in income (2M)

Under this indicator:

> *A household is classified as energy poor if its share of energy expenditure in income is more than twice the national median share.*

This indicator aims to identify the level of economic burden caused by energy expenditure by measuring the relationship between income and energy expenditure. The indicator defines as energy poor those households whose share of energy expenditure in income is twice the national median. To calculate this indicator SocialWatt Analyser uses actual energy expenditure from utility customer data. Household income data is not held by utilities so is substituted within the tool by average national or subnational income data, and data on the national median share of energy expenditure in income imported by the user from external data (either national data or Eurostat).

The main drawback of this indicator is that it relies on household-level income data which utilities do not hold. This is a common limitation of all of the income-based indicators – 2M, LIHC and 10%.

Utilities also found that this indicator can underestimate energy poverty in countries where national median energy expenditure in income is quite high; that is, where energy expenditures are high and/or incomes are relatively low. Because this indicator identifies households that spend twice the median, in cases where the national median expenditure is already high it will only identify households that spend a huge proportion of their income on energy. Therefore, the indicator has the tendency to identify only those households that are very severely energy poor, and can miss other households in need of support.

Low absolute energy expenditure (M/2)

Under this indicator:

> *A household is classified as energy poor if its absolute energy expenditure is below half the national median.*

This indicator aims to capture those households that have very low energy expenditure due to unaffordability, sometimes referred to as hidden energy poverty. Those households whose expenditure is below half the national median are considered energy poor. The indicator is calculated by comparing the customer's actual energy expenditure from the utility customer data with the national median energy expenditure imported from external data (either national data or Eurostat).

A clear benefit of this indicator is that it does not rely on household income data, which is unavailable to utilities. It relies heavily on actual consumption data which utilities, uniquely, hold, making it very promising for analysis of energy poverty by utilities.

This indicator does, however, have innate drawbacks. In identifying all households that spend low amounts on energy, it is likely to pick up households living in very efficient homes or holiday homes and second homes only occupied for part of the year. Conversely, this indicator can fail to identify households who spend higher sums on energy but at the expense of other household necessities. Therefore, this indicator can most usefully be employed in conjunction with an indicator that assesses energy expenditure compared to income.

10% approach

Under this indicator:

> *A household is classified as energy poor if it spends more than 10% of its income on energy expenditure to maintain an adequate level of thermal comfort.*

To calculate this indicator the Analyser uses actual energy expenditure from utility customer data and customer income data which, when not available, is substituted with average national or subnational income data.

Like the 2M indicator, the accuracy of this indicator is severely limited by the lack of household income data. The use of national or municipal average income data results in only households that have relatively high energy expenditure – expenditure which is more than 10% of the average income – being recognised as energy poor. A further limitation of this indicator is that it is highly sensitive to the 10% threshold, which may be more or less relevant to different national contexts.

For utilities that hold data on only one energy carrier, for example just electricity use, the 10% indicator does not adjust for this but compares the partial energy use data to the fixed 10% threshold. This means that, when total energy use data is not available, the 10% indicator is likely to underestimate levels of energy poverty.

Low income high cost (LIHC)

Under this indicator:

> *A household is classified as energy poor if its actual energy costs are above the national average level and its residual income (i.e. energy costs subtracted from income) is below the official poverty line.*

To calculate this indicator the tool uses the actual annual energy cost from the customer data compared with the national average energy cost. It then uses customer income data – substituted with average national or subnational income data – against the official poverty line. To be identified as energy poor under this indicator a customer must "pass" two tests: first, that their energy costs are above average, and second, that their residual income is below the official poverty line.

For many utilities this indicator returned very low numbers or percentages of energy-poor households. The main reason for this is that this indicator, uniquely, contains a double test which must be passed before a household is classified as energy poor. Although utility data is well suited to accurately assessing the first test, which compares energy expenditure with the national average, the lack of accurate household income data and the substitution of average area-based income data makes it very difficult for a customer to pass the second test. Therefore, this indicator can significantly underestimate energy poverty if household income data is not available.

SocialWatt indicator

Under this indicator:

> *If the actual energy consumption of a household is lower than the theoretically required level for maintaining thermal comfort, the household is classified as energy poor. If consumption is not lower than the theoretically required level, the ratio between energy cost and income is taken into consideration.*

This indicator compares the customer's actual energy consumption to their calculated energy need. If their actual consumption is below their calculated need (i.e., they are energy rationing), they are defined as energy poor.

To define "energy need", reference households are modelled for each location. Open data sources[9] are used to approximate the energy needs of a "reference household". National standards (e.g., wall, window, roof, and floor heat transfer coefficients) and typical types of dwelling per geographical area (e.g., apartments or single houses) are considered in order to make sure that the energy consumption calculated ensures thermal comfort and is representative of the examined areas. Depending on the availability of data in each country, assumptions are introduced when needed.

The tool allows the user to set sensitivity thresholds – the Building Evaluation Index – to identify customers whose actual energy consumption is slightly below or significantly below its energy need. Therefore, the SocialWatt indicator identifies households that are both in energy poverty and at risk of energy poverty. It also allows the user to define a lower threshold for energy consumption, in order to ensure that households that spend very low amounts on energy are not classified as energy poor (such as holiday homes and second homes only occupied for part of the year).

For those customers whose actual energy consumption is found to be above the calculated energy need – who are not considered to be rationing energy – a further test is performed to assess if they are energy poor based on an assessment of their energy spend as a proportion of their income. Users can set sensitivity parameters to identify households who are spending a larger or smaller percentage of their income on energy – this is called the Household Evaluation Index. By doing so they can better identify households who are either

[9] EnergyPlus, Renewables.ninja, Tabula and other open data sources are extensively utilised to approximate the energy needs of a "reference household".

energy poor or at risk of energy poverty.

Similar to the M/2 indicator, the SocialWatt Analyser studies the actual customer consumption to assess if the household is under-consuming. It therefore makes good use of the accurate consumption data that utilities commonly hold, which is a strength. Improving on the M/2 approach, the SocialWatt indicator compares consumption data to calculated energy need as opposed to national average consumption, potentially offering a much more accurate result.

With its two-stage assessment this single indicator combines two approaches to capture a wider range of energy-poor households. However, the accuracy of the second assessment is hampered the lack of household income data in the same way as the other expenditure-in-income-based indicators.

Arrears on utility bills

Under this indicator:

> *A household is classified as energy poor if it has arrears on utility bills.*

This is perhaps the simplest indicator as it uses utility data on customers' energy bill arrears or debt, identifying customers who have energy bill arrears as energy poor. It presents data that utilities already hold without any further analysis. Therefore, although useful as an overlay to the results of other indicators, use of this indicator alone does not contribute a new understanding of energy poverty to utilities.

Summary

Perhaps the most significant issue arising from access to data stemmed from utility partners' lack of access to individual customer's household income. In the absence of customer-level income data, the Analyser is designed to use average income data at the lowest geographical scale available (e.g., municipality). However, income data at municipal level is not granular enough to generate highly accurate results from the indicators that rely on household income data. These are the 10% indicator, low income high cost (LIHC), and high share of energy expenditure in income (2M).

The low income high cost (LIHC) indicator is particularly sensitive to the accuracy of household income data as one of the two tests that a household must pass to be classified as energy poor relies solely on income compared to the national poverty line. Average income compared to the national poverty line is unlikely to reveal energy-poor households.

The SocialWatt indicator somewhat circumvents this issue with its two-stage analysis which first identifies those households that are energy rationing before going on to make an assessment of energy expenditure in income. Household-level income data would enable more accurate analysis but is largely unavailable to utilities at present.

Two indicators do not rely on household income data. The low absolute energy expenditure and arrears on utility bills indicators both make good use of the data that utilities uniquely hold on absolute energy expenditure and fuel debt. However, used in isolation these indicators do not present a full picture of energy poverty so are best used in addition to an income-based indicator.

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1.3.3 SOCIALWATT PLAN AND DESIGN OF SCHEMES TO ALLEVIATE ENERGY POVERTY

The SocialWatt Plan tool, alongside the other capacity-building activities that are part of the SocialWatt project, has been effective at introducing utilities to the range of potential schemes and providing input into the design of energy poverty action plans. It has also provided much-needed insight into the comparative cost-effectiveness of different interventions. Although the tool has also provided very specific outputs in terms of the contents of a final portfolio, final numbers of interventions, energy savings or renewable energy production, it is unlikely that utilities will follow the outputs of the tool to this level of detail.

Of the many scenarios produced by the tool to meet the utility targets and constraints, two optimal portfolios are highlighted: the cost-optimal and risk-optimal portfolios. All utilities have chosen the cost-optimal scenario for further exploration. This portfolio delivers the lowest-cost solution to the utility to achieve its targets. It often does this by combining cost-effective interventions with finance schemes that rely on heavy contributions from other parties, through for example third-party contributions, crowdfunding or on-bill financing. The viability of achieving these levels of external investment needs to be considered within the relevant national and utility context. The risk-driven portfolio offers a more balanced approach to financing, but utilities have not selected this option in their analysis for this report. In designing their action plans, utilities will carefully consider the amount of direct investment needed from the utility and the viability of external investment.

The cost-effectiveness calculations for each of the schemes assessed in the SocialWatt Plan tool are based on country-specific costs and other data from the utility. Therefore, the cost-effectiveness of schemes cannot be directly compared between countries on a like-for-like basis. It can, however, be broadly observed that the Renovate your Home scheme, which installs low-cost measures like efficient lighting, and the Smarter Home scheme, which installs smart thermostats, consistently appear to be the most cost-effective schemes in the portfolios for SocialWatt partners. Information and communication schemes were assessed as less cost-effective. Despite being low-cost measures, these activities trigger low levels of energy savings.

Interestingly, despite not being the most cost-effective scheme, White Appliances is a popular choice to take forward by partners. This is perhaps due to the ease of replacement of appliances, the relative simplicity of the scheme and partnership opportunities.

SocialWatt Plan calculates the savings generated by the measures within the 10-year investment period, not over the measures' lifetime. Measures that are installed in the early years of the portfolio therefore contribute more calculated savings than measures installed later in the investment period. Although this raises the value of early investment, which is positive, it can produce results that are not always directly comparable across scenarios.

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2 UTILITY EVALUATION OF SCHEMES TO TACKLE ENERGY POVERTY

2.1 HEP ESCO, Croatia

HEP ESCO is one of the companies within the HEP Group. HEP Group is a state-owned corporation and has four energy supply companies as subsidiaries, which are obligated parties to the energy efficiency obligation (EEO) since 2019.

HEP ESCO specialises in the implementation of energy efficiency and renewable energy projects. It also provides support to other companies within the HEP Group in the implementation of energy efficiency and renewable energy projects and programmes. After the obligation system was established in Croatia, HEP ESCO was appointed by the HEP management board as the coordinator for the EEO scheme for the group. It provides technical and administrative support to the supplier companies and management board. In accordance with its assigned role and status within the HEP Group, HEP ESCO joined the SocialWatt project in order to integrate innovative ideas and good practices from other EU partners into proposed plans and strategies for the HEP management board related to the EEO and energy poverty alleviation.

2.1.1 Assessment of energy poverty

The analysis of energy poverty by HEP ESCO has been hampered by difficulties in accessing customer energy data. Unlike other utility partners in SocialWatt, HEP ESCO is not an energy supplier so does not directly own data.

As such, HEP ESCO has made great effort to obtain access to customer data to use for the analysis of energy poverty but has met a number of barriers associated with corporate rules and compliance with the GDPR. Despite considerable efforts to overcome complicated bureaucratic obstacles, HEP ESCO was unable to obtain permission to use and process relevant household customer databases in the SocialWatt Analyser in order to determine the share of energy-poor households in the utility's total customer portfolio. Nevertheless, HEP ESCO was able to obtain access to two datasets for a small number of customers of one of the electricity supply companies within the HEP Group in order to test the tool and be able to promote its use by HEP utilities and beyond.

Energy poverty definition and input data

There is currently no official definition of energy poverty in Croatia, nor are there any detailed criteria for identifying energy-poor households at the national level. The data captured at the national level are also limited in their ability to define energy poverty in the population. Household income or household members' health conditions are used to define "vulnerable households." Members of these households are in a very bad financial or health situation, but can benefit from the services of social welfare centres (which provide minimum guaranteed benefits) and are entitled to receive help for covering the costs of energy consumption. According to the latest publicly available official data from March 2018, 61,958 households were identified as "vulnerable customers"[10] and received financial

[10] https://mdomsp.gov.hr/pristup-informacijama/statisticka-izvjesca-1765/statisticka-izvjesca-za-2018-godinu/10185

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assistance from social welfare centres and/or local government.

The data that the HEP energy supply companies hold include the minimum type of data required for billing customers according to their energy consumption (i.e., name and surname of customer, location, the period that meter readings cover, electricity consumption and cost). Moreover, the databases for different fuels (e.g. district heating systems, electricity, gas) are unconnected because these are owned by separate companies within the same joint stock company. It is therefore not possible at this time to consolidate these to determine the overall energy consumption of each household. In addition to this, the databases lack important data that could significantly refine the analysis to determine energy-poor households, such as the size and condition of dwellings, number and age of household members, household income, overall energy costs, and year of construction.

Energy poverty assessment

Given that the entire database of household customers could not be obtained and analysed, two datasets, containing a limited number of customers, were analysed. The first dataset includes customers who, according to national criteria, are considered "vulnerable energy customers" while the other dataset includes "regular" customers. More specifically, *CustomersDatabase#1* includes data from 57 "regular" customers from *Adriatic Croatia* and *CustomersDatabase#2* includes data from 55 "vulnerable energy customers" from *Continental Croatia*.

The analysis of both datasets was undertaken to see whether, despite the small number of customers, the SocialWatt Analyser would identify customers from the list of vulnerable households as energy poor, and what percentage of "regular" customers would be identified as energy poor.

Four energy poverty indicators were considered: the 10% approach, low income high cost (LIHC), high share of energy expenditure (2M), and low absolute energy expenditure (M/2).

The following input parameters per indicator have been used for the analysis:

- 10% approach: Average annual national household (dwelling) income: €7371
- Low income high cost (LIHC):
  - Average annual national household (dwelling) income: €7371
  - National poverty line: €6530 annual income for a single-person household
  - Average annual national electricity cost: €506
- High share of energy expenditure (2M):
  - Average annual national household (dwelling) income: €7371
  - National median share of energy expenditure in income: 6%
- Low absolute energy expenditure (M/2): national average annual electricity expenditure: €506

Data on consumption and costs for both 2018 and 2019 were analysed. As mentioned previously, specific data on household income are not available and therefore the average national income was used in the analysis.

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Table 3 presents the results for "regular" customers and Table 4 presents the results for "vulnerable" customers. It should be noted that a very small sample size has been analysed introducing a high level of uncertainty in the results presented.

Table 3: SocialWatt Analyser: Customers Database#1 results, HEP ESCO

Indicator	Energy poor 2018/2019 [%]	Energy poor 2018/2019 (# households)
10% approach	98.2 / 98.2	56 / 56
Low income high cost (LIHC)	0 / 0	0 / 0
High share of energy expenditure (2M)	98.2 / 98.2	56 / 56
Low absolute energy expenditure (M/2)	1.8 / 1.8	1 / 1

Source: Dataset of 57 "regular" customers/households and SocialWatt Analyser

Table 4: SocialWatt Analyser: *Customers Database* #2 results, HEP ESCO

Indicator Low Income High Cost (LIHC)	Energy poor 2018/2019 [%]	Energy poor 2018/2019 (# households)
10% approach	61.8 / 60.0	34 / 33
Low income high cost (LIHC)	1.8 / 0	1 / 0
High share of energy expenditure (2M)	61.8 / 60.0	34 / 33
Low absolute energy expenditure (M/2)	38.2 / 40.0	21 / 22

Source: Dataset of 55 "vulnerable" energy customers and SocialWatt Analyser

From the analysis, it is evident that the results related to the low income high cost (LIHC) indicator give a low number of energy-poor households: i.e., less than 2% of customers, even within the vulnerable customer dataset, are identified as energy poor. This indicator uses average annual national household income as a parameter, which when actual energy costs have been subtracted, is directly compared to the national poverty line. The difference between national average income and the national poverty line is €841 (€7371 minus €6530). This means that this indicator only identifies households as energy poor if their electricity costs (not total energy costs, as only electricity is considered in this analysis) are higher than €841. This is an inherent limitation of this indicator in combination with the input parameters.

With regard to the 10% indicator and the 2M indicator, these both estimate a very high number of households as energy poor in both customer databases used. As both indicators heavily rely on average income data, it is clear that most households studied spend more than 10% of their income on energy to maintain an adequate level of thermal comfort.

Finally, the M/2 indicator, which does not rely on income data but identifies households whose absolute energy expenditure is below half the national median, seems to more accurately predict energy-poor households. Nevertheless, the low number of energy poor

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households identified in the vulnerable energy customers dataset suggests that vulnerable households spend on electricity more than half the national median electricity expenditure.

Conclusion

The analysis was hindered by the lack of relevant and complete input data, primarily:

- ***A complete customer database*** – data from 112 customers were analysed. Such a small sample size is not representative of the variability within a utility's customer database and affects the reliability of the results and the conclusions drawn.
- ***Overall household energy consumption and costs*** – only electricity consumption data were available. The availability of only electricity data is likely to have caused distortions in the results. For example, when the average consumption per household of both datasets is considered, it can be seen that households in Adriatic Croatia ("regular" customers) use 31.20% more electricity. This can be explained by the fact that in Adriatic Croatia, the majority of households use electricity for heating and cooling, so electricity is often the only energy source used. In Continental Croatia ("vulnerable" customers) households mostly use firewood and gas for heating but the data on consumption of these other fuels is not available.
- ***Income data per household*** – data on average household income were available by county. Given that income is an important input parameter for some of the indicators considered, the data on the actual income of households would significantly improve the accuracy of the results.

Given the above, the results of the analysis are potentially unreliable (e.g. under some energy poverty indicators, more energy-poor households are identified in the "regular" customers dataset than in the "vulnerable" customers dataset). In order to draw useful conclusions and better identify energy-poor households, therefore, it is necessary to use more complete databases, both in terms of sample size and context (e.g. energy consumption data on all energy sources used). However, in Croatia there is no systematic monitoring and recording of key data required (demographic, income, real estate data), while data on households' energy consumption and costs related to different energy sources cannot be integrated (the GDPR is a key barrier to this).

In conclusion, HEP ESCO will explore alternative approaches to identify energy-poor households, in particular through the involvement of social welfare centres and local government.

2.1.2 Analysis of energy poverty schemes

Inputs into the SocialWatt Plan tool

HEP ESCO set the following targets and constraints for the use of the SocialWatt Plan tool to identify suitable energy poverty alleviation schemes to be implemented in the period 2021-2030.

Targets:

- 50 gigawatt hours (GWh) energy savings
- 2.6 GWh renewable energy production

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- €15 million total renewable energy or energy efficiency investments
- 29 kilotonnes (kt) CO_2 emissions savings from electricity.

In terms of constraints, HEP ESCO defined the following:

- 10% of interventions to be in new buildings, built after 1980
- 10% maximum share of energy savings from interventions in new buildings, built after 1980
- 20% of interventions to be large scale.

Evaluation of schemes

Based on the above targets and constraints, the two optimal portfolios – from a cost and risk perspective – proposed by the SocialWatt tool are outlined below.

The finance scheme scenario proposed by the SocialWatt tool as most appropriate to the entire cost-driven portfolio is crowdfunding, with a contribution from the utility/obligated party of 5% of the investment. It is on the basis of this financing scheme that the investment from the utility is calculated.

The cost-driven scenario suggests that the goal of energy savings could be achieved by implementing the following interventions:

- Under the Renovate your Home scheme, to install energy-efficient lighting with 7,398 interventions, calculated to save 9,740 MWh at a cost to the utility of €25,304. This equates to a cost of €2.60 for every MWh energy saved.
- Through the Smarter Home scheme, to install smart thermostats with 1,802 interventions, calculated to save 18,620 MWh at a cost to the utility of €38,300. This equates to a cost of €2.06 for every MWh energy saved.
- Through the RES4All scheme, to enable 2,194 solar thermal interventions and 106 photovoltaic interventions, calculated to produce 21,640 MWh at a cost to the utility of €132,988. This equates to a cost of €6.15 for every MWh energy produced.

The tool calculates that the cost-driven portfolio will deliver the 50GWh energy savings target at a cost of almost €200,000 (€196,592).

Risk-driven portfolio:

The risk-driven portfolio contains a similar combination of measures but the Renovate your Home scheme in this portfolio installs low-cost renovations alongside a smaller number of lighting-only interventions. The risk-driven scenario from the tool suggests that the goal of energy savings could be achieved by implementing the following interventions:

- Under the Renovate your Home scheme, to undertake 6,611 low-cost renovations and 729 energy-efficient lighting interventions.
- Through the Smarter Home scheme, to install smart thermostats through 1,860 interventions.
- Through the RES4All scheme, to enable 2,194 solar thermal interventions and 106

photovoltaic interventions.

The finance scheme scenario proposed by SocialWatt Plan as most appropriate to the entire risk-driven portfolio is on-bill repayment with a contribution from the utility/obligated party of 30%.

The tool calculates that the risk-driven portfolio will deliver the 50GWh energy savings target (at a cost of almost €1.28m (€1,276,026).

Next steps and developing the energy poverty action plan

In considering schemes to alleviate energy poverty and developing an action plan, HEP ESCO faces a number of challenges in the national context and in relation to the nature and role of the organisation in the group.

In the national context, there are two significant barriers. Firstly, as described above, there is no national definition or specific criteria for energy-poor households, or a national energy poverty strategy, although official regulations do recognise "vulnerable energy customers." Secondly, the Croatian regulations that introduced the EEO in early 2019 define the achievement of the social goal within the EEO as voluntary. Suppliers are encouraged to implement measures and programmes for vulnerable customers in order to receive an administrative uplift to the savings triggered in eligible households. This uplift is between 10% and 30%, depending on the status and location of the customer. Despite this incentive, investments in measures in the business sector are significantly more cost-effective. Suppliers have therefore focused on the non-domestic sector to comply with the EEO. Programmes and projects with the greatest positive impact for the company are those prioritised. As savings in the housing sector, and in particular for energy-poor households, have been assessed to be less cost-effective, it is very challenging to promote these projects as part of EEO compliance. A further aggravating circumstance is that the regulation related to the EEO, which has only recently been established in Croatia, has a number of shortcomings and new amendments have been announced. Significant changes are possible that will affect the group's operations and decision-making.

For the HEP Group specifically, the group has not yet developed an internal strategy to combat energy poverty or an investment plan for energy poverty mitigation. HEP is a socially responsible company and implements various programmes and awards donations related to this segment. For example, HEP has taken on the cost of the "solidarity charge," i.e., €0.004 (HRK 0.03) per kWh to pay for electricity bills for vulnerable households, which was initially intended to be paid by all customers. On average, this charge amounts to around €22.19 million (HRK 167.35 million) per year.

However, to implement socially responsible initiatives, it is necessary to internally develop and approve programmes or strategies and plan resources. Market rules also apply, thus further restrictions are placed on HEP given that it is a state-owned company and leader in the Croatian energy supply market. To adapt business models or introduce new investments, it is therefore often necessary to intervene in regulations, which is a lengthy process. Given the significant investment already being made into the solidarity charge, making a case for a new investment programme aimed at preventing energy poverty is also challenging.

Finally, specific challenges for HEP ESCO include the company's lack of direct access to

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and relationships with household customers, which will affect the design of the schemes to alleviate energy poverty. HEP ESCO has so far exclusively worked with companies in implementing energy efficiency and renewable energy projects, meaning that there are no existing business models that can be adapted and developed. In Croatia, households that are categorised as "vulnerable energy customers" are most often households with extremely low or no income. The ESCO model is based on a financing model in which the ESCO company returns the money invested via repayment by the client. Consequently, in Croatia, the classic ESCO model is not suitable for "vulnerable energy customers" at this time and in this form. Even for regular household customers, the cost-effectiveness of applying an ESCO model is very questionable because relatively small energy savings can be achieved through interventions in the household sector. The cost of energy savings (EUR/kWh of savings) is too high for an ESCO company compared to other sectors (industry, services).

Conclusion

The SocialWatt Plan tool provided useful guidance for achieving a specific energy savings target by implementing measures to benefit energy-poor households. As mentioned earlier, the implementation of such models requires a more detailed analysis, more detailed data on households, the implementation of legal and bureaucratic procedures by the parent company and the final approval of the management board.

HEP ESCO will strive to encourage energy supply companies in the HEP Group and the management board to develop models for financing energy efficiency and renewable energy projects for energy-poor households, building on the experience gained through the SocialWatt project and examples of good practice of project partners.

Given all the above, it is realistic for HEP ESCO to proceed with the following:

- Continue to develop new and improve old proposals for programmes aimed at alleviating energy poverty in Croatia.
- Consider the two optimal scenarios of SocialWatt Plan during the process, i.e., for selecting energy efficiency and renewable energy measures.
- Continue to exchange experiences and examples of good practice through SocialWatt, as this helps create new ideas and introduces innovative elements in initiatives and programmes regarding energy-poor households.
- Develop an action plan to alleviate energy poverty that will be submitted to the Group's management board for approval.

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2.2 EDF, France

2.2.1 Assessment of energy poverty

Due to a number of bureaucratic and IT licencing issues faced, EDF has been unable to run SocialWatt Analyser to date. Nevertheless, EDF aims to run the tool and compare its results with the French housing stock database analysis undertaken and presented in this section.

Energy poverty definition and input data

In France,[11] the following indicator, with a double condition, is used in the national measurement of energy poverty:

- High share of energy expenditure in income (2M); and
- Households belonging to the first three income-per-consumption-unit deciles (D1-D2-D3) (the criterion "consumption unit" allows income to be weighted according to the household composition).

This second condition is important to limit the indicator to low-income households and avoid targeting households with financial resources that are considered "comfortable."

Definition of the consumption unit (CU) of a household

To compare the living standards of households of different size or composition, a measure of adjusted income per consumption unit is used (the number of people is reduced to a number of consumption units) using an equivalence scale. The most widely used equivalence scale (OECD) uses the following weighting:

- 1 CU for the first adult in the household;

- 0.5 CU for other people aged 14 or over;

- 0.3 CU for children under 14.

The French housing stock database contains the following datasets:

- Type of dwelling (house/apartment)
- Occupancy status (owner-occupied, social housing tenant, private housing tenant)
- Period of construction of dwelling
- Climate zone:
    - Climatic area H1 – semi-continental climate
    - Climatic area H2 – oceanic climate
    - Climatic area H3 – Mediterranean climate
- Income-per-consumption-unit deciles
- Energy expenditure.

[11] National Observatory of Fuel Poverty (ONPE) https://onpe.org

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Energy poverty assessment

The French housing stock database was used to assess and compare five energy poverty indicators:

- High share of energy expenditure in income (2M)
- The French energy poverty indicator, based on high share of energy expenditure in income (2M) and households belonging to the first three income-per-consumption-unit deciles
- 10% approach
- Low Income high cost (LIHC)
- Low absolute energy expenditure (M/2).

Table 5: Percentage of energy poor households per indicator, France

Indicator	Energy poor (%)
10% approach	11.5%
Low income high cost (LIHC)	8%
High share of energy expenditure (2M)	16.5%
High share of energy expenditure and first three income-per-consumption-unit deciles (French EP indicator)	12.5%
Low absolute energy expenditure (M/2)	12%

Source: French building stock database

The low income high cost (LIHC) indicator identified the lowest percentage of energy-poor households (8%). This indicator classifies a household as energy poor if its actual energy costs are above the national average level (€1,570 per year) and when subtracting this amount of money, its residual income is below the official poverty line (€12,750 per year).

The highest number of energy-poor households was identified when using the High share of energy expenditure (2M) indicator (16.5%). A household is classified as energy poor if its share of energy expenditure in income is more than twice the national median share (the national median share is 4% so 2M identifies household that spend more than 8% of income on energy).

Three indicators – the10% approach, Low absolute energy expenditure (M/2) and the French energy poverty indicator – return approximately the same result for the number of energy-poor households (between 11.5% and 12.5%).

Given that the French energy poverty indicator is based on the 2M indicator, with a refinement to focus only on households in the lowest three income deciles, a further assessment was undertaken to compare the results of these two indicators. This analysis looks at the percentage of energy poor households identified by income by dwelling type, tenure, age of dwelling, climatic zone and income decile is shown in Table 6 below.

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Table 6: Distribution of households classified as energy poor in France

Comments	High share of energy expenditure (2M)	High share of energy expenditure and first three income-per-consumption-unit deciles
Share of households classified as energy poor among the total population	16.5%	12.5%
Distribution of households classified as energy poor by type of dwelling		
Apartment	45%	49%
House	55%	51%
Distribution of households classified as energy poor by tenure		
Owner	47%	37%
Social housing tenant	22%	25%
Private housing tenant	31%	38%
Distribution of households classified as energy poor by period of construction of dwelling		
Before 1975	72%	71%
From 1975 to 1981	11%	10%
1982 and later	17%	19%
Distribution of households classified as energy poor by location (climate zone) of dwelling		
Climatic area H1 – semi-continental climate	60%	58%
Climatic area H2 – oceanic climate	30%	30%
Climatic area H3 – Mediterranean climate	10%	12%
Distribution of households classified as energy poor by income deciles per consumption unit		
Income per CU deciles (D1-D2-D3)	75%	100%
Income per CU deciles (D4-D5)	16%	
Income per CU deciles (D6 to D10)	9%	

Source: National Observatory of Fuel Poverty - ONPE

The main difference between the indicators is that the 2M indicator, which does not include the second filter of income decile, identified households in both middle and even higher income deciles as energy poor (Figure 3).

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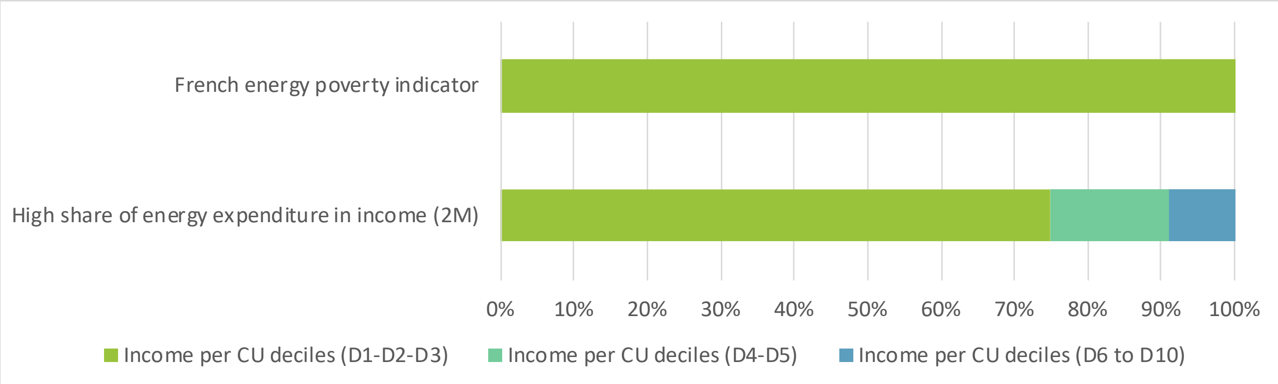
Figure 3: Distribution of households classified as energy poor by income per consumption unit decile, France



Source: National Observatory of Fuel Poverty - ONPE

Focusing just on the 2M indicator, households classified as energy poor under this indicator:

- Live more often in a house (55%) than in an apartment (45%);
- Are more often owners (47%);
- Live in old dwellings (83% live in a dwelling built before 1981), many of which have insufficient thermal insulation;
- Live in climatic area H1 – semi-continental climate (60%) which is the coldest zone;
- Are predominantly but not exclusively low income (75% are in the first three income-per-consumption-unit deciles D1-D2-D3).

Conclusion

The assessment of fuel poverty using the 2M indicator leads to an overestimation of energy poverty compared to the assessment using the French two-conditional indicator (i.e., high share of energy expenditure, limited to the first three income-per-consumption-unit deciles).

The disaggregated analysis of the French energy poverty indicator and the 2M indicator shows that energy-poor households live more often in old dwellings, many of which have insufficient thermal insulation.

This assessment of fuel poverty, using different indicators, provides information on the socio-economic characteristics of households (and the housing they occupy) according to low-income or mid-income or high-income per consumption unit decile, which can allow an adaptation of the level of financial aid needed to alleviate energy poverty.

2.2.2 Analysis of energy poverty schemes

Inputs into the SocialWatt Plan tool

Eight different sets of parameters were used to test the Plan tool and explore the suggested combination of schemes. In all of the eight cases (as presented below in Table 7) a target was set of a minimum of 5,000 energy-poor households to benefit with an annual budget of €3 million. All of the cases also required 80% of interventions to be large scale and set a target of 30-60 MWh renewable electricity production. The different cases then tested different minimum energy-saving targets, from 300 GWh to 900 GWh, and different shares of interventions and energy savings between new and old buildings.

Table 7: Summary of input parameters used in the SocialWatt Plan tool, EDF

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
Energy-saving target (min)(GWh)	900	600	500	400	300	300	600	900
Energy-poor households (min)	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Utility budget (max)(M€/year)	3	3	3	3	3	3	3	3
Share of interventions (new/old buildings)(%)	10%/ 90%	10% / 90%	10% / 90%	10% / 90%	10% / 90%	50% / 50%	50% / 50%	50% / 50%
Share of energy saving (new/old buildings)(%)	20% / 80%	20% / 80%	20% / 80%	20% / 80%	20% / 80%	30% / 70%	30% / 70%	30% / 70%
Share of total interventions (large/small scale)(%)	80% / 20%	80% / 20%	80% / 20%	80% / 20%	80% / 20%	80% / 20%	80% / 20%	80% / 20%
Renewable electricity production (min/max)(MWh)	30/60	30/60	30/60	30/60	30/60	30/60	30/60	30/60

Source: SocialWatt Plan

Evaluation of schemes

In Figure 4 below the number of interventions proposed for cases one to five are presented for the lowest- and highest-risk scenarios in each case. The results are broken down by interventions in new and old buildings and in the coldest (semi-continental climate H1) and hottest (Mediterranean climate H3) climate regions. In cases one to five all of the input parameters are the same apart from energy savings targets which vary from high (900 GWh) in case one to low (300 GWh) in case five (see Table 7).

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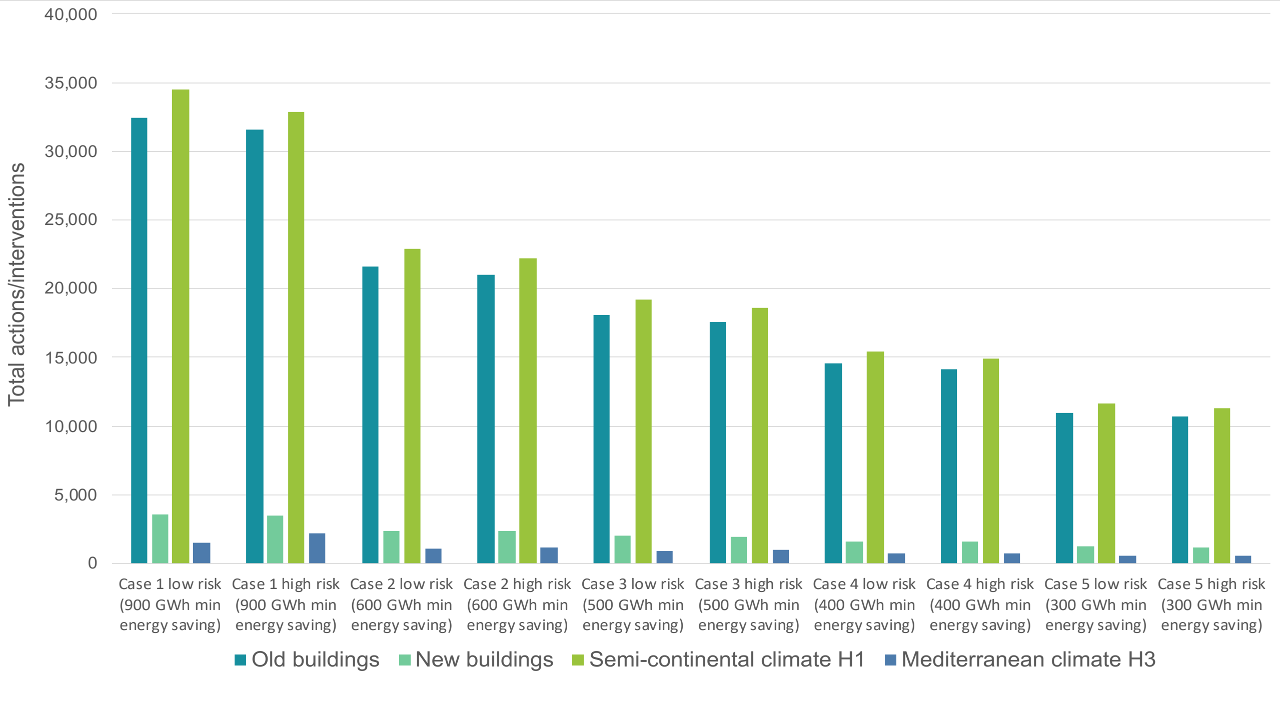
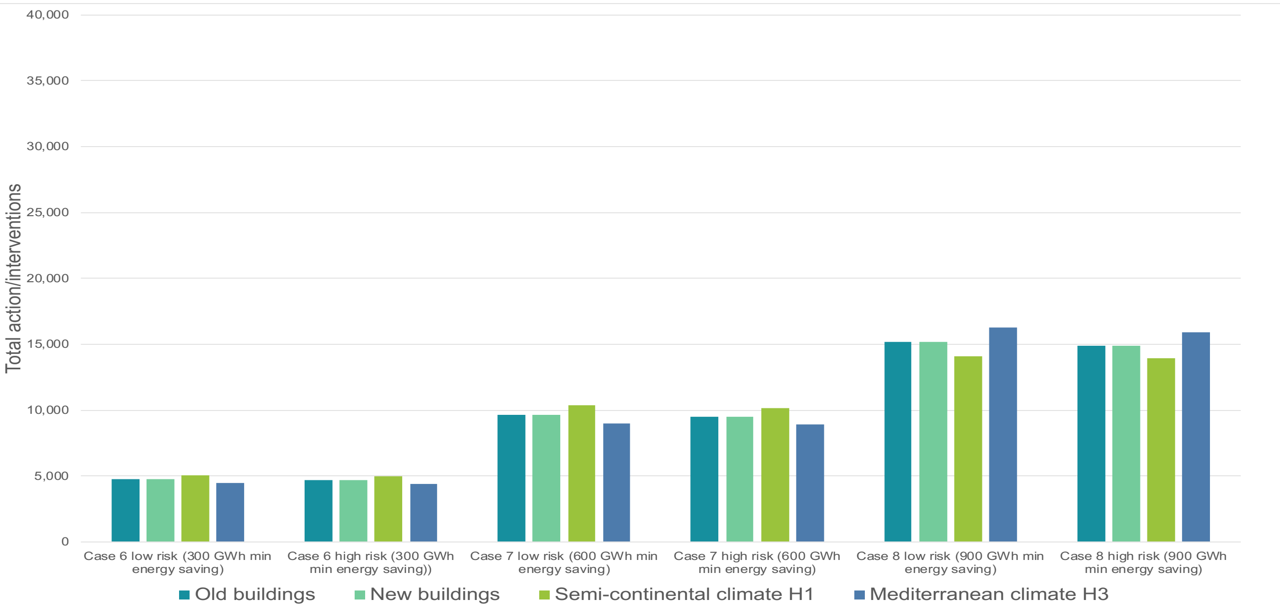
Figure 4: SocialWatt Plan tool results – total number of actions (2021-2030) in high- and low-risk portfolios for cases 1-5, EDF



Source: SocialWatt Plan

Figure 5 below shows the same results for cases six to eight. These cases are based on a slightly different set of parameters in which the balance of effort between old buildings and new buildings is more even (50% of interventions in new and 50% of interventions in old; 30% of energy savings in new buildings and 70% in old buildings). The energy savings targets vary across cases six to eight from a low target (300 GWh) in case six to the highest target (900 GWh) in case eight.

Figure 5: SocialWatt Plan tool results – total number of actions (2021-2030) in high- and low-risk portfolios for cases 6-8, EDF



Source: SocialWatt Plan

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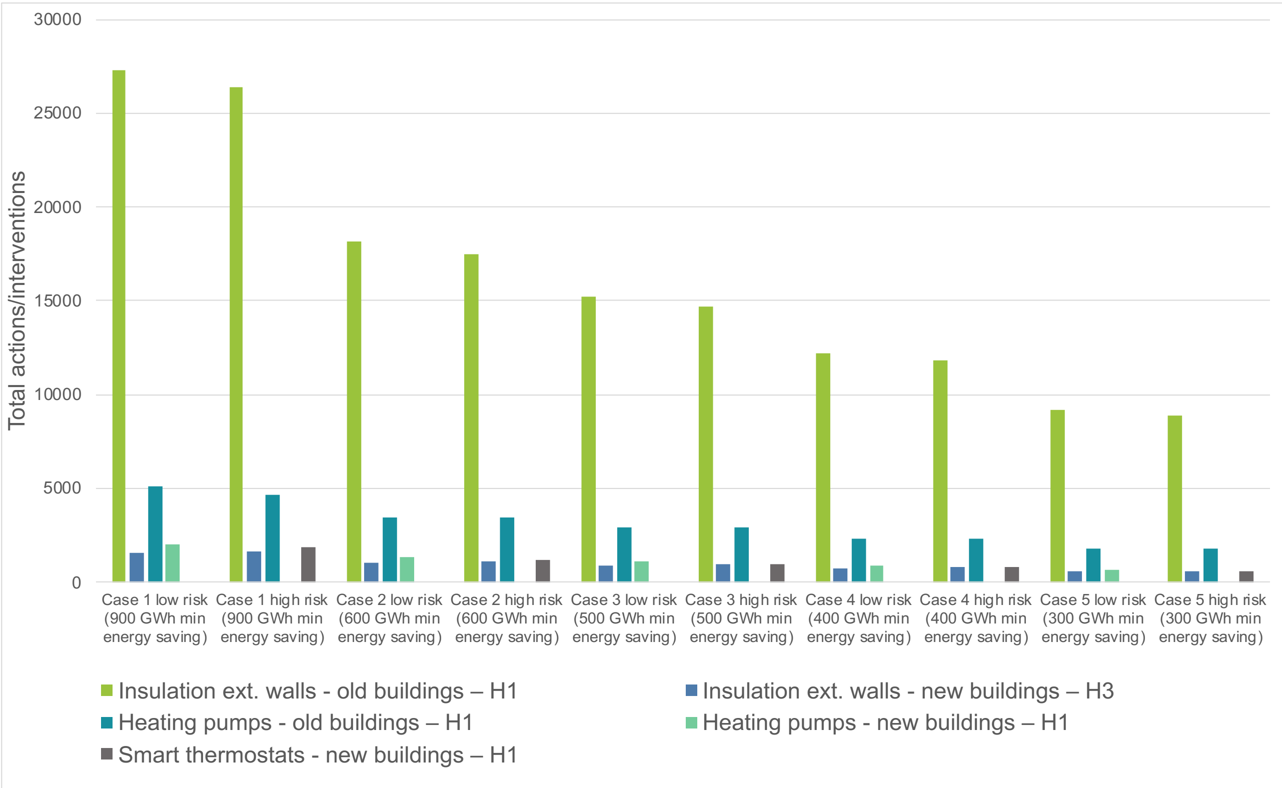
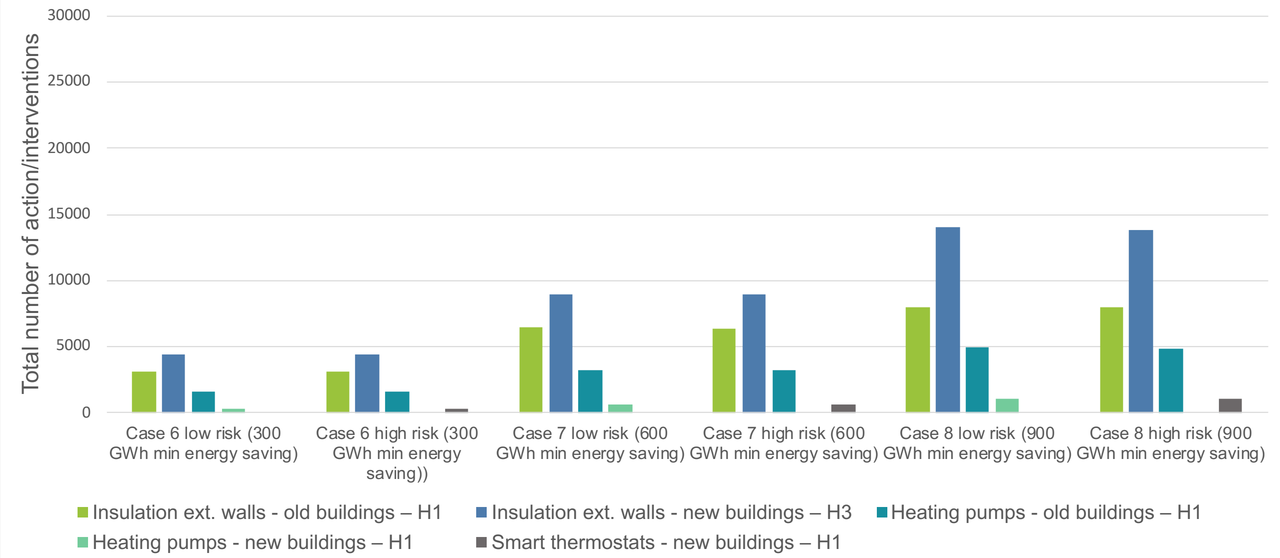
These results are expanded upon in Figure 6 and Figure 7 below which show the number and types of specific interventions proposed in the portfolios. The SocialWatt Plan tool has identified insulation to external walls as by far the most prominent measure in all cases. The input parameters for cases one to five required that 90% of interventions be carried out in old buildings, which usually have solid walls; this is the reason that external wall insulation features so prominently in Figure 10. Heat pumps in older buildings also feature as a common measure in many of the portfolios.

Figure 6: SocialWatt Plan tool results – number and type of measures within high- and low-risk portfolios for cases 1-5, EDF



Source: SocialWatt Plan

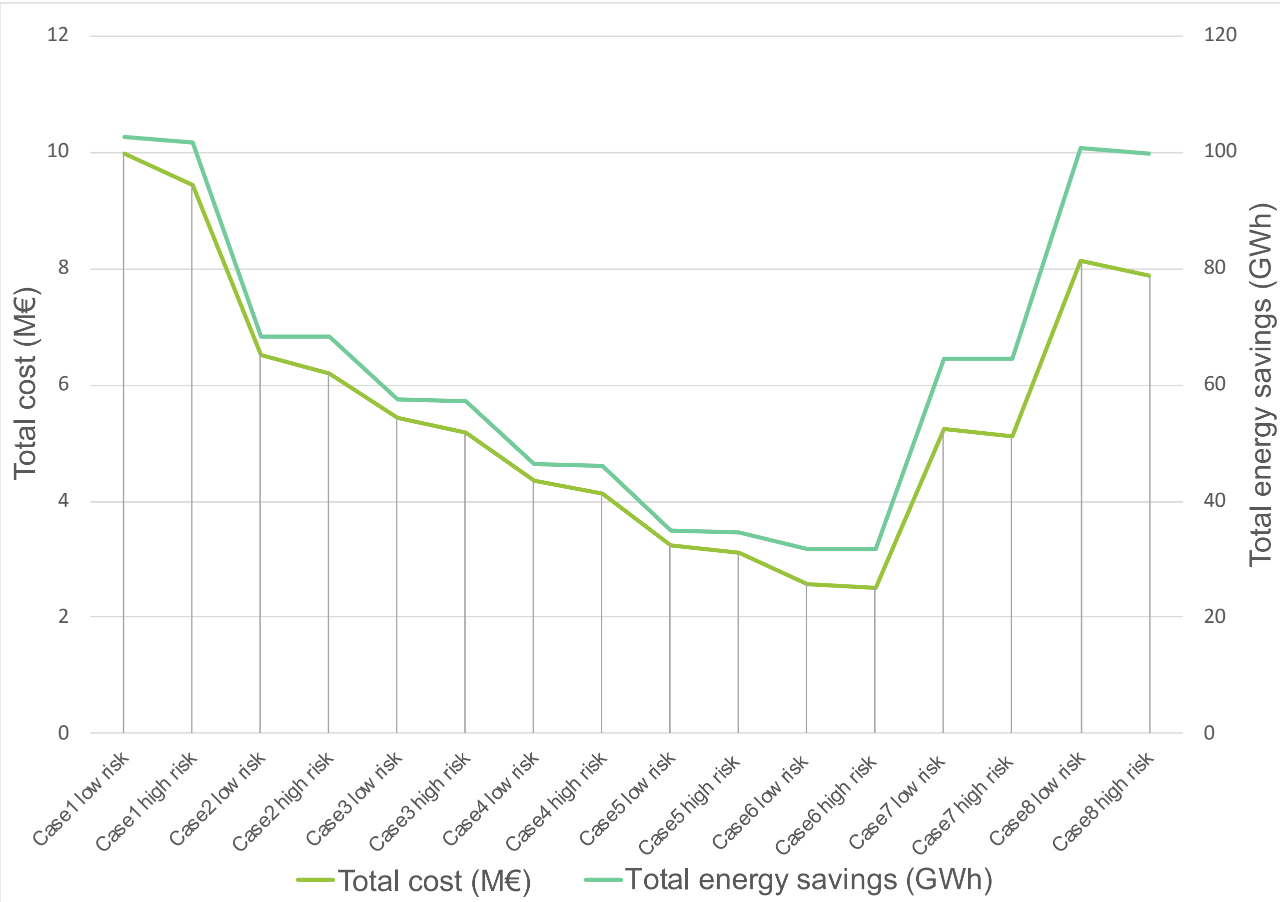
Figure 7: SocialWatt Plan tool results – number and type of specific measures within high- and low-risk portfolios for cases 6-8, EDF



Source: SocialWatt Plan

Finally, Figure 8 below compares the expected total cost and impact for each of the portfolios – high and low risk – for each of the eight cases.

Figure 8: SocialWatt Plan tool results – Cost and energy savings for each of the portfolios, EDF



Source: SocialWatt Plan

Cost-optimal scenario

The SocialWatt Plan tool was further customised for EDF, so that schemes and measures that

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have been ruled out (either because they are not considered appropriate or have already been implemented in large numbers) can be excluded from the analysis. In the final assessment of the optimal portfolio, the analysis was refined to focus on insulation, heating and cooling measures, PV, and information and communication measures.

The following targets and constraints were applied for this assessment (as per case 5 above):

- 300 GWh energy savings target
- 5,000 households to be engaged
- €3 million annual utility budget
- 90% of interventions in old buildings built before 1980, 10% in new buildings
- 80% of energy savings to be achieved in old buildings built before 1980, 20% in new buildings
- 80% of interventions to be large scale, 20% to be small scale
- Between 30 and 60 MWh renewable energy production.

Based on the above parameters, the cost-optimal portfolio is calculated to deliver the 300 GWh savings target at an investment from the utility of €1.58m. This investment from the utility is the contribution calculated within the optimal financing option. The financing option presented by SocialWatt Plan as the most appropriate for this portfolio was crowdfunding with the utility contributing 5% of the total investment cost. The cost-optimal portfolio comprising four schemes is outlined below:[12]

- The largest scheme in the portfolio is the Greening Home scheme, which delivers roof insulation in warmer climatic zone in France. The scheme is calculated to deliver a total of 15,925 interventions, saving 262 GWh (262,625 MWh) at a cost to EDF (once the optimal financing has been applied) of €1.26m. This equates to a cost of €4.80 for every MWh energy saved.
- Fighting the Cold makes the next biggest contribution in saving through delivering 481 heat pumps in the colder climatic region. This scheme is calculated to deliver 37 GWh (37,042 MWh) of savings at a cost to EDF of €297,000. This equates to a cost of €8.02 for every MWh of energy saved.
- Information and Communication measures in the form of distribution of 3,500 focussed energy advice and leaflets focused are calculated to deliver 350 MWh of savings at a cost to EDF of €18,025. This equates to a cost of €51.50 for every MWh of energy saved.
- RES4ALL also proposes to install one solar PV array, producing 54.7MWh of renewable energy.[13] This equates to a cost of €8.06 for every MWh of energy generated.

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[12] EDF is currently reviewing the underlying assumptions of the Plan tool and will update if deemed necessary.

[13] This measure is proposed to be installed at the beginning of the investment period and the renewable energy generation is calculated over the entire 10-year investment period, which is how the renewable energy generation impact is calculated.

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Conclusion

The schemes to alleviate energy poverty could be on two levels:

- To help households to pay (or reduce) their energy bills; and
- On a preventive level, to improve the thermal efficiency of dwellings in order to reduce their energy bills in the long term while maintaining comfort; in this case, the actions are intended for the owners of the dwellings (owner-occupiers or landlords).

As actions to improve the thermal efficiency of dwellings are quite high cost, the schemes will have to include financial aid. This financial aid may or may not be exclusively included in the French energy saving certificate scheme dedicated to energy-poor households.

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2.3 PPC, Greece

2.3.1 Assessment of energy poverty

Energy poverty definition

In Greece there is no formal definition of energy poverty, nor specific indicators for monitoring the phenomenon. Article 9 of Law 4342/2015 requires the development of a National Action Plan to Alleviate Energy Poverty that will outline actions for improving energy efficiency, as well as other social policy or energy pricing measures. This plan is currently under development and will include a definition of energy poverty.

On the other hand, vulnerable consumers have been defined in Greece. Decision ΥΠΕΝ/ΔΗΕ/78337/224/06.11.2018, defines the criteria, conditions and procedure for including electricity customers in the vulnerable customers registry. More specifically, residential electricity customers may be included in the vulnerable customers registry if they belong to one of the following categories:

- Category A: Customers included in the social residential tariff;
- Category B: Customers whose household includes a member or members who need life-supporting medical equipment at home and meet the income criteria currently applied for the inclusion of customers in the social residential tariff;
- Category C: Customers who have reached the age of 70, provided that there is no other adult member in the household who has not reached the age of 70, and who meet the same income criteria currently applied for the inclusion of customers in the social residential tariff, increased by €8,000.

Social residential tariff beneficiaries include:

- Anyone who meets the criteria for the social solidarity payment (that is, meeting specific maximum income thresholds and maximum asset value thresholds, as well as two key residence criteria, i.e. have a legal and permanent residence status in Greece);
- Anyone with an actual or deemed total annual income below specific thresholds.

SocialWatt Analyser input data

Due to the absence of a national energy poverty definition, it was deemed important to assess whether PPC's vulnerable consumers, as defined by national regulation, are likely to also be energy poor. As such, 2019 data from a total of 481,484 vulnerable customers were analysed.

All six of the energy poverty indicators incorporated in the SocialWatt Analyser were used to identify energy-poor households: the 10% approach, low income high cost (LIHC), high share of energy expenditure (2M), low absolute energy expenditure (M/2), the SocialWatt indicator, and arrears on utility bills.

The PPC customer database includes the most important parameters for the analysis, i.e.: annual electricity consumption, annual electricity cost, location, age of building's construction and presence of any overdue debt for each customer.

The following input parameters per indicator have been used for the analysis:

- 10% approach: Average annual national household (dwelling) income: €9,049[14]
- Low Income high cost (LIHC):
  - Average annual national household (dwelling) income: €9,049
  - National poverty line: €7,021 (weighted average for a single person household and a household of two adults and two children),[15]
  - Average annual national electricity cost: €471[16]
- High share of energy expenditure (2M):
  - Average annual national household (dwelling) income: €9,049
  - National median share of electricity expenditure in income: 3.5%
- Low absolute energy expenditure (M/2): National average annual energy expenditure: €471
- SocialWatt indicator:
  - Average annual national household (dwelling) income: €9,049
  - Floor area of a typical household: 88.6 m^2
  - Lowest energy consumption: 40%
  - Building evaluation index (min/max): 90/110 %
  - Household evaluation index (min/max): 9/11 %
- Arrears on utility bills (overdue debt).

Energy poverty assessment

The results obtained from the SocialWatt Analyser are presented in Table 8 below, namely the number of energy-poor households identified per indicator used.

Table 8: SocialWatt Analyser: Percentage of vulnerable customers that are also energy poor per indicator, PPC

Indicator	Energy poor (%)	Energy poor (# households)
10% approach	11.3%	54,279
Low income high cost (LIHC)	0.7%	3,557
High share of energy expenditure (2M)	28.2%	135,974
Low absolute energy expenditure (M/2)	17.7%	85,258
SocialWatt indicator	86.5%	416,511
Arrears on utility bills	34.2%	164,649

Source: Dataset of 481485 "vulnerable" customers/households and SocialWatt Analyser

[14] Eurostat data for 2019
[15] Ibid.
[16] https://ec.europa.eu/energy/sites/ener/files/documents/20142207.78-93.pdf

Three indicators return low numbers of energy-poor households in this database of vulnerable customers. The 10% approach and the high share of energy expenditure (2M) indicator identified a low number of vulnerable households (11% and 18% respectively) as energy poor. These indicators identify a household as energy poor if it spends more than 10% of its income on energy or if its share of energy expenditure to income is more than twice the national median share respectively. In this analysis, energy costs were lower overall since data were only available for electricity costs, and not costs from other energy carriers; meanwhile the national average income used in the analysis is not representative of vulnerable customers. As a result, these indicators did not effectively identify energy-poor households.

The low income high cost (LIHC) indicator identified the lowest number of energy-poor households (<1%). This indicator classifies a household as energy poor if its actual energy costs are above the national average level and when subtracting this amount of money, its residual income is below the official poverty line. Considering the input parameters and the results, this indicator identifies households as energy poor if they spent more than €2,000 on electricity, revealing an inherent limitation of using this indicator, related to the use of national average income.

The highest number of energy-poor households was identified when using the SocialWatt indicator. These results are more in line with expectations, as one would expect that a high percentage of vulnerable households are also energy-poor households.

On the other hand, only about a third of vulnerable households were identified as energy poor when using the arrears on utility bills indicator. This is in line with data on this indicator available from the Energy Poverty Observatory,[17] which found 35.6% of Greek households were considered to be energy poor in 2018. Although arrears on utility bills is often used as a proxy to identify energy poverty, the analysis supports that this may not necessarily be the most accurate approach, due to the lack of causality. For example, arrears on utility bills may not be the result of energy poverty – as there are other reasons why a household may be in arrears – and energy-poor households may not be in arrears on utility bills.

Finally, when using the low absolute energy expenditure (M/2) indicator, just under a fifth of the vulnerable households were identified as energy poor. This indicator classifies a household as energy poor if its absolute energy expenditure is below half the national median. As vulnerable consumers are identified based on income, whereas this indicator uses energy costs, it is understandable why these two are not fully aligned.

In conclusion, it is evident that indicators that rely on national average income data, especially the 10%, 2M and LIHC indicators, are less accurate in their identification of energy-poor households, within the sub-group of vulnerable households studied.

Across the 330 locations within the database the five municipalities with the highest number of PPC customers are Athens, Thessaloniki, Patra, Larissa and Agrinio. The percentage of energy-poor households compared to total households in these municipalities is presented in Table 9.

[17] https://www.energypoverty.eu/indicators-data

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Table 9. SocialWatt Analyser: Number of energy-poor households in five municipalities and as a percentage of total vulnerable households in that municipality in PPC data

Indicator	Percentage of energy-poor households in the vulnerable household dataset (Number of energy-poor households)				
	Athens	Thessaloniki	Patra	Larissa	Agrinio
Number of vulnerable households in PPC database	33,273	19,344	14,512	9,126	8,349
10% approach	9.6% (3,183)	7.9% (1,521)	11.4% (1,657)	6.7% (609)	7.1% (593)
Low income high cost (LIHC)	0.4% (129)	0.8% (154)	0.4% (53)	0.3% (31)	0.1% (9)
High share of energy expenditure (2M)	25.6% (8,517)	17.8% (3,450)	31.0% (4,493)	18.7% (1,702)	24.0% (2,006)
Low absolute energy expenditure (M/2)	21.9% (7,287)	30.3% (5,859)	15.8% (2,297)	22.0% (2,012)	16.4% (1,369)
SocialWatt indicator	84.3% (28,042)	80.4% (15,555)	88.0% (12,766)	84.5% (7,714)	89.1% (7,441)
Arrears on utility bills	31.3% (10,410)	32.6% (6,299)	40.3% (5,846)	38.0% (3,472)	35.9% (2,997)

Source: PPC vulnerable households dataset and SocialWatt Analyser

As can be seen, the highest absolute number of energy-poor households is concentrated in Athens, while the two areas with the highest levels of energy poverty for most indicators are Thessaloniki and Patra, the second and third most populated cities in Greece after Athens.

In order to better understand energy poverty, especially when using income-dependent indicators, it is important to have data on the actual income per household. This would also enable a more detailed and accurate analysis of energy poverty using SocialWatt Analyser. Such data are confidential and only available to national authorities in Greece.

Conclusion

Considering the analysis, but also PPC's business priorities and strategies, the schemes that will be developed will aim to support vulnerable consumers to escape energy poverty. Once an official national energy poverty definition is available, PPC will explore expanding the scheme to more households that fall within the definition.

2.3.2 Analysis of energy poverty schemes

In Greece, energy poverty is currently addressed indirectly in national policies in the form of special protective measures for vulnerable consumers. These include partial and interest-free payment of bills and suspension of the supplier's right to issue a disconnection order due to overdue payments during the winter and summer periods. Subsidies are also available, such as the social tariff for low-income households and vulnerable households provided by PPC in the form of a discount on supply charges, to help households pay their bills.

The two schemes that will be developed by PPC, within the framework of SocialWatt, will go beyond these types of support and aim to address the root of energy poverty instead of just helping energy-poor households meet their energy needs. In order to identify suitable energy poverty schemes, SocialWatt Plan has been used. This tool identifies cost- and risk-driven optimal portfolios that consist of numerous schemes and measures.

PPC aims to develop schemes that are eligible under the national energy efficiency obligation (Article 7 of the Energy Efficiency Directive). However, targets and limitations for eligible schemes have not yet been finalised by the Ministry of Environment and Energy. The final targets and constraints of any scheme developed within the SocialWatt project will be defined when there is clarity on the requirements set by the energy efficiency obligation.

Inputs into the SocialWatt Plan

For running the SocialWatt Plan tool, two main sets of input parameters have been defined: targets to be achieved, and constraints.

Targets:

- 20,930 beneficiaries in total to be supported through the schemes. Specifically, PPC aims to target:
  - 18,200 energy-poor households that will benefit from behavioural/low-cost measures
  - 2,730 energy-poor households that will benefit from energy efficiency interventions/actions
- 465.2 GWh of energy savings (electricity)
- 28 GWh of renewable energy production
- €10 million investment into renewable energy/energy efficiency
- 271 kt CO_2 emissions savings.

Constraints:

- 20% of interventions to be in new buildings, built after 1980
- All interventions are to be small scale; no large-scale interventions
- 80% of energy savings to be made in old buildings, built before 1980, and a maximum of 20% of energy savings to be made in new buildings, built after 1980.

Evaluation of schemes

The SocialWatt Plan tool identified five key schemes as the most appropriate to consider, under both the cost-driven and risk-driven assessments:

- Renovate your Home, in particular with efficient lighting.
- Fighting the Cold, especially the replacement of boilers with more energy-efficient ones.

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- White Appliances, especially replacing kitchen cookers and hobs with more energy-efficient ones.
- RES4ALL, in particular the installation of small-scale photovoltaic systems.
- Information and Communication.

Both the cost- and risk-driven optimal portfolios proposed schemes that deliver very similar energy savings that meet the pre-defined targets, at around 465 GWh for the 2021-2030 period. As the cost-optimal portfolio delivers these savings at a lower cost, this portfolio has been considered further.

The optimal financial mechanism proposed by the tool is "collaboration with third parties" with the utility contributing 5% of the total cost. The financial schemes initially identified by the SocialWatt Plan tool as the most appropriate to fund these actions were on-bill repayment, collaboration with third parties, and crowdfunding. More specifically:

- For on-bill repayment, the optimal utility contribution was estimated to be 5-10% (depending on the measure) of the total cost of the interventions.
- For collaboration with third parties, the optimal utility contribution was estimated to be 5% of the total cost of the interventions.
- For crowdfunding, the optimal utility contribution was estimated to be 5% (depending on the measure) of the total cost of the interventions.

Under the cost-optimal portfolio, the cumulative cost to the utility after the finance option has been applied and impact of the five schemes proposed is as follows:

- Renovate your Home – A total of 68,069 interventions (replacing lighting bulbs), with a cost of €236,500 for PPC, is expected to result in 83,235 MWh energy savings (representing approximately 18% in energy savings across the portfolio). This equates to a cost of €2.84 for every MWh of energy saved.
- Fighting the Cold – A total of 5,237 interventions (replacing boilers), with a cost of €2.2 million for PPC, is expected to result in 363,*714* MWh (representing 78% of the total energy savings across the portfolio). This equates to a cost of €6.07 for every MWh of energy saved.
- White Appliances – A total of 6,101 interventions, with a cost of €400,000 for PPC, is expected to result in 18,059 MWh energy savings (representing about 4% in energy savings across the portfolio). This equates to a cost of €22.15 for every MWh of energy saved.
- RES4ALL – A total of 594 interventions (photovoltaics), with a cost of €91,800 for PPC, is expected to result in 28,000 MWh of renewable energy produced. This equates to a cost of €3.28 for every MWh of energy produced.
- Information and Communication – A total of 17,940 interventions, with a cost of €102,299 for PPC, is expected to result in 1,176 MWh energy savings. This equates to a cost of €86.96 for every MWh energy saved.

Considering the results from the SocialWatt Plan tool, Renovate your Home is the most favourable scheme, with the highest cost-effectiveness, i.e. a cost of implementation of €2.84/MWh energy savings. Two further schemes, White Appliances and Fighting the Cold,

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also have an acceptable cost-effectiveness.

Conclusions

Based on the analysis from the SocialWatt Plan tool and considering business strategies and priorities, budget, risks and constrains, PPC considers White Appliances and Information and Communication of high interest to consider further.

Innovative options for financing these schemes will be explored. More specifically, PPC will focus on two possible options, revolving funds and collaboration with third parties (also identified as optimal in SocialWatt Plan), in particular, technology providers, banks and regional authorities.

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2.4 ESB, Ireland

2.4.1 Assessment of energy poverty

Energy poverty definition

In Ireland, energy poverty is defined as when: "*a household's energy spend is greater than 10% of disposable income (equivalised for housing costs). Thresholds are used to determine severity: severe energy poverty when spending is 15% of income and extreme energy poverty when spending is 20% of income.*"[18]

A key alleviation of energy poverty in Ireland is the payment of a 'Fuel Allowance'. A Fuel Allowance is a payment under the National Fuel Scheme to help with the cost of heating the home during the winter months. It is paid to people who are dependent on long-term social welfare payments and who are unable to provide for their own heating needs. For the purposes of qualifying for energy efficiency measures or other support, the receipt of this payment can be also used as a blunt instrument to determine a fuel poor household.

SocialWatt Analyser input data

Although Ireland has a national definition of energy poverty, the SocialWatt analyser was used to test all six of the indicators - the 10% approach, Low Income High Cost (LIHC), High Share of Energy Expenditure (2M), Low Absolute Energy Expenditure (M/2), the SocialWatt Indicator, and Arrears on Utility Bills - to explore differences in the results and test the tool.

ESB's customer database includes key parameters for the analysis: annual electricity and gas consumption, annual electricity and gas cost, location, and overdue debt for each customer.

There were a number of internal difficulties in obtaining permission to install and run the tool. As a result, SocialWatt Analyser was run for only a small sample dataset, with a total of 486 customers from 2019. Nevertheless, after carefully reviewing the dataset, it was concluded that this did not Include dual fuel customers, half of the sample were electricity customers, the other half were gas customers. As such, the analysis focused on electricity customers only, of which there are 260.

The following input parameters per indicator have been used for the analysis:

- 10% approach: Average annual national household (dwelling) income: €28,626[19]
- Low Income High Cost (LIHC):
  - Average annual national household (dwelling) income: €28,626
  - National poverty line: €23,885 (weighted average national poverty line for a single person household and a household of two adults and two children)[20]

[18] European Commission. (2016). *Working Paper on Energy Poverty*. Available at: https://ec.europa.eu/energy/sites/ener/files/documents/working_paper_on_energy_poverty_0.pdf

[19] Eurostat data for 2019

[20] Ibid.

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  - Average annual national electricity cost: €1,100.[21]
- High share of energy expenditure (2M):
  - Average annual national household (dwelling) income: €28,626
  - National median share of electricity expenditure in income: 4%.
- Low absolute energy expenditure (M/2): National average annual electricity expenditure: €1,100
- SocialWatt indicator:
  - Average annual national household (dwelling) income: €28,626
  - Floor area of a typical household: 80 m^2
  - Lowest energy consumption: 60%
  - Building evaluation index (min/max): 90/110 %
  - Household evaluation index (min/max): 9/11 %.

Energy poverty assessment

The number of energy poor households identified per indicator studied is presented in Table 10 below.

Table 10: SocialWatt Analyser: Percentage of energy poor households per indicator, ESB

Indicator	Energy poor (%)	Energy poor (# households)
10% approach	0.8	2
Low Income High Cost (LIHC)	0.4	1
High Share of Energy Expenditure (2M)	3.1	8
Low Absolute Energy Expenditure (M/2)	46.5	121
SocialWatt Indicator	0.4	1
Arrears on Utility Bills	0.0	0

Source: ESB dataset of 260 customers/households and SocialWatt Analyser

As it can be seen from the results, the majority of indicators identify less than 1% of households as energy poor. Considering the low number of households incorporated in the analysis, no firm conclusions can be drawn. Nevertheless, it can be seen that most of the households considered spend less than 8% of the national average income on electricity expenditure. In addition to this, the absolute electricity expenditure of almost half of the households considered is below half the national median (i.e. €1,100).

Considering the abovementioned analysis, national requirements (in particular GDPR compliance), the availability of other methods to identify 'true' fuel poor households and ESB's business priorities and strategies, the disaggregated results (i.e. customers classification as energy poor or not) will not be used for directly targeting energy poor households.

[21] https://www.electricireland.ie/residential/help/billing/estimated-annual-bill

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Nevertheless, ESB plans to run SocialWatt Analyser with its customer data and use the results to identify areas of interest, for example where high percentages of energy poor households are thought to be concentrated).

Finally, ESB is currently exploring different options for targeting prequalified energy poor households, with the help of the SEAI (Ireland's regulatory body overseeing commitment to energy reduction targets), social services, fuel poverty charities and public authorities. Several agencies that assist households in financial difficulties have also shown an interest to take part in such project development. With the onset of a recession, all involved feel the timing is right for such schemes and there is now some momentum to move forward.

Several discussions with the abovementioned parties have taken place and a number of areas of interest have arisen. As Ireland is very progressive in fuel poverty programs, more innovative projects are required. With households suffering extreme fuel poverty provided for by local and national grant and social welfare schemes, it is felt that a concentration needs to be on the 'new fuel poor'. Those who may have dropped into the category but are not caught in the net of the national and local programs. Especially of note is the area of households who rent their homes who are on a low income. Housing owned and provided by the state or local authority will fall under funded renovation schemes but those who are privately renting suffer from the impact of the split incentive - as the landlord is not incentivized to improve the efficiency of the property, yet it is the low income tenant that suffers the effects of the resulting fuel poverty.

2.4.2 Analysis of energy poverty schemes

The Irish Government has a long-established programme of initiatives to tackle energy poverty. These include the Warmer Home Scheme that was introduced to specifically tackle fuel poverty through free energy efficiency upgrades for households on certain state benefits and the Better Energy Communities programme, building on the Warmer Home Scheme, to broaden the scope to buildings across the community including fuel poor and non-fuel poor schools, and community halls.

Electric Ireland, the supply division of ESB, has actively supported these programmes through a variety of means. For example, under the Better Energy Communities programme, Electric Ireland provided financial and technical support to the Louth County Council's plan to upgrade heating controls in 2,100 houses. ESB also provided financial and technical support to NABCO, a central association for housing cooperatives in Ireland, and undertook full energy upgrades to 90 semi-detached houses.

Given the vast experience in designing and implementing schemes to tackle energy poverty, and in order to develop innovative and effective schemes within the framework of SocialWatt, ESB has established an internal energy poverty working group. This is actively assessing potential schemes to be implemented, having also considered the results obtained from the SocialWatt Plan tool, alongside efficient ways to target and reach energy poor households.

It should be noted that ESB aims to develop schemes that are eligible under the national EEO (in compliance with Article 7 of the Energy Efficiency Directive). However, the national framework of targets, measures and eligible schemes have not yet been finalised for the next obligation period. Therefore, the final selection of schemes will only be possible when there is clarity on the requirements set under the EEO.

Inputs to the SocialWatt Plan

For running SocialWatt Plan, two main sets of input parameters have been defined: targets to be achieved, and constraints. Targets include:

- 10,000 beneficiaries supported through the schemes to be designed
- 40 GWh energy savings (electricity)
- 14 GWh renewable energy production
- €10 million renewable energy or energy efficiency investments
- 65 kt CO_2 emissions savings

In terms of constraints, ESB has defined the following:

- 90% of interventions to be in old buildings built before 1980 and 10% in new buildings
- 40% of interventions to be large scale, 60% small scale
- A maximum of 10% of energy savings to be from new buildings, built after 1980.

Evaluation of schemes

The SocialWatt Plan Tool identified three schemes as the most appropriate to consider, under both the cost- and risk-driven assessments:

- 'Greening your Home', in particular installing double glazed windows (as well as insulating roofs under the risk driven optimal portfolio).
- 'RES4ALL', in particular the installation of small-scale photovoltaic systems.
- 'Information and Communication'.

Both the cost- and risk-driven optimal portfolios proposed schemes that deliver similar energy savings, exceeding the 40 GWh target for the 2021-2030 period. Nevertheless, as the cost optimal portfolio delivers these savings at a lower cost, the cost-driven portfolio has been considered further. Under the cost optimal portfolio, where the optimal financial mechanism has been considered, the cumulative cost to the utility and impact of the five schemes proposed is as follows:

- Greening your Home – A total of 6,648 interventions, installing double glazed windows, with a cost of €1,18m for ESB, is expected to result in 82,108 MWh energy savings (representing approximately 99% in energy savings across the portfolio). This equates to a cost of €14.30 for every MWh energy saved.
- RES4ALL – A total of 572 interventions, with a cost of € 215,000 for ESB, is expected to result in 14,006 MWh of renewable energy produced. This equates to a cost of €15.30 for every MWh energy produced.
- Information and Communication – A total of 9,400 interventions, with a cost of €47,000 for ESB, is expected to result in 774 MWh energy savings. This equates to a cost of €60.80 for every MWh energy saved.

Considering the results from the SocialWatt Plan tool, Greening your Home is the most

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favourable scheme, with the highest cost effectiveness, i.e. a cost of implementation of €14.3 per MWh energy savings, followed by RES4ALL.

The financial schemes identified by the SocialWatt Plan tool as the most appropriate to fund these actions were: on-bill repayment, collaboration with third parties, and crowdfunding. More specifically:

- For on-bill repayment, the optimal utility contribution was estimated to be 5% of the total cost of the interventions.
- For collaboration with third parties, the optimal utility contribution was estimated to be 5-6% (depending on the action) of the total cost of the interventions.
- For crowdfunding, the optimal utility contribution was estimated to be 5% of the total cost of the interventions.

To fund the entire portfolio with one financial mechanism the tool evaluated "crowdfunding" with a utility participation of 5% of the total cost as the most appropriate.

Conclusions

Based on the analysis from the SocialWatt Plan and considering business strategies and priorities, budget, risks and constrains, ESB considers Greening your Home and Information and Communication of interest to consider further.

Nevertheless, the internal working group is considering these and other actions, alongside a various different financial mechanisms.

For the Communication scheme for example, Electric Ireland will be looking to work with an energy action charity and a financial hardship charity to develop a brochure that contains quick and easy wins in energy savings and further information on national and local schemes available to the home owners. These can be targeted via energy action and poverty groups as well as financial advice and assistance groups.

For the Greening Your Home scheme, there are projects to be explored working with landlords to target renting fuel poor households. Discussion on funding of these will be initiated with the relevant national bodies. A further scheme in discussion is regarding a fuel poverty qualification scheme. This would bring together inputs from the fuel poor charity and Electric Ireland and could result in some of the 'middle ground' homeowners, who fall into fuel poverty but are not covered by the various local and national schemes, being offered support.

2.5 EVISO, ITALY

2.5.1 ASSESSMENT OF ENERGY POVERTY

Energy poverty definition and input data

Italy does not have a national definition of energy poverty. Therefore, the SocialWatt indicator of energy poverty was chosen to determine levels of energy poverty and risk of energy poverty. The SocialWatt indicator assesses:

> *If the actual energy consumption of a household is lower than the theoretically required level for maintaining thermal comfort, the household is classified as energy poor. If consumption is not lower than the theoretically required level, the ratio between energy cost and income is taken into consideration.*

Specific customer data imported to perform this analysis included electricity consumption (eVISO is an electricity supplier and does not supply gas), total electricity bill costs covering several years, location (municipality, province or region) and households' energy debt. In addition to specific customer data, other data included average income data by province, municipality, region and average floor area for a typical household (117m^2).[22] Where local income data is missing the national average income (€21,641)[23] was used.

The "lowest energy consumption" parameter was set at 10% of the average. This parameter is designed to exclude properties with very low energy consumption in order to exclude homes that are infrequently/not occupied or used as holiday homes, so that these are not identified as energy-poor households.

Energy poverty assessment

The results obtained from using the SocialWatt indicator are summarised in Table 11. Data from 2019 have been analysed.

Table 11: SocialWatt Analyser results when using the SocialWatt indicator, eVISO, 2019

Energy poverty	Result	Percentage
	2019	
At risk of energy poverty	302	4.3%
Energy poor	1,523	21.7%
Not energy poor	5,206	74.0%
Total	**7,031**	**100%**

Source: eVISO and SocialWatt Analyser

The 7,031 residential household customers analysed for 2019 include both direct household customers of eVISO (3,222 households in 2019) and household customers served by energy resellers that buy power from eVISO (3,809 households in 2019). For the second group, the relationship with the customer is held by the reseller and not eVISO directly. Of the total

22 https://www.truenumbers.it/grandezza-case-italia

23 No income data for 2019 and 2020 are available at the time of writing. For 2018 data, see https://www1.finanze.gov.it/finanze3/analisi_stat/v_4_0_0/contenuti/analisi_dati_2018_irpef.pdf?d=1587655800

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customer base, 21.7% were identified as energy poor with a further 4.3% identified as at risk of energy poverty.

A sensitivity analysis was undertaken to assess the impact of the lowest energy consumption parameter. A small change in the parameter was found to have a large impact on the energy poverty assessment. Decreasing the parameter from 10% to 5% will lead to an increase of 21.4% in energy-poor households (and an increase of 3.6% on households at risk of energy poverty).

The analysis was run for a second time using energy data for six months in 2019 and six months in 2020 to understand the impact of the COVID pandemic. Notwithstanding a small variation in absolute customer numbers (additional customers were taken on in this period), the percentage of energy-poor households changed in 2020 from 21.7% (2019) to 32.2% (2020), and those at risk of energy poverty changed from 4.3% (2019) to 6.8% (2020). Energy poverty as assessed is higher in the 12 months to the middle of 2020 than in January to December of 2019, largely as energy consumption in households varied during lockdown. So, potentially, this tool could be very effective at tracking households' energy poverty history over time, by updating the tool to make time scales customisable.

However, for the assessment of longer-term energy poverty, the 2019 dataset was used (Figure 10). For the subset of direct customers alone, in 2019, 308 were identified as energy poor and 101 at risk of energy poverty. For the resellers, 215 were identified as energy poor and 201 at risk of poverty.

The correlation between consumption and income, broken down by region, is shown in Figure 9. Where the customer data do not indicate a municipal location then the national income has been used for this analysis. The results are very similar at a municipal and provincial level (using local and provincial income data), so whether municipal or provincial income data is used does not have a significant influence on the overall results.

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Figure 9: Mapping energy poor households and households at risk of energy poverty (2019) and regional statistics on net income (2018), eVISO

Source: eVISO

Figure 9 can also be displayed as a chart, as shown in Figure 10. The results in Figure 9 and Figure 10 do not illustrate a strong correlation between the number of energy-poor households in eVISO's customer base in a region with the average income of that region. A higher number of energy-poor households does not necessarily correspond to a lower-income region, or vice versa.

The comparison of number of households identified as energy poor and average income in regions is only indicative, as the number of households assessed relates only to eVISO customers and not to all the households within a region. Number of customers varies significantly between regions, with the largest number of customers being in Piemonte. The results of the comparison may therefore be skewed.

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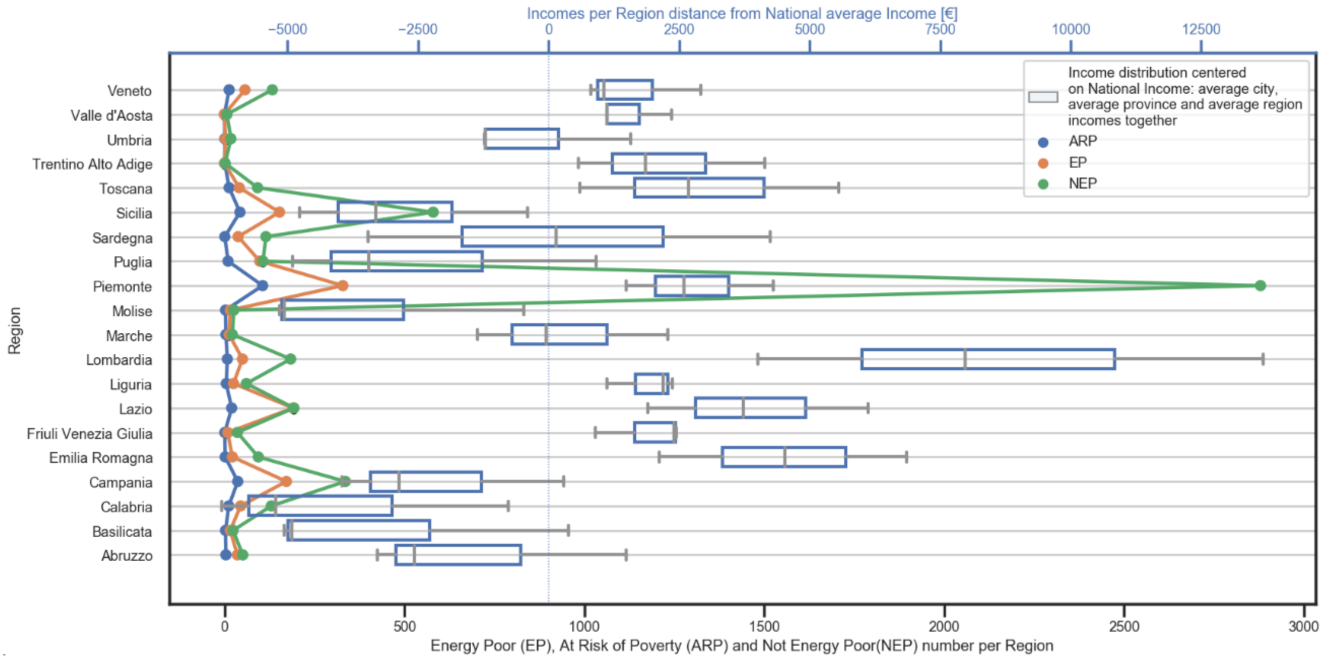
Figure 10: Energy-poor households and households at risk of energy poverty (2019) compared to regional statistics on net income (2018), eVISO



Source: eVISO

The analysis by region, presented in Table 10 illustrates in which regions the prevalence of energy poverty in the eVISO customer base is highest. This table also compares energy poverty prevalence in the eVISO customer base with average regional income. It shows that, compared to the average national income (€21,641), some lower-income regions are estimated to have a higher number of energy-poor households (e.g. Puglia, Abruzzo, Basilicata, Molise) but significant outliers mean that this is not a firm trend (e.g. Lazio and Toscana).

Table 12. Percentage of eVISO customers identified as energy poor per region along with regional income statistics

Region	Regional income [€]	Energy poor [%]	eVISO direct [%]	Reseller [%]
Lazio	23,544	47.8%	0	47.8
Puglia	16,746	45.4%	0	45.4
Abruzzo	18,364	39.1%	0	39.1
Basilicata	16,579	37.2%	0	37.2
Molise	16,482	35.6%	0	35.6
Marche	20,285	33.3%	0	33.3
Toscana	22,245	32.9%	0	32.9
Campania	17,682	31.6%	0	31.6
Veneto	22,706	30.9%	0	30.9
Liguria	22,766	29.2%	6.3	22.9
Trentino Alto Adige	23,495	25.0%	0	25

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Region	Regional income [€]	Energy poor [%]	eVISO direct [%]	Reseller [%]
Sardegna	18,178	24.5%	0	24.5
Calabria	15,376	24.3%	2.6	21.7
Lombardia	25,653	22.3%	0.4	21.9
Sicilia	16,879	20.7%	0	20.7
Emilia Romagna	23,758	20.7%	0	20.7
Friuli Venezia Giulia	22,539	20.4%	0	20.4
Umbria	20,415	16.7%	0	16.7
Piemonte	23,127	10.2%	8.9	1.3

Source: eVISO and SocialWatt Analyser

Finally, the low absolute energy expenditure (M/2) indicator was also explored. This indicator identifies households whose absolute energy expenditure is below half the national median, or in other words abnormally low.[24] For this indicator, the national median absolute electricity expenditure only was used, which is €417 (for both electricity and gas it is €1,200). The Analyser then divides this value by two (i.e. €208.50) and uses this as a threshold to determine energy poverty. This indicator, when used in isolation, does not explain energy poverty well, so was ultimately rejected for this analysis. By identifying households that use low amounts of electricity, this indicator groups not only those who are energy rationing but also potentially those who live in very efficient homes or who live in the home in question for part of the year. In eVISO's analysis the M/2 indicator identified 38% of all customers as energy poor. This is a very high result, much higher than the results produced by more sophisticated indicators like the SocialWatt indicator and than revealed by eVISO's own customer data.

Conclusion

This analysis has identified over 1,500 households in eVISO's customer base that are in energy poverty, when using the SocialWatt indicator. From these, 308 are in eVISO's direct customer base and 1,215 are customers of eVISO's resellers. The initial focus of eVISO's energy poverty alleviation work will be within the direct customer base and will also include other households, identified via outreach activities. Engagement with the customers of the resellers will be a longer-term objective, achieved by working with the resellers to encourage replication of the energy poverty schemes.

The analysis has also identified that, in two regions, over 45% of eVISO's customers are assessed to be energy poor (Lazio and Puglia). In a further seven regions more than 30% of eVISO's customers are assessed to be energy poor.

The results also show that the correlation between average regional/local income and energy poverty is not strong, suggesting that regional/local income may not be a good indicator for identifying energy poverty in eVISO's customer base.

[24] https://www.energypoverty.eu/indicator?primaryId=1463

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2.5.2 Analysis of energy poverty schemes

The Italian Regulatory Authority for Electricity Gas and Water (ARERA),[25] in its implementation of Article 7 of the Energy Efficiency Directive,[26] defined a list of obligated parties for Italy. In this decree,[27] ARERA determined that only electricity and gas distributors are obligated under Article 7 and therefore eVISO, which is a retailer and not a distributor, is not required to deliver on this obligation.

However, outside of an obligation under Article 7, eVISO decided to join the SocialWatt project to improve its knowledge about markets all over Italy and, moreover, to expand its work in line with the company motto "to have a positive impact on the world" to other areas, learning from SocialWatt partners.

Inputs into the SocialWatt Plan tool

The SocialWatt Plan tool was used to explore and develop eVISO's plan within certain constraints and risks, considering a number of possible schemes to be developed in Italy to help households alleviate energy poverty.

eVISO ran two investment scenarios, the first with a maximum €300,000 investment for a wider range of schemes and the second with a smaller €200,000 maximum investment for a smaller collection of schemes.

For these analyses, eVISO's targets included:

- 2.5 GWh energy savings
- 4.5 GWh renewable energy production (only for the higher investment scenario)
- 4 kt CO2 emissions savings from electricity.

eVISO defined the following constraints:

- All interventions to be in old buildings built before 1980
- 20% of interventions to be large scale, 80% small scale
- Maximum 20% of total energy savings to be achieved from new buildings.

Evaluation of schemes

As a first simulation, eVISO considered schemes to be studied to help alleviate energy poverty in Italy with a €300,000 investment over the period 2021-2030. Both cost- and risk-driven analyses were assessed. The cost-optimal portfolio, calculated to require €234,635 investment from eVISO, is outlined below.

To finance the identified schemes the SocialWatt Plan tool identified crowdfunding (delivering 60.4% of the total investment), on-bill repayment (delivering 19.8% of total investment) and collaboration with third parties (delivering 19.8% of total investment) as suitable options. The funding and finance mechanism proposed by the tool as most appropriate to this overall portfolio was crowdfunding, with the utility contributing 5% of the

[25] Autorità di Regolazione per Energia Reti e Ambiente: https://www.arera.it/it/index.htm
[26] 2012/27/UE, https://eur-lex.europa.eu/legal-content/IT/TXT/PDF/?uri=CELEX:32018L2002&from=IT
[27] DMRT/EFC/01/2020, https://www.arera.it/allegati/docs/20/001-20dmrt.pdf

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total investment costs. The utility investment figures below are based on this finance option.

Among the schemes in the cost-optimal portfolio, three generate energy savings, and one produces renewable energy. The results from the tool over the 10-year investment are summarised as follows:

- White Appliances – replacing inefficient washing machines. This scheme proposes 4,514 interventions for an investment by the utility of €102,000, which would save 5 GWh of energy. This scheme delivers savings at a cost to the utility of €19.32/MWh.
- Renovate your Home – installing energy-efficient lighting. This scheme will trigger 2,001 interventions as a result of a utility investment of €6,700, which would save almost 3 GWh of energy. This scheme delivers savings at a cost to the utility of €2.22/MWh.
- Fighting the Cold – installing efficient gas boilers. This scheme proposes 26 interventions for a utility investment of €21,100, which will save more than 1 GWh of energy. This scheme delivers savings at a cost to the utility of €16.25/MWh.
- RES4ALL – installing PV. A total of 213 interventions for a utility investment of €104,900 is expected to generate 4.5 GWh of renewable energy. This scheme delivers savings at a cost to the utility of €23,30/MWh.

Based on the SocialWatt Plan tool output, the Renovate your Home scheme is the most favourable, considering both the cost-driven and risk-driven analysis, while the least favourable is the RES4ALL scheme.

A second simulation was run with a lower investment of €200,000 and fewer schemes considered, including only the below three schemes and Information and Communication. With the €200,000 budget, the following cost-optimal portfolio was proposed by the tool, with a financing package based on on-bill repayment with the utility contributing 5% of the total cost:

- White Appliances: 4,735 interventions for an investment by the utility of €106,600, which would save almost 6 GWh of energy. This scheme delivers savings at a cost to the utility of €18.56/MWh.
- Renovate your Home: 2,001 interventions as a result of utility investment of €6,500, which would save 3 GWh of energy. This scheme delivers savings at a cost to the utility of €1.99/MWh.
- Fighting the Cold: 30 interventions for a utility investment of €24,500, which will save more than 1 GWh of energy. This scheme delivers savings at a cost to the utility of €16.60/MWh.

In this second assessment, the Renovate your Home scheme was once again the most cost-effective, with savings delivered at less than €2/MWh. The White Appliances scheme was the most expensive, at €18.60/MWh. So, similar results are observed for both simulations in terms of costs.

Conclusion

According to these results, eVISO decided to pursue four schemes and follow the second budget strategy, in line with eVISO's priorities, risks and constraints. Crowdfunding and collaboration with third parties are the financing schemes that will be explored as most appropriate. Where these mechanisms are not available or suitable eVISO will cover the costs. In this case, final payback will be in terms of social benefits: if energy-poor households improve their conditions, then society as a whole will gain, energy consumption will be reduced and so will CO_2 emissions, leading to an overall gain for eVISO too.

Three of these schemes fall within the Information and Communication scheme type:

- Scheme 1: with this scheme, eVISO will produce videos, social campaigns, web pages and questionnaires to engage energy-poor households.
- Scheme 2: eVISO will train Caritas (an international anti-poverty charity) volunteers about energy, so that they can give advice to energy-poor households.
- Scheme 3: mapping energy poverty together with Caritas (as a stakeholder). Caritas volunteers will go door-to-door and visit households to complete a questionnaire and give advice. If necessary, an energy counsellor will go to the household and give further advice or suggest changing some appliances. After receiving these inputs, beneficiaries will be visited again one year after to assess their experience and evaluate the impact of the advice.

The above schemes do not directly come from the SocialWatt Plan tool suggestions, but have been developed through engagement with Caritas-Austria, another SocialWatt partner, building on their experience and adapting this for the Italian context.

One further scheme that was proposed by the Plan tool is the White Appliance scheme. eVISO will also explore this approach, replacing inefficient appliances, working together with an appliance retailer.

2.6 Fortum, Latvia

2.6.1 Assessment of energy poverty

Energy poverty definition and input data

In Latvia there is no official definition of energy poverty. The Ministry of Economics is planning to make changes to the Energy Law to include a definition, the draft of which is:

"Energy poverty: difficulties or inability to maintain an adequate temperature in the dwelling due to low energy efficiency or inability to use or pay for the services provided by the energy supply merchant due to low income or high costs of energy supply services".

The following criteria are planned for households to qualify as energy-poor:

"An energy affected household is a household in which a family or person meets at least one of the following criteria:

1) is recognised as a family, or a person living separately, with the status of a poor or low income family (person) in accordance with the laws and regulations and, at the same time, it receives a housing benefit in accordance with the laws and regulations regarding the provision of social assistance;
2) it is provided with a residence in a social apartment in accordance with the laws and regulations regarding the recognition of a person as entitled to rent a social apartment."

Discussions are still ongoing and potential changes to the definition and criteria are possible.

It is likely that municipalities will be authorised to bestow energy-poor household status according to the criteria set by the state.

Fortum is a district heating company. In investigating the suitability of using district heating companies' internal data alongside public data to identify energy-poor households, significant challenges were identified.

In contrast to gas and electricity retail companies, district heating utilities have limited data on end users' and households' energy consumption. Historically, energy consumption in district heating systems is metered at the building level, not for each household or flat. More recently, separate meters for each unit have been installed in new buildings but the majority of multiapartment buildings typically split total heating energy consumption based on apartment size. The same size flats in one multiapartment building will have exactly the same invoice for heat supply, even if a household in one flat has undertaken heat-saving measures (e.g., set low temperature, changed windows, etc.). District heating companies do not therefore hold unit-level data on heat energy consumption.

In addition, utilities do not hold data on the number of household members and income level, which would aid accurate assessment of energy poverty. Each month, municipalities send utilities data about households that receive support from the municipality because they have low-income household status.

Fortum provides district heating in the city of Jelgava, therefore the analysis focuses on customers in that location. In the city of Jelgava, about 15% of all multiapartment buildings that are connected to district heating use allocators/meters that count heat consumption

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for each flat. In these buildings the apartment owners decide on a coefficient that divides total heat consumption in two parts: one part is calculated according to each flat's consumption, as metered by the allocator, and the second part is split according to flat size. This second part represents the heating consumption for the common areas of the building – basements, staircases, hallways. All consumption data was uploaded into the Analyser tool to analyse its potential to identify energy-poor households.

Existing IT systems have limited data export options and the relevant datasets must therefore be prepared manually. For this reason and the fact that households level data is not always available or accurate, only data for buildings that use allocators for heat metering were included in this analysis.

Furthermore, there are no public data on electricity and natural gas consumption for each household. Therefore, the analysis is based only on data on heat consumption, which does not represent total household energy cost. Dwellings that are heated by district heating largely use natural gas in small volumes for cooking but to have more precise data on energy costs per household, data on costs for hot water could be added using Fortum internal data.

The following input parameters per indicator have been used for the analysis:

- 10% approach: Average annual national household (dwelling) income: (€14,753).[28]
- Low income high cost (LIHC)
  - Average annual national household (dwelling) income: €14,753
  - National poverty line: €635 per month (average for a single person household and for a two-adult family with two children under age of 14 household in 2018)
  - Average annual national energy cost: €300[29]
- High share of energy expenditure (2M)
  - Average annual national household (dwelling) income: €14,753
  - National median share of energy expenditure in income: 2%[30]
- Low absolute energy expenditure (M/2)
  - National median absolute annual energy expenditure: €30029
- SocialWatt Indicator
  - Average annual national household (dwelling): €14,753

[28] Central Statistical Bureau of Latvia

[29] In the absence of available national statistics, average household energy costs (district heating) were derived by analysing the customer database of Fortum.

[30] In the absence of available national statistics. The average share of energy expenditure in income was derived by analysing the customer database of Fortum.

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- Floor Area of a typical Household:[31] 49.5 m^2.
- Lowest energy consumption: 60%
- Building evaluation index (BEI): 90-110
- Household evaluation index (HEI): 9-11.

For arrears on utility bills, Fortum's internal data was used. For this indicator households that have not made full payment on bills for 30 or more days were considered as being in arrears. Those households with debts for longer than a year and which no longer use heating services were excluded.

Energy poverty assessment

The following results were produced from analysing the data in the SocialWatt Analyser tool.

Table 13. SocialWatt Analyser: Percentage of energy poor households per indicator, Fortum, 2019

Indicator	Energy poverty %
10% approach	0%
Low income high cost (LIHC)	0%
High share of energy expenditure (2M)	6.5%
Low absolute energy expenditure (M/2)	30.5%
SocialWatt indicator	56.3%
Arrears on bills	12.4%

Source: Fortum and SocialWatt Analyser

As already mentioned, in the absence of household-level income data, average national income data was used. For two of the indicators that rely on the use of income data (10% and LIHC), this approach, along with the fact that only heat consumption data and not total energy consumption were used, resulted in no energy poor households being identified. The high share of energy expenditure (2M) indicator identified 6.5% of customers as energy poor.

By contrast, the results for the low absolute energy expenditure indicator (M/2) show that about a third of households are energy poor. This means that about a third of households spend below half the average district heating costs.

The SocialWatt indicator results show that 56.3% of households are energy poor. Finally, 12.4% of households have arrears on utility bills for a period of 30 days or more. The number of households identified as energy poor under this indicator is quite high, and appears to be inaccurate. To address this issue the underlying data used in SocialWatt Analyser, in particular modelled energy needs of households in Spain, have been reviewed and are being revised. [32]

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[31] The floor area of a typical household dwelling was derived from Fortum internal datasets for households.

[32] Energy needs were modelled by the Dynamic high-Resolution dEmand-sidE Management model (DREEM), Results appear accurate for most countries modelled, however they appear inaccurate for Spain and Latvia. As a result, calculated energy needs will be revised in SocialWatt Analyser,

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Lack of data from other energy carriers (on electricity and gas) to provide a complete picture of total energy expenditures and lack of data on income level per household are challenging factors that considerably impact the accuracy of the analysis.

Conclusion

- District heating companies compared to other utilities hold less information about end users as most metering of heat consumption is done at building level. Limited availability of information leads to less accurate outputs from the tool.
- Taking into account data gaps and limitations, arrears on utility bills could be the most suitable method for identifying energy-poor households.
- 12.4% of households have arrears on utility bills over 30 or more days.
- Lack of data on total energy consumption (natural gas, electricity, heating costs for hot water) and income per household limits the accuracy of the results derived from the SocialWatt Analyser.
- If municipalities have the responsibility to assign households as energy-poor, then alternative methods used by utilities may be at odds with the municipality approach.

2.6.2 ANALYSIS OF ENERGY POVERTY SCHEMES

Inputs into the SocialWatt Plan tool

The SocialWatt Plan tool was used to identify optimal schemes to consider for implementation to reduce energy poverty.

The energy efficiency obligation scheme in Latvia is binding for electricity retail companies whose annual sales are 10 GWh or more. District heating, natural gas and transport fuel companies are not currently obligated under the EEO but the Ministry of Economics is planning to make changes.

District heating companies are regulated businesses. Tariffs for end users are controlled, so companies are cost-sensitive as allowed profit margins are small. The cost of implementing energy poverty schemes is one of the main criteria to be considered, but the risk-optimal portfolio was also evaluated.

To evaluate optimal schemes for Jelgava, the following input data were used:

- 1.5 GWh energy savings
- 1 GWh renewable energy production
- €4 million renewable energy/energy efficiency investments
- 2.5 kt CO_2 emissions savings from gas
- Target of 3,000 interventions.

The following constraints were defined:

- 80% of interventions should be in old buildings, built before 1980, and 20% in new buildings
- All interventions to be small scale

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- Maximum 20% of energy savings from new buildings, built after 1980.

Evaluation of schemes

According to SocialWatt Plan the risk-optimal portfolio contained four schemes: Renovate your Home, Information and Communication, Fighting the Cold and RES4ALL.

There are different levels of savings, costs and interventions depending on the scheme. Detailed results can be seen in Table 14 below.

Table 14: SocialWatt Plan: Summary of the risk-optimal portfolio, Fortum

Scheme	Interventions	Costs (€) to the utility	Energy savings (MWh)
Renovate your Home	557	3,617	928.8
Info & Communication	2043	25,231	80
Fighting the Cold	361	57,775	8,325
RES4ALL	39	6,026	1,004
Total	**3000**	**92,300**	**10,338**

Source: SocialWatt Plan

The tool suggested crowdfunding with a contribution from the utility of 10% as the optimal financing scheme to cover this entire portfolio.

The cost-optimal portfolio presented by the SocialWatt Plan tool contained the same four schemes but with a different proportion of interventions and investment between the schemes, as shown in Table 15 below.

Table 15: SocialWatt Plan: Summary of the cost-optimal portfolio, Fortum

Scheme	Intervention s	Cost (€) to the utility	Energy savings (MWh)
Renovate your Home	314	1,010	542.4
Info & Communication	2286	13,952	99
Fighting the Cold	357	28,164	9,636
RES4ALL	43	3,421	1,019
Total	**3000**	**46,548**	**11,296**

Source: SocialWatt Plan

The tool suggested collaboration with third parties with a contribution from the utility of 5%, as the optimal financing scheme to cover this entire portfolio.

Further detail on the actions within each of the four schemes within the cost-optimal portfolio is as follows:

- Renovate your Home: energy-saving bulbs that will support beneficiaries to reduce electricity consumption to be implemented between 2022 and 2023. At a cost to the utility of €1,010 for an energy saving of 542.4MWh, this scheme has a cost-effectiveness of €1.86 per MWh saved.

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- Information & Communication: information campaigns to change energy consumption habits and educate consumers about energy-saving options to be implemented between 2023 and 2030. At a cost to the utility of €13,952 for an energy saving of 99 MWh, this scheme has a cost-effectiveness of €141.10 per MWh saved.
- Fighting the Cold: investing in modern and efficient gas boilers to be implemented between 2021 and 2022. At a cost to the utility of €28,164 for an energy saving of 9,636 MWh, this scheme has a cost-effectiveness of €2.92 per MWh saved. Fortum customers do not use natural gas as a heating source but targeting households that use old gas boilers could be considered. Investing in district heating to substitute old gas boilers would not only increase energy efficiency but would also reduce fossil fuel consumption.
- RES4ALL: investing in modern PV solutions to be implemented in 2022. At a cost to the utility of €3,421 for an energy generation of 1,091 MWh, this scheme offers a cost of €3.36 per MWh generated.

The outputs of SocialWatt will be used in the evaluation of possible schemes to implement, alongside alternatives.

Conclusion

According to the SocialWatt Plan tool, the following schemes are recommended to be implemented: Renovate your Home, Information and Communication, Fighting the Cold and RES4ALL.

Lack of clarity about upcoming changes to legislative requirements and means to finance schemes are the main criteria that influence decision-making on which schemes to implement, and how. Discussions with local municipalities about specific projects in the city are planned. The SocialWatt Plan results will be considered during the decision-making process and may also reveal new opportunities to tackle energy poverty, on the basis of these schemes. Results will also be used for the evaluation of different strategies, considering business strategies and priorities, budget, risks and constraints. The tool can be further used to review other schemes if some of the identified schemes are not considered a priority to implement.

2.7 CEZ Vânzare, Romania

2.7.1 Assessment of energy poverty

Energy poverty definition and input data

Romania does not have a current definition of energy poverty, although Law 196/2016 regarding the minimum income for inclusion will come into force in 2021 and includes the following definition: "*Energy poverty is defined as the impossibility of the vulnerable consumer to meet their minimum energy needs for the optimal heating of the home during the cold season*."

In order to better address and identify energy-poor citizens, five indicators incorporated in the SocialWatt Analyser tool have been considered (10% approach, low income high cost [LIHC], high share of energy expenditure [2M], SocialWatt indicator and arrears on utility bills) and the results obtained compared.[33]

The data analysed by the SocialWatt Analyser tool include 1,039,080 records from the CEZ Vânzare customer database (including customers on regulated prices). The data include the most important parameters: annual electricity and gas consumption, annual electricity and gas costs, customer's age, location and disconnection notices.

Energy poverty assessment

SocialWatt Analyser has been used to estimate the percentage of energy-poor households in the CEZ Vânzare dataset per energy poverty indicator used. The following input parameters per indicator have been used for the analysis:

- 10% approach: Average annual national household (dwelling) income: €11,000[34]
- Low income high cost (LIHC): Average annual national household (dwelling) income: €11,000, national poverty line: €6,200[35] in terms of annual income, national average annual energy cost: €1,771[36]
- High share of energy expenditure (2M): Average annual national household (dwelling) income: €11,000, national median share of energy expenditure in income: 8%[37]
- SocialWatt indicator: Average annual national household (dwelling) income: €11,000, floor area of a typical household: 50m^2,[38] lowest energy consumption: 60%,[39] building evaluation index (BEI) and household evaluation index (HEI)[40]

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[33] The sixth indicator – low absolute energy expenditure – was initially run in the Analyser tool. However, an issue with how the tool dealt with the use of electricity use data only, not total energy data, caused the results to be unreliable. This issue has been identified and subsequently rectified within the tool. However, this indicator has not been re-analysed.

[34] www.insse.ro

[35] Energy poverty: the social impact of energy price reform on life standard study

[36] www.insse.ro

[37] Ibid.

[38] Eurostat

[39] Estimation based on vacation houses usage

[40] SocialWatt Analyser estimation

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- Arrears on utility bills (disconnection notices[41]).

The results obtained from the SocialWatt Analyser tool are presented in the three tables below. They present the number of energy-poor households identified per indicator, the percentage of energy-poor households compared to total households in the five most vulnerable municipalities in terms of energy poverty, and the percentage of energy-poor households in the five most vulnerable municipalities compared to total energy poor-households in the dataset.

The LIHC and 2M indicators result in the lowest number of energy-poor households, identifying <1% of customers as energy poor. In the case of the LIHC indicator, this is not surprising as, in the absence of household income data, average annual national household income has been used. This is compared with the national poverty line (which is 60% of the national income).[42] This means that this indicator identifies households as energy poor only if energy costs are higher than €4,200. This is an inherent limitation of this indicator when used with national annual average income, instead of actual income per household. The 2M indicator also identifies a low number of energy-poor households, implying that for the vast majority of energy-poor households identified under the 10% approach, the share of energy expenditure in income is between 10% and 16% (as 8% has been defined as the median national share).[43]

Finally, the SocialWatt indicator and the 10% approach reveal very similar numbers of energy-poor households, at around 17% and 18% of the population, and the arrears on utility bills identifies 11.8% of households as energy poor.

Table 16. SocialWatt Analyser: Percentage of energy-poor households per indicator, CEZ Vanzare

Indicator	Energy poor (%)	Energy poor (Number of households)
10% approach	17.1%	177,888
Low income high cost (LIHC)	0.3%	3,635
High share of energy expenditure (2M)	0.8%	7,801
SocialWatt indicator	18%	187,326
Arrears on utility bills	11.8%	122,175

Source: CEZ Vânzare and SocialWatt Analyser

Regarding the 1,120 locations analysed, the top five municipalities in which the greatest proportion of households estimated to suffer from energy poverty are Craiova, Pitești, Drobeta-Turnu Severin, Râmnicu Vâlcea and Târgu Jiu. Table 18 presents the percentage of households identified as energy poor in these municipalities, while shows what percentage of the total energy-poor households these regions represent. It should be noted that similar trends are observed per municipality to those observed in the whole dataset

[41] CEZ Vânzare internal database

[42] Given that a household is classified as energy poor if its actual energy costs are above the national average level AND when subtracting this amount of money, its residual income is below the official poverty line.

[43] Given that this indicator identifies households as energy poor if their share of energy expenditure in income is more than twice the national median share.

Table 17 when different indicators are considered.

Table 17. SocialWatt Analyser: Percentage of energy-poor households in the five most vulnerable municipalities identified, CES Vânzare

Indicator	Percentage of energy poor households				
	Craiova	Pitești	Drobeta-Turnu Severin	Râmnicu Vâlcea	Târgu Jiu
10% approach	17.8%	14.3%	28.7%	12.4%	14.3%
Low income high cost (LIHC)	0.5%	0.3%	0.5%	0.2%	0.3%
High share of energy expenditure (2M)	1.1%	0.6%	1.1%	0.5%	0.5%
SocialWatt indicator	18.4%	16.5%	28.5%	13.3%	15.7%
Arrears on utility bills	10.7%	4.9%	4%	2.9%	2.2%
Number of households	111,205	50,535	41,129	29,904	22,827

Source: CEZ Vânzare and SocialWatt Analyser

As can be seen, the highest percentage of the population identified as energy poor live in Drobeta-Turnu Severin, followed by Craiova.

Table 18. SocialWatt Analyser: Percentage of energy-poor households in the five most vulnerable municipalities compared to total energy-poor households in the dataset, CEZ Vânzare

	Top 5 energy-poor households/ municipalities, from total energy-poor households				
	Craiova	Drobeta-Turnu Severin	Pitești	Râmnicu Vâlcea	Târgu Jiu
10% approach	19,824	11,792	7,207	3,698	3,301
	11.14%	6.63%	4.05%	2.08%	1.86%
Low income high cost (LIHC)	604	222	146	61	60
	16.62%	6.11%	4.02%	1.68%	1.65%
High share of energy expenditure (2M)	1,241	462	316	144	126
	15.91%	5.92%	4.05%	1.85%	1.62%
	12.27%	4.68%	4.94%	2.36%	2.05%
SocialWatt indicator	20,476	11,715	8,335	9,992	3,641
	10.93%	6.25%	4.45%	2.13%	1.94%
Arrears on utility bills	15,271	5,245	6,306	3,982	3,642
	12.5%	4.3%	5.2%	3.3%	3%

Source: CEZ Vânzare and SocialWatt Analyser

Comparing the results for each of the municipalities with the population of poor households,

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Craiova is the city with the highest proportion of energy-poor households, followed by Drobeta-Turnu Severin.

Thus, the results clearly identify these two cities as of particular interest to target when developing a scheme that aims to alleviate energy poverty.

Furthermore, based on complex cross-checking analysis of all six indicators[44] defined in SocialWatt Analyser, 24,189 households are classified as energy poor as follows:

- 777 households are energy poor under all six indicators;
- 23,412 households are energy poor according to four indicators (10% approach, M/2, SocialWatt Indicator, arrears on utility bills).

A key conclusion that can be drawn is that actual income per household[45] would result in a better overview of energy poverty, in particular for some indicators, such as the low income high cost (LIHC) indicator. However, such information is confidential and available only to public authorities. This emphasises the importance of defining clear eligibility criteria for any scheme developed that aims to alleviate energy poverty.

Conclusion

Considering the assessment and analysis carried out using the SocialWatt Analyser tool, CEZ Vânzare will aim to target energy poverty in the schemes that will be developed for Romania by focusing on the:

- 24,189 energy-poor households identified as a result of all six indicators analysed, if compliance with the GDPR can be ensured;
- Top five cities, with an emphasis on the poorest ones (Craiova and Drobeta-Turnu Severin);

Nevertheless, schemes will not be limited to the above target groups.

2.7.2 Analysis of energy poverty schemes

In order to identify suitable energy poverty schemes, SocialWatt Plan has been used. This tool identifies cost- and risk-driven optimal portfolios that consist of numerous schemes and measures.

Inputs into the SocialWatt Plan tool

Two main sets of input parameters were defined – targets to be achieved, and constraints – before running the tool.

Romania has not established an energy efficiency obligation under Article 7 of the Energy Efficiency Directive, thus CEZ Vânzare does not have to develop schemes to meet specific energy efficiency targets. The targets CEZ Vânzare has set for the time period 2021-2030, within the framework of SocialWatt, include:

- Total number of beneficiaries to support through the schemes to be designed:

[44] The summary results presented here and in the conclusion include the results of the low absolute energy expenditure indicator (M/2). However, an error was identified in the tool related to this indicator. The issue has been resolved, so a new analysis can be undertaken using this indicator.
[45] In the analysis statistical data are used for income of households.

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12,489. In particular, CEZ Vânzare aims to support:

  - 10,860 energy-poor households with behavioural/low-cost measures, such as changing lamps, changing small but energy-consuming appliances to more efficient ones, using a "smart" power strip, etc.;
  - 1,629 energy-poor households to benefit from the schemes and implement renewable energy/energy efficiency interventions/actions, for instance adding roof and/or wall insulation, changing the heating system (and/or heating source), double glazing, etc.;
  - 2,480 energy poor households to reduce arrears on utility bills (note: this number is not considered in the total as the above-mentioned actions will help meet this target).

- 72.5 GWh energy savings (including both electricity and gas)
- 21 GWh renewable energy production
- €10 million renewable energy/energy efficiency investments
- 89 kt CO_2 emissions savings (79 kt from electricity, 10 kt from gas).

In terms of constraints, CEZ Vânzare has defined the following:

- 80% of interventions to be made in old buildings, built before 1980, and 20% in new buildings;
- All interventions should be small scale;
- Maximum 20% of energy savings to be made in new buildings, built after 1980.

Evaluation of schemes

The SocialWatt Plan tool identified four key schemes as the most appropriate to consider, under both the cost-driven and risk-driven assessments:

- Renovate your Home, in particular with efficient lighting
- Smarter Home, relating to the Installation of smart thermostats
- Fighting the Cold, especially the replacement of boilers with more energy-efficient ones
- RES4ALL, in particular the installation of small-scale photovoltaic systems.

Both the cost- and risk-driven optimal portfolios proposed schemes that deliver very similar energy savings that meet the pre-defined target, at around 72.5 GWh for the 2021-2030 period. As the cost-optimal portfolio delivers these savings at almost half the cost, this portfolio has been considered further. More specifically, under the cost-optimal portfolio, where the optimal financial mechanism is applied (see below), the cumulative cost[46] and impact of the five schemes proposed is as follows:

- Renovate your Home – A total of 7,586 interventions, with a cost of €26,300 for CEZ

[46] It should be noted that the total cost of each measure may differ to the one presented, depending on the financial mechanism selected as optimal.

Vânzare, is expected to result in 9,346 MWh energy savings (representing approximately 13% in energy savings across the portfolio). This equates to a cost of €2.81 for every MWh energy saved.

- Smarter Home – A total of 3,275 interventions, with a cost of €69,800 for CEZ Vânzare, is expected to result in 40,854 MWh energy savings (representing about 56% in energy savings across the portfolio). This equates to a cost of €1.71 for every MWh energy saved.
- Fighting the Cold – A total of 813 interventions, with a cost of €62,800 for CEZ Vânzare, is expected to result in 22,300 MWh (representing 31% of the total energy savings across the portfolio). This equates to a cost of €2.80 for every MWh energy saved.
- RES4ALL – A total of 816 interventions, with a cost of €63,000 for CEZ Vânzare, is expected to result in 21,004 MWh of renewable energy produced. This equates to a cost of €3 for every MWh energy produced.

Considering the results from the SocialWatt Plan tool, Smarter Home is the most favourable scheme, with the highest cost-effectiveness, i.e., a cost of implementation of €1.70/MWh energy savings. Renovate your Home and Fighting the Cold have a similar cost-effectiveness at €2.80/MWh.

The financial schemes initially identified by the SocialWatt Plan tool as the most appropriate to fund these schemes were on-bill repayment, collaboration with third parties, and crowdfunding. More specifically:

- For on-bill repayment, the optimal utility contribution was estimated to be 5% of the total cost of the interventions.
- For collaboration with third parties, the optimal utility contribution was estimated to be 5% of the total cost of the interventions.
- For crowdfunding, the optimal utility contribution was estimated to be 5-10% (depending on the measure) of the total cost of the interventions.

For the financing of the portfolio as a whole, the optimal financial mechanism to support implementation presented by the tool is "collaboration with third parties" with a utility participation of 5% of the total cost.

Conclusions

Based on the analysis from the SocialWatt Plan tool and considering business strategies and priorities, budget, risks and constraints, CEZ Vânzare has identified four suitable schemes to implement within the framework of SocialWatt to alleviate energy poverty in Romania. Two of these are schemes identified as the most suitable by the SocialWatt Plan tool, namely Renovate Your Home and Smarter Home. In particular:

- Renovate your Home: Energy-saving bulbs will be offered to energy-poor households for free to help them reduce their electricity consumption:
    - Implementation start and end date: 2021 – 2022
    - Target group: 11,000 energy-poor households.

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- Smarter Home: Thermostats will be offered to customers, who will pay for these over time in fixed rates without interest. The thermostat can be linked to the apartment/house heating system (powered with electricity or gas) and also to the air conditioning system (powered with electricity):
    - Implementation start and end date: 2020 – 2021
    - 2,000 households.
- Information and Communication: The focus will be on running information and education campaigns, for children, customers and non-customers, to reach and better address each age target group, in order to improve and educate people regarding energy efficiency behaviour:
    - Implementation start and end date: 2020 – 2022
    - More than 4 million people are expected to be reached through media campaigns.
- Helping Hand – A dedicated fundraising campaign will be launched to attract donations in order to subsidise part of energy-poor households' energy bills:
    - Implementation start and end date: 2020 – 2021
    - 753 households and children.

Innovative options for financing these schemes will be explored. More specifically, CEZ Vânzare will consider five financing options, most of which have also been identified in SocialWatt Plan as optimal: utility funding, partial/scalable funding by the utility, collaboration with third parties, on-bill repayment and crowdfunding.

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2.8 Naturgy, Spain

2.8.1 Assessment of energy poverty

A number of challenges associated with the assessment of energy poverty were faced when performing this analysis.

Firstly, data protection policies within Naturgy require that customer profiling can only be undertaken if customers have given explicit consent or if there is a "legitimate interest", for example the benefits that the analysis will bring to the identified customers. The processing of customer data to identify energy-poor households in order to offer them support and alleviate energy poverty, which is the key objective of SocialWatt, provides a clear justification for processing data based upon the legitimate interests of the customers, but it is important to note that this required internal scrutiny and reflection. Thus, data protection is extremely sensitive and can hinder such analysis.

Further challenges faced included security concerns, so the relevant departments had to be involved, such as the IT department, which had to validate the SocialWatt Analyser tool that was downloaded and installed on the company systems.

Energy poverty definition and input data

Naturgy has nearly 7 million customers in Spain who are gas and/or electricity customers. For this analysis, customers to whom Naturgy supplies both gas and power were selected. The reason for this decision is that several of the indicators incorporated in the SocialWatt Analyser tool compare customers' energy costs with average annual income, so the results are considered more accurate if total energy costs of households are considered.

The analysis was further restricted to customers that live in cities in which Naturgy is primarily interested in targeting for the energy poverty schemes that will be developed. These cities were chosen because they are either cities with which Naturgy has a historical relationship or cities in which Naturgy has a large number of customers. These include the largest cities in Spain, which is a further justification for prioritising them. Finally, customers who have been with Naturgy for less than a year were not considered, to ensure that accurate energy consumption and cost data for a full year are available.

To summarise, the analysis considered data for 422,610 customers that live in the cities of Barcelona (65,710), Coruña (24,256), Madrid (329,076), Mataró (3,568) and Sevilla (9,219).

Having selected the customer dataset, the tool was initially run using all energy poverty indicators available to compare the results, in terms of number of energy-poor customers identified.

Nevertheless it should be noted that the high share of energy expenditure in income (2M) and the low absolute energy expenditure (M/2) indicators are considered more appropriate for Spain. These are two of the four indicators included in the national strategy against energy poverty, so it is important to align the approach with the national approach. The other two indicators used included in the national strategy are 'arrears on utility bills' and 'inability to keep home adequately warm'. Arrears on utility bills was not assessed further, as fuel bill debt is not considered sufficient on its own to define whether a household is in energy poverty. Naturgy does not hold any data to assess 'inability to keep home adequately warm' so this indicator was also not considered.

The dataset used by SocialWatt Analyser included the following information for each customer: the type, amount and cost of each energy carrier; amount of debt and number of arrears on invoices. Naturgy does not collect data related to the year of construction of the building, the number of people in the household or the size of the homes (in square metres).

Average household income data per municipality, average annual household energy expenditure by autonomous community[47] as absolute value, national median share of energy expenditure in income and the national poverty line were also used. The table below presents the sources of the data and insights important to the analysis.

Table 19: Type of external data used in the analysis, Naturgy

External data	Note	Source
Average household income per municipality		INE (National Statistics Institute)
National average annual household energy expenditure	Not available per municipality, only per autonomous community/national level	Family budget survey (INE)
National median share of energy expenditure in income	Only available at national level	Family budget survey (INE)
National poverty line	There are two poverty lines depending on the type of household. Both were used in the analysis.	INE

The following input parameters per indicator were used for the analysis:

- 10% approach: Average annual household (dwelling) income (2018):
  - €29,515 for Mataró
  - €37,371 for Barcelona
  - €31,973 for Coruña
  - €39,613 for Madrid
  - €29,394 for Sevilla.[48]
- Low income high cost (LIHC):
  - Average annual household (dwelling) income: as above
  - Poverty line: €18,629 (2017) representing households with two adults and

[47] An autonomous community is the Spanish first-level political and administrative division that groups provinces and municipalities.

[48] Naturgy's Business Intelligence from INE

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two children[49]

- Average annual national energy cost per household: €1,082.[50]

- High share of energy expenditure (2M):
  - Average annual household (dwelling) income: as above
  - Median energy expenditure in income per autonomous community: derived from the values below.
- Low absolute energy expenditure (M/2): Median absolute annual household energy expenditure per autonomous community:
  - € 801 for Andalucia (Sevilla)
  - €973 for Catalunya (Barcelona and Mataró)
  - €850 for Galicia (Coruña)
  - €1,078 for Madrid.
- SocialWatt indicator:
  - Average annual household (dwelling) income: as above
  - Floor area of a typical household: 80 m^2
  - Lowest energy consumption: 60%
  - Building evaluation index: 90-110%
  - Household evaluation index: 9-11%

Energy poverty assessment

The table below presents the results from the SocialWatt Analyser tool per city studied. The number of energy-poor households identified varies significantly per indicator used.

Table 20: SocialWatt Analyser: Share of energy-poor customers per city, Naturgy, June 2019-May 2020

	Barcelona	Coruña	Madrid	Mataró	Sevilla
10% approach	0.04%	0.03%	0.1%	0.2%	0.1%
LIHC	<0.01%	<0.01%	<0.01%	<0.01%	0.02%
2M	0.5%	0.03%	0.6%	0.9%	0.9%
M/2	18.5%	23.6%	30.4%	12.1%	5.8%
SocialWatt indicator	40.4%	44.4%	45.0%	43.2%	63.9.%
Total	**65,710**	**24,256**	**329,076**	**3,568**	**9,219**

Source: Naturgy and SocialWatt Analyser

The analysis undertaken has an important limitation, as it relies on average income data per municipality, whereas in reality the range of actual income within one municipality is large.

[49] The national definition is 60% of the average annual national household income.
[50] Encuesta de presupuestos familiars. INE

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This issue mainly affects the results of the following three indicators:

- 10% approach: Under this indicator, a household is identified as energy poor if it spends more than 10% of its income on energy. By using an average income value, there is a risk that households are miscategorised. For example, households identified as energy poor may not be (i.e., as energy costs may be higher than 10% of average income, but lower than 10% of actual income), while households that are not identified may actually be energy poor (i.e., energy costs may be lower than 10% of average income but higher that 10% of actual income). Thus, the accuracy and usefulness of this indicator is limited by the lack of household-specific income data.
- High share of energy expenditure in income (2M): Under this indicator, a household is identified as energy poor if its share of energy expenditure in income is more than twice the national median share. As with the 10% approach, using an average income value introduces the same risk that households are miscategorised.
- Low income high cost (LIHC): This indicator identifies households that pass two tests: first, "a household is classified as energy poor if its actual energy costs are above the national average level" and second, "when subtracting this amount of money, its residual income is below the official poverty line." The use of average income data for the analysis makes it unlikely that a customer is assessed as being below the official poverty line in the second test (as energy costs would need to be greater than €10,000).

On the other hand, the SocialWatt indicator identifies a household as energy poor "if the actual energy consumption of a household is lower than the theoretically required level for maintaining thermal comfort." If this is not true, then "the ratio between the energy cost and income is taken into consideration". The number of households identified as energy poor under this indicator is quite high, and appears to be inaccurate. To address this issue the underlying data used in SocialWatt Analyser, in particular modelled energy needs of households in Spain, have been reviewed and are being revised. [51]

With regard to the M/2, this identifies a household as energy poor if its absolute energy expenditure is below half the national median. Real energy costs of customers were used and compared with average annual energy expenditure. When using this indicator, up to a third of customers are identified as energy poor, depending on the city. This indicator seems more suitable for identifying energy poor households, as it does not rely on income. Nevertheless, Madrid has many district heating systems and as Naturgy data does not capture costs of heat from district heating this may explain why energy costs are low when compared to other cities (natural gas will be used for cooking purposes only by these households). As such, this indicator is not considered as suitable for Madrid.

Naturgy has a number of customers identified as "vulnerable," who either receive a social tariff or have been identified as energy poor by social services. To supplement the analysis,

[51] Energy needs were modelled by the Dynamic high-Resolution dEmand-sidE Management model (DREEM), Results appear accurate for most countries modelled, however they appear inaccurate for Spain and Latvia. As a result, calculated energy needs will be revised in SocialWatt Analyser,

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SocialWatt Analyser was re-run using the "vulnerable" customer database only. The table below presents the results.

Table 21: SocialWatt Analyser: Share of "vulnerable" customers identified as energy poor, Naturgy, June 2019-May 2020

	Barcelona	Coruña	Madrid	Mataró	Sevilla
10% approach	<0.01%	<0.01%	<0.01%	<0.01%	<0.01%
LIHC	<0.01%	<0.01%	<0.01%	-	-
2M	0.2%	<0.01%	<0.01%	2.8%	<0.01%
Already identified as energy poor	937	928	9,967	71	43

Source: Naturgy and SocialWatt Analyser

**The SocialWatt indicator was not run for Coruña*

A significant portion of customers identified as vulnerable are not picked up in this analysis of energy poverty using the income-based indicators. This could be explained (at least partially) by the fact that vulnerability is not the same as energy poverty. In addition, it is evident that the three income based indicators perform worse in a database that potentially includes a higher number of energy poor households. The use of average income clearly negatively impacts this analysis.

Conclusions

A number of indicators have been used to identify energy-poor households. The ones that rely on income data would significantly benefit from using such data at a household level. This is technically feasible and possible from a data protection point of view if it can be considered as being in the legitimate interest of the customer. From the analysis so far, and in the absence of this data, the M/2 and SocialWatt indicators seem to be the most reliable.

2.8.2 ANALYSIS OF ENERGY POVERTY SCHEMES

Inputs into the SocialWatt Plan tool

Naturgy's targets and constraints set for running the tool for the period 2021-2030 include:

- An energy saving target of 2,000 MWh. This has been set based on the company's historical experience on energy poverty actions that achieved around 200 kWh energy savings per year per person. This goal is aligned with the Energy Efficiency National Fund that is devoted to financing mechanisms to comply with Spain's obligations under Article 7 of the Energy Efficiency Directive.
- A budget of €1 million.
- 10,000 energy-poor households to be reached.
- All interventions to take place in old dwellings, built before 1980, thus energy savings to be achieved by old dwellings too.
- 80% of interventions should be smaller scale, with 20% large scale.
- Between 10 and 20% of the budget to be allocated to renewable energy investment.

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Description of the schemes

Based on the above inputs the SocialWatt plan tool proposed the following cost-optimal portfolio:

Table 22: SocialWatt Plan: Summary of cost-optimal portfolio, Naturgy

Scheme	Actions	Number of interventions
Greening Home	Windows – double-glazed windows	8,010
Renovate your Home	Efficient lighting	31,701
RES4ALL	PV installation	346
	Total	**40,057**

Source: SocialWatt Plan

The financial mechanism proposed by the tool is establishing collaborations with third parties, with Naturgy's contribution to the financing approximatively 5% of the total.

Evaluation of schemes

Building on some of the schemes identified by the tool, Naturgy plans to structure support to energy poor households in the following way:

- Identified customers will be invited to participate in an energy efficiency advisory programme.
- Corporate volunteers from Naturgy's employees will carry out an assessment of customers' energy bills and propose changes to achieve savings on the bill.
- The volunteers will carry out online training, which will be specifically focused on changing behaviour to use energy more efficiently in the home.
- Volunteers will also identify the need for interventions in the home.

These interventions will include, but not be limited to, those listed in the table below as identified by the tool (including the number of recommended interventions to meet Naturgy's targets).

Table 23: Indicative summary of interventions to be taken forward by Naturgy

Scheme	Action	Number of interventions identified by the tool
Greening Home	Windows – double-glazed windows	8,010
Renovate your Home	Efficient lighting	16,638
Renovate your Home	Efficient lighting	15,063

Source: SocialWatt Plan

Conclusion

In addition to the interventions identified by SocialWatt Plan, Naturgy will include a more ambitious range of interventions for energy-poor households. These will include insulation of exterior walls, insulation of roofs, replacement of windows with double pane windows, low-budget interventions (e.g. to deal with leaking roofs, plumbing insulation, air leakages, efficient lighting), replacing white appliances with more energy-efficient ones, installing smart thermostats, replacing boilers with more efficient ones, and installing heat pumps.

Finally, Naturgy will consider installing solar and photovoltaic systems in buildings in areas where energy-poor customers live, as an action to reduce their energy bills and help them escape energy poverty.

The innovation of the proposed schemes lies in the following aspects:

- This will be the first time that Naturgy will directly design and implement schemes for energy-poor customers.
- These will be implemented through the group's network of volunteers and the interventions at home will be carried out through the Naturgy group's collaborating companies, which regularly carry out network maintenance and other work.

Naturgy will explore collaboration with third parties (in particular for co-financing the schemes by 20%).

3 CONCLUSION

3.1 The assessment of energy poverty

As has already been established, there is no one perfect indicator of energy poverty that is suitable for all countries and contexts. The lack of the necessary data, at European and national level, makes assessment imperfect.

It is clear, however, from the experience of the SocialWatt partners that utility data on actual energy consumption can make a significant contribution to better analysis and targeting of energy poverty, particularly in identifying those who are energy rationing. The SocialWatt indicator, which introduces a comparison of actual energy use against deemed energy need, has also proved to be a useful development on the existing indicators used at European level when utility data on consumption is available.

As has been evidenced by the experience of SocialWatt partners using the Analyser tool, any analysis, calculation tool or assessment is only as good as the data that is put in. Although the Analyser calculation tool has helped utilities to assess energy poverty within their customer base, the results are imperfect, especially for income-based indicators, due to a lack of household-level data. Thus, the results of the different indicators need careful consideration and engagement.

The SocialWatt tools are designed to be user friendly, guiding users through the necessary inputs needed for each indicator and explaining their different characteristics. However, accurately selecting data, choosing suitable proxies when household-level data is not available, selecting and understanding the indicators and critically engaging with the results are all complex and challenging. The ability to fully engage with, and therefore use, the results of the various indicators relies on a concrete understanding of the dynamics of the indicators and which ones are likely to be more or less suitable for the types of data available to the individual utility. Some of the indicators are based on complex assessments and each looks for a different indicator of energy poverty – e.g., low energy use, high use or arrears on bills. They therefore deliver different and even contradictory results. A lack of clear understanding of the dynamics of the indicators risks the results of the assessment being meaningless or distorting.

The availability of a calculation tool like SocialWatt Analyser can, therefore, support the successful assessment of the complex issue of energy poverty, as long as this is accompanied with significant capacity building. The SocialWatt team has found that significant capacity building is also needed to enable utilities to engage with the tool, choose the most relevant indicators and assess the results. In particular, significant support has been needed to explore and explain the root causes in the data when indicators return surprising or contradictory results in terms of level of energy poverty from the same dataset.

The analysis undertaken by utilities using the SocialWatt Analyser is very valuable, and a significant development on the approaches that many utilities had taken to date on assessing energy poverty. However, the analysis alone is only part of the solution to assessing energy poverty and targeting and supporting energy-poor households. The analyses can be used to assess significant issues within client base – like significant energy rationing, or to identify geographical areas where energy poverty is more prevalent – and therefore to

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target initial outreach. However, for some utilities, directly engaging individual customers with differentiated offers based on the analysis of customer data may not be permitted within internal or regulatory rules. For other utilities this customer targeting is permitted if it can be proved on the basis of a legitimate interest – i.e., that the activity will bring benefit to the customer. Therefore, the assessment of energy poverty based on indicators cannot be entirely relied upon to target energy poverty alleviation schemes. Furthermore, significant households in need may not be identified by the indicators of energy poverty, so a responsive approach that can support these households is also needed.

Most importantly, utilities need to define eligibility criteria and checks to confirm the energy-poor status of households that will benefit from the schemes to be implemented. This will require information and data to be gathered from individual households as a result of engagement either direct or through third-party partners.

3.2 Schemes to alleviate energy poverty

The SocialWatt Plan tool has been effective at introducing utilities to the range of potential schemes and measures, and providing input into the design of energy poverty action plans.

Looking forward to the design and implementation of the utility action plans, a number of issues have already been identified that will need to be addressed or managed. A number of utilities have highlighted that designing and signing off programmes to be delivered by the utility is a lengthy process, particularly where significant utility investment in concerned. Utilities have strong internal structures and accountability processes which must be adhered to for all proposals.

For those utilities delivering energy poverty schemes as part of a national energy efficiency obligation, further delays to implementation may be caused by the design of the energy efficiency obligation itself. In some of the SocialWatt countries, national energy efficiency obligations are still under development, or in others are undergoing periodic revision, meaning that schemes may need to be revised to deliver against targets and requirements that will be established nationally in the future.

Finally, utilities working to deliver on a national energy efficiency obligation that contains no ringfence for savings to be achieved in energy-poor, low-income or vulnerable households will find it very hard to successfully propose energy poverty schemes as part of the obligation. It is clear that energy poverty schemes cannot compete in the market for energy savings. Energy poverty schemes can deliver significant energy savings but these are not the most cost-effective savings available nationally. Even where uplifts are allowed within the structure of the EEO to incentivise investment into energy poverty schemes, these uplifts may not be sufficient to overcome the cost-effectiveness and other barriers to investment. Designing a scheme to target energy-poor households that can compete on energy-saving terms with the most cost-effective alternative programmes may not be possible unless other priorities are taken into account. Energy poverty programmes therefore need to be justified on the basis of wider multiple benefits and on utilities' corporate social responsibility priorities. Alternatively, national energy efficiency obligations need to be restructured to introduce a more concrete ringfence for energy poverty schemes to be rolled out.

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