ENERGISE

EUROPEAN NETWORK FOR RESEARCH, GOOD PRACTICE AND INNOVATION FOR SUSTAINABLE ENERGY

Project acronym:	ENERGISE
Title:	European Network for Research, Good Practice and Innovation for Sustainable Energy
Grant Agreement number:	727642

DELIVERABLE 3.5

ENERGISE LIVING LAB EVALUATION AND ASSESSMENT MANUAL

Description:	Sustainability Assessment Toolkit (SAT) ENERGISE Living Lab evaluation and assessment manual, including output, outcome and impact indicators and measures, as well as detailed methods for baseline definition, identification of rebound effects and identification of spin-off effects
Lead parties for deliverable:	University of Helsinki
Document type:	Demonstrator
Due date of deliverable:	28-2-2018
Actual submission date:	
Revision:	Version 1
Dissemination level:	Public
Authors:	Eva Heiskanen, Senja Laakso and Kaisa Matschoss (UH)

Note: This is a work in progress. Please do not cite or circulate!

ENERGISE partners	Logo
National University of Ireland, Galway (NUIG), University Road, Galway, Ireland	
Aalborg Universitet (AAU), Fredrik Bajers Vej 5, Aalborg 9220, Denmark	
Kingston University Higher Education Corporation (Kingston), River House High Street 53-57, Kingston Upon Thames KT1 1LQ, United Kingdom	
Universiteit Maastricht (UM), Minderbroedersberg 4-6, Maastricht 6200 MD, Netherlands	
Université de Genève (UNIGE), 24 rue du Général-Dufour, 1211 Genève 4, Switzerland	
GreenDependent Institute (GDI), Eva utca 4, Godollo 2100, Hungary	
Ludwig-Maximilians-Universitaet Muenchen (LMU Muenchen), Geschwister-Scholl-Platz 1, Muenchen 80539, Germany	
Focus Drustvo Za Sonaraven Razvoj (FOCUS), Maurerjeva Ulica 7, Ljubljana 1000, Slovenia	
Applied Research and Communications Fund (ARC Fund), Alexander Zhendov Street 5, Sofia 1113, Bulgaria	
Helsingin Yliopisto (UH), Yliopistonkatu 4, Helsingin Yliopisto 00014, Finland	

TABLE OF CONTENTS

LEGAL NOTICE

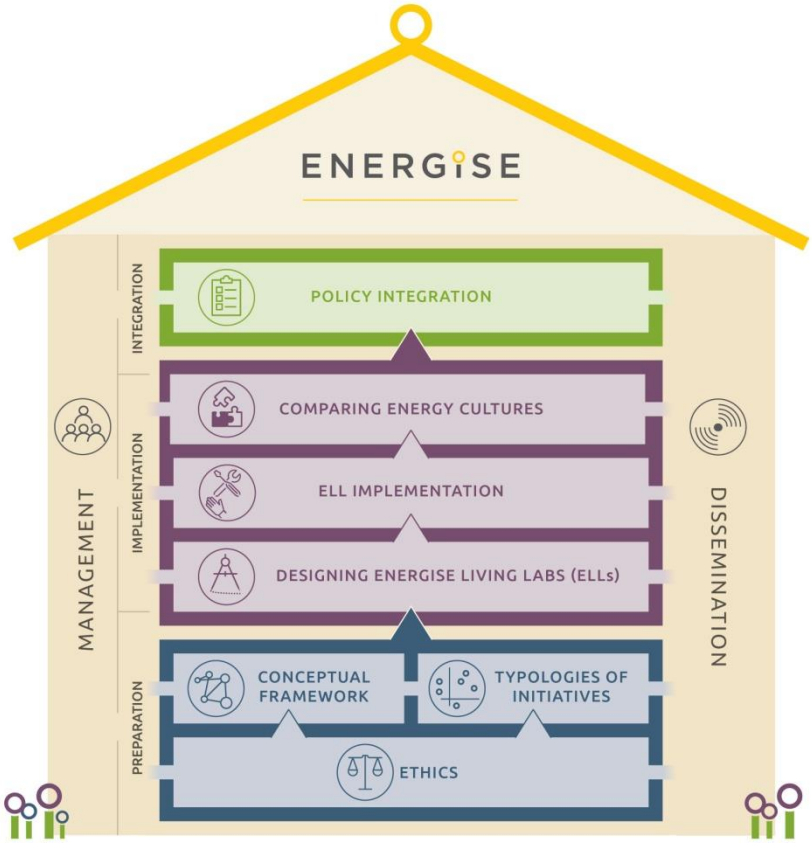
DISCLAIMER

ENERGISE is a Horizon 2020 project funded by the European Commission. The views and opinions expressed in this publication are the sole responsibility of the author(s) and do not necessarily reflect the views of the European Commission.

ENERGISE PROJECT

ENERGISE is an innovative pan-European research initiative to achieve a greater scientific understanding of the social and cultural influences on energy consumption. Funded under the EU Horizon 2020 programme for three years (2016-2019), ENERGISE develops, tests and assesses options for a bottom-up transformation of energy use in households and communities across Europe. ENERGISE's primary objectives are to:

- **Develop an innovative framework** to evaluate energy initiatives, taking into account existing social practices and cultures that affect energy consumption.
- **Assess and compare the impact** of European energy consumption reduction initiatives.
- **Advance the use of Living Lab approaches** for researching and transforming energy cultures.
- **Produce new research-led insights** into the role of household routines and changes to those routines towards more sustainable energy.
- **Encourage positive interaction** between actors from society, the policy arena and industry.
- **Effectively transfer** project outputs towards the implementation of the European Energy Union.



EXECUTIVE SUMMARY

[To be added in the next version.] This deliverable offers a manual on the formats for engaging households and communities, based on good practices examples identified in WP2, and defines methods, techniques and tools for ENERGISE Living Labs and their timing.

1 INTRODUCTION

The ways in which households engage in mundane practices that use energy vary greatly across Europe and within European countries (Laakso & Heiskanen 2017). These variations have implications for how initiatives to save energy take effect in different European countries and local contexts. While there have been several successful European projects that have rolled out similar interventions in several countries, there is some evidence of variable outcomes depending on geographical, institutional and socio-material context (see Laakso & Heiskanen 2017).

ENERGISE Work Package 3 is leading the design of ENERGISE Living Labs (ELLs). The objectives of WP3 are to

- **identify interventions** that work across practice cultures and diverse energy infrastructures, considering differences in metering and billing practices, the housing stock, and socio-economic and cultural conditions in EU Member States;
- **design two types of ENERGISE Living Labs** that work across diverse energy cultures and engage various hard-to-reach households and communities;
- **select sites and target groups** for the ELLs that allow for widespread and rapid upscaling of the interventions in the participating countries and beyond; and
- **define indicators of success** and related quantitative and qualitative measures, including baseline analysis, and methods for assessing rebound and spin-off effects.

WP1 has set out the conceptual framework for experimentation with new versions of household practices. WP2 systematically identifies, examines and classifies 1,000+ case studies of sustainable energy consumption initiatives from 30 European countries (EU-28, Switzerland and Norway). WP3 translates these findings into designs for innovative, replicable and scalable Living Labs (implemented in WP4). In this context, the Sustainability Assessment Toolkit (SAT) provides guidelines for evaluation and assessment of the Living Labs, in a way that also supports data collection for comparative analyses of energy-related household practices and cultures (in WP5).

The aim of this document (D3.5), ENERGISE Living Lab evaluation and assessment manual, is to serve as Sustainability Assessment Toolkit (SAT) that includes output, outcome and impact indicators and measures, as well as detailed methods for baseline definition, identification of rebound effects and identification of spin-off effects. **It is a toolkit for evaluation and assessment, rather than research. It should be applicable by anyone after the project.** Because of this, it consists largely of quantitative and standardized measures to be applied before and after the ELLs. However, some of the tools can also provide input for research, whereas others can be applied in conjunction with collecting data for research.

For further guidelines for the planning, implementation and monitoring of ELLs, please consult the following deliverables:

- D3.2 ELL Background report
- D3.4 Easy-to-use ENERGISE Living Labs intervention and engagement guidebook
- D4.1 ENERGISE Living Labs Implementation and Monitoring Plans
- D4.2 ENERGISE Online Monitoring Platform

2 SUMMARY OF THE ELLs AND ROLE OF THE SUSTAINABILITY ASSESSMENT TOOLKIT (SAT)

ENERGISE adopts the living lab methodology in order to test novel ways to perform everyday practices together with the households in the real-life surroundings. ENERGISE Living Labs (ELLs) are **targeted initiatives to transform energy use in households and communities** that address

- individual-level, organisational, institutional and societal (i.e., contextual) influences on household energy-related practices,
- the relationship between routines and ruptures in shaping energy cultures,
- the prevention of rebound and 'backfire' effects in initiatives, and
- policy options for changing the quality and quantity of energy use[1] through individual-level and community-based initiatives to shift unsustainable energy cultures.

In addition, ELLs will incorporate

- good practice **measures that are relatively context-independent** and that are expected to work (more or less) across European energy cultures, and
- **highly context-dependent measures** for modifying energy use that are likely to work differently in diverse European contexts.

The main aim of ELLs is to promote sustainable energy use while acknowledging the context-dependence of the change initiatives. The process guiding the design of ENERGISE Living Labs can be summarised in seven key features (see also Laakso et al. 2017).

Designing ENERGISE Living Labs – Seven Key Features

1. Select intervention and engagement methods that are applicable in diverse practice cultures.
2. Combine intervention and engagement methods in effective and engaging ways.
3. Involve hard-to-reach households.
4. Engage and use (local) influencers and their social networks.
5. Strategically select ELL sites and target groups to allow for widespread and rapid upscaling in the participating countries and beyond.
6. Develop easily usable tools and manuals for intervention design, evaluation and public engagement across practice cultures and ensure their widespread dissemination.
7. Engage academics and practitioners in the development of the ELL, with a view to effectively incorporating existing knowledge and lessons learned and to building up a user community for upscaling the ENERGISE results.

ENERGISE will closely and systematically **monitor and compare the sustainability outcomes** of ELLs by developing, testing and refining a Sustainability Assessment Toolkit (SAT) that focuses on

[1] By quantity, we mean achieving reductions in energy use, whereas by quality, we refer to e.g. environmental and social sustainability of energy use (i.e. use of renewable energy sources and tackling energy poverty).

(1) total energy use in the participating households, also including identification of rebound, backfire and spin-off effects,
(2) other relevant indicators of social, economic and environmental sustainability,
(3) socio-demographic influences on energy use, and
(4) levels of social acceptability of the two types of ELLs and their individual elements.[2]

On the basis of SAT, an **online monitoring tool** will be developed for data collection (in WP4). ELLs act as tools for cross-national data collection and energy reduction action across cultural contexts (WP5). Monitoring and comparing the sustainability outcomes of ELLs thus needs to imply a high degree of consistency in sampling and Living Labs design, without ignoring differences between and within countries regarding energy-relevant practice cultures. The ELLs also aim to design and test promising solutions for developing common, or at least harmonised measures for improving the implementation of sustainable energy policies across Europe (in WP6).

3 EVALUATION AND ASSESSMENT APPROACH

3.1 FOUNDATIONS OF THE EVALUATION AND ASSESSMENT APPROACH

The ENERGISE Living Labs are small-scale interventions that aim to engage the participating households in co-creating and testing new and better energy-related practices. Because of this, we cannot employ a strict quantitative experimental design with standardized interventions and randomized control groups. Knowledge about the value of the new practices is created together with the households and other stakeholders, and because of this, it is by nature transdisciplinary, action-oriented and hence, by nature, to some extent context-bound (Heiskanen et al. *forthcoming;* Schäpke et al. 2017). The most important knowledge collected will be qualitative and situated in nature (Rau & Grealis 2017).

While collecting data on the value of the ELL approach (the sustainability assessment toolkit, SAT), we are also providing material for analysis of the influence of diverse European practice cultures conducted in WP5. Because of this, it is important to be open for critical moments and tensions in introducing a unified ELL framework in diverse national, geographical and socio-material contexts. This can be accomplished through continual reflection by consortium members throughout the project. This follows the idea of realistic evaluation that the intervention outcomes always depend on both the type of mechanism that is used to transform practices (and thus the researchers as implementers of these chosen methodologies), and the context (Pawson & Tilley 1997). The consortium members are encouraged to pay attention to the different theories of change (also their own ones) in different phases of the ELLs (see also Laakso & Heiskanen 2017).

[2] This text is from Annex 1 of the ENERGISE Grant Agreement.

Nonetheless, ENERGISE aims is to create an approach to changing energy practices that is to some extent transferable. This requires common criteria of valuation which are to some extent stable across the ELL process (as well as after it) and recognized and hence trusted by those to whom our work is addressed, such as policy makers (Thévenot 2014). Not the least because of this, we also need to create a relevant set of quantitative indicators, measured before and after the ELLs, in order to provide proof (and the possibility of criticism) of the worth of the ELL approach. Data collection concerning these indicators also offers a foundation for understanding outcomes across several countries and by several different implementation teams.

The overall evaluation of ENERGISE is naturally a much more complex issue, which draws on the entirety of research conducted. Most of this is qualitative, interpretive, theoretically informed and grounded in the unique encounters between ENERGISE team members and households as the process of change unfolds. This evaluation manual proposes some qualitative interview schemes, which can serve both the evaluation of the ELLs and the wider research purposes of the ENERGISE.

3.2 OUTCOME, OUTPUT AND IMPACT INDICATORS

The aim is to assess the ELLs in terms of outcomes, outputs and impacts (Figure 1)[3]. Following Vedung (1997), project *outputs* are what the ENERGISE project delivers in the ELLS. These are shown in Figure 1 in terms of the number of ELLS organized, the number of households participating in the ELLs, and the number and type of activities delivered in each site. The indicators of such output are thus verification that these outputs have been delivered and these steps have been performed (these indicators are addressed in D4.2 and D4.3).

[3] This is defined in Annex 1 to the ENERGISE Grant Agreement.

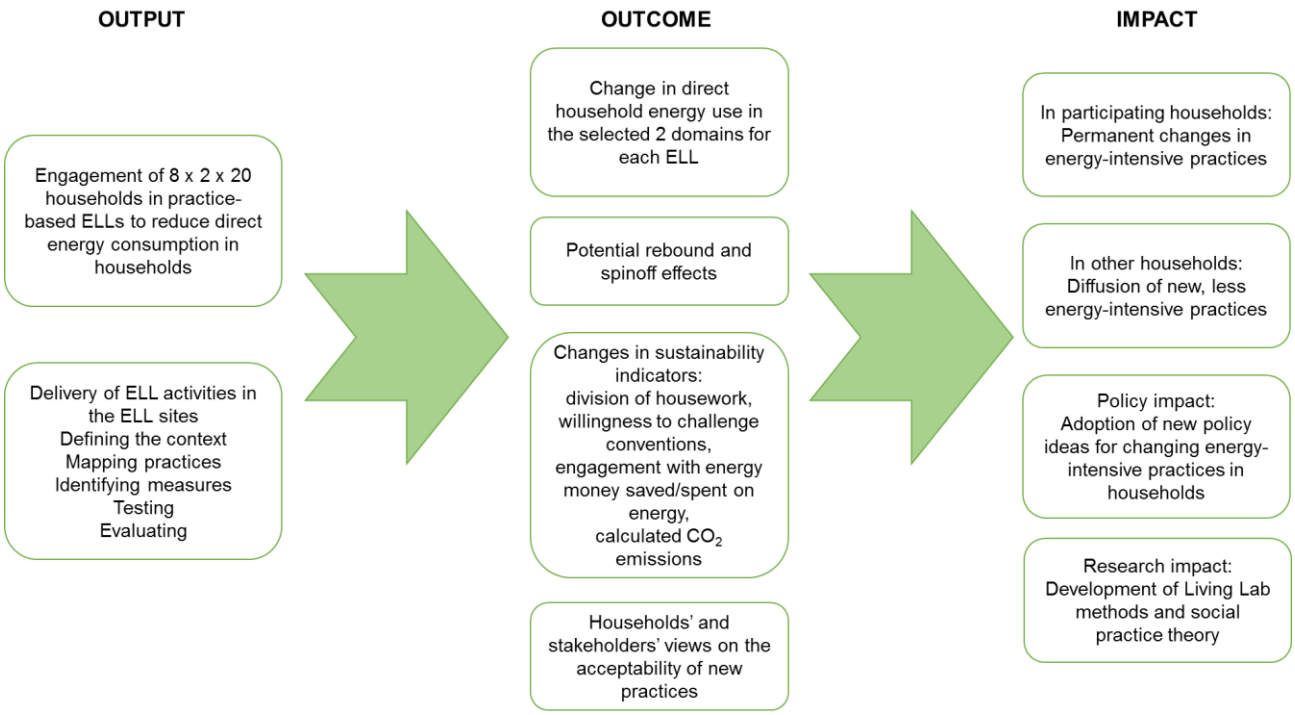


Figure 1. Output, outcome and impact indicators of the ELL evaluation.

Outcomes are what is delivered to participants and stakeholders (Vedung 1997). In the case of the ELLs, these should focus on (1) total energy use in the participating households, also including identification of rebound, backfire and spin-off effects, (2) other relevant indicators of social, economic and environmental sustainability, (3) socio-demographic influences on energy use, and (4) levels of social acceptability of the two types of ELLs and their individual elements. Figure 1 presents relevant outcome indicators:

(1) In terms of total energy use, we will focus on changes in energy use in the two selected domains, but also provide an assessment of total energy use in the home and for mobility before and after the intervention. The change represents the outcome in terms of energy use.
(2) In terms of potential rebound and spinoff effects, we will focus on (a) direct rebound, which in our case is included in the total energy use in the two selected domains and (b) two categories of indirect rebound, focusing on how households are likely to spend any money saved on energy and any time savings accruing through the adoption of new energy-related practices. In terms of spinoff effects, we will investigate (c) spillover effects, i.e., reported or observed changes in other domains and in energy-related competences and (d) any new social learning processes or innovations arising from the ELLs.[4]
(3) As other indicators of sustainability, we have selected the following rough but (to some extent) measurable indicators:

[4] Examples of such social learning processes might be if the ELLs, for example, help energy service providers to better understand the needs of energy end-users, help build new links between parties that have not interacted before, help place practice-based living labs on the agenda of parties that have not previously engaged with them, or help to establish permanent structures like self-help networks, social movements, associations, intersectional working groups or new enterprises (MECHanisms 2017).

a. Environmental sustainability: changes in calculated CO_2 emissions from direct energy use
b. Conventions: changes in households' willingness to challenge established conventions
c. Gender equity: changes in households' total time and division of labour for household work
d. Financial stability: changes in money saved/spent on energy
e. Sufficiency awareness: changes in overall ratings on the sufficiency awareness scale

(4) Social acceptability: this will be measured only after the ELLs and will include an overall assessment by households and stakeholders of how acceptable the new energy-related practices are for the households involved, other households, and stakeholders engaging in energy-related interventions.

Impacts are more difficult to assess, since the ultimate impacts of the project depend on several other factors, such contextual factors, including other potential concurrent initiatives and change processes (Vedung 1997). Nonetheless, we aim to assess (1) permanent changes in energy-intensive household practices with follow-up interviews about four months after the ELLs are concluded. Moreover, we use these interviews to investigate (2) the diffusion of the practices in the participating households' immediate social circles, and complement this with other qualitative data (stakeholder interviews, media analysis).

Finally, via ENERGISE WP6, we can collect data on the adoption of new policy ideas for changing energy-intensive practices in households. Throughout the evaluation it is important to bear in mind that targeting practices within 20 households in each ELL does not yet change practices-as-entities, and that the potential and prerequisites for wider change can only be estimated indirectly through the experiences of participating households and other stakeholders involved. Change in energy-related practices on a large scale (practices-as-entities) depends on larger systems of provision (energy, housing, daily goods, public services), public policies (not only energy-related), shared cultural conventions and urban infrastructures (Shove 2014).

4 SUSTAINABILITY ASSESSMENT TOOLKIT

4.1 ASSESSING CHANGE: COMPARISON TO BASELINE AND ASSESSMENT AS PART OF THE CHANGE PROCESS

In order to establish the outcome and potential impact of the ELLs, we need to make a comparison vis-à-vis a baseline. Ideally, this baseline describes what the situation would have been *without the project*. In reality, baselines often describe the situation *before the project* (see MECHanisms 2017), allowing us to make a comparison between before and after the active phase of the ELLs in order to assess the changes in outcomes that can be attributed to the ELLs. There is always room for criticisms in such assessments, since several contextual factors can also cause changes over the duration of the ELLs, but the

comparison of a final assessment to a baseline is the best approximation we can produce on the outcomes of the ELL.

Since the ELLs are collaborative and transdisciplinary, we are not trying to isolate the participating households from the assessment. To the contrary, we try to engage them as far as possible in assessing the changes produced by the ELLs. However, since the ELL design (see Laakso et al. 2017) is quite time-consuming for households, we do not want to place too onerous a burden in terms of assessment on the households, either. This suggests the use of automation as far as possible for collecting assessment data. Moreover, it strongly suggests finding a comfortable flow and pacing of data collection vis-à-vis the actual ELL implementation stages.

The various needs of the ENERGISE project place relatively heavy demands on data collection, in terms of time and effort required by households, as well as in terms of time and effort required by ENERGISE consortium partners. Because of this, we suggest concentrating assessment data collection at five points in time (Figure 2):

(1) Selection of context and recruitment of households. This is the point where we:
   a. Identify whether the context is suitable for our ELLs, and in particular, whether it is suitable for testing measures for intervening in practices within the selected domains (i.e., e.g., to what extent the socio-material context supports householders' active engagement with space heating systems, or the extent to which alternatives to car use are relevant and feasible).
   b. Ensure the participation of a diverse mix of households, including hard-to-reach groups and representing various household compositions and age groups.
   c. Assess the conditions for organising a separate ELL1 focusing on individual households and a separate ELL2 focusing on households as part of communities.

(2) Before the start of the ELL, collection of the baseline data. This is divided into data to be collected before meeting and interviewing the households (daily practices tracking, social norms and willingness to challenge them, sufficiency awareness, as well as collection of household energy bills and meter readings and data on appliance ownership and usage). The weekly practices diary aims to build on the idea of a time-use-diary (hopefully, mobile application) which can be used to collect data two weeks before the ELL active phase and then over the entire eight weeks of the ELL active phase. These will serve as background for a personal interview with each household, in which we collect further qualitative data on daily practices, and also ensure that necessary meters are appropriately installed. Also group discussions are organised as an additional element in community ELLs (ELL2).

(3) Interim data collection to make sure the ELL is on track. For the interim assessment, we suggest the regular review of weekly practice diaries (with text message reminders). This is to be complemented with one telephone interview with the households in week 4 of the ELL active phase. After four weeks of the ELL active phase would also be a good time to organize a reflective session among all ENERGISE consortium members to support reflective, theory-based evaluation.

(4) Data collection at the end of the ELL includes collecting a final set of data points on daily practices, social norms and willingness to challenge them, sufficiency awareness, daily practices diaries (and potential photo reports) as well as household fuel bills and energy meter readings. Additionally, we collect data through a self-assessment of the division of household work and potential changes in stress levels, and administer a questionnaire on social acceptability. These data are complemented with a concluding interview (complemented by a group discussions in ELL2) focusing on changes in daily practices, rebound & spinoff effects (including any unexpected lessons learned), as well as the acceptability and potential for scaling up of the measures tested in the ELL.

(5) The follow-up interviews, to be conducted four months after the end of the ELL will focus on the more long-term effects. We will ask households about any permanent changes to energy-intensive practices, diffusion of these practices in their social networks, and potential spinoffs such as further innovations in practice or householders' engagement in social movements. This can be organised as a focus group discussion in both ELL1 and ELL2, where necessary, complemented with telephone interviews. Additionally, media monitoring and stakeholder interviews are used to assess social acceptability and potential for scaling up.

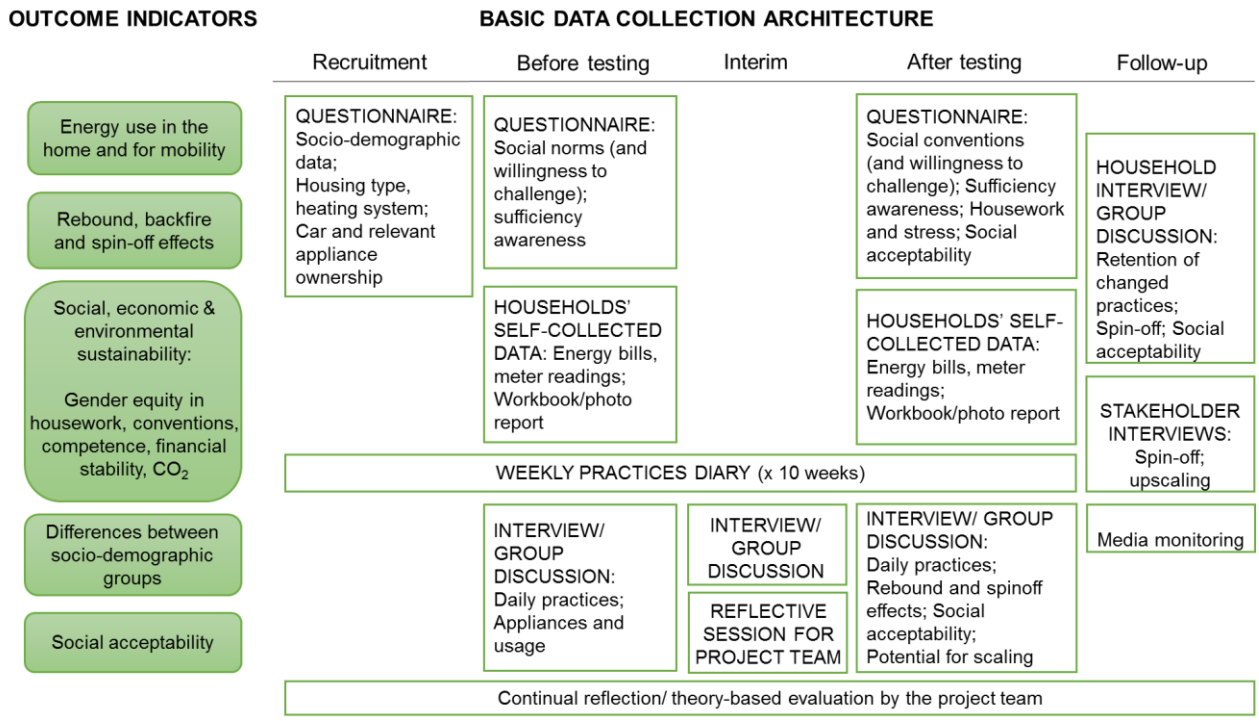


Figure 2. Framework for assessing change in the ELLS.

4.2 SUSTAINABILITY ASSESSMENT TOOLS

4.2.1 CONTEXT AND RECRUITMENT DATA COLLECTION TEMPLATE

The relevant background information for households includes socioeconomic and demographic factors such as household size, life stage, education, income level and home ownership status. The domain and site specific background information include e.g. building type, heating system and energy source(s), energy costs, car ownership, relevant public transport connections, cycling infrastructure, ownership of washing machine and availability of shared laundry facilities and teleworking facilities. Other information include information on communities of practice, place and interest, as well as previous engagement in energy initiatives.

In terms of total energy use and related carbon emission reductions due to ELLs, we need to be able to collect household consumption data both before and after the active phase of ELLs. This, in turn, requires that the participating households have access to this data (e.g. meters, billing information or online monitoring). Moreover, households must agree to consent to the collection and storage of this data, naturally with assurances of anonymity and appropriate data management practices. A template for collecting data on context and the households to be recruited is provided in Annex 1. Data management practices are outlined in section 4.4.

4.2.2 ENERGY USE DATA COLLECTION TOOL

The collection of energy use data is a compromise. It balances between what is possible, given the complex and diverse conditions concerning household energy use in the participating eight European countries and the combination of urban and rural households, and the desire to gain definitive data on total household energy use and potential changes in household energy use owning to experimentation with new practices.

We propose a three-layered approach to collecting data on energy use, with (1) a more general approach to collecting data from all households, as well as a (2) more detailed, domain-specific approach for collecting data on the selected domain with which households experiment in particular countries and ELLs, as well as (3) a method for calculating nominal energy savings from measures taken (see Figure 3).

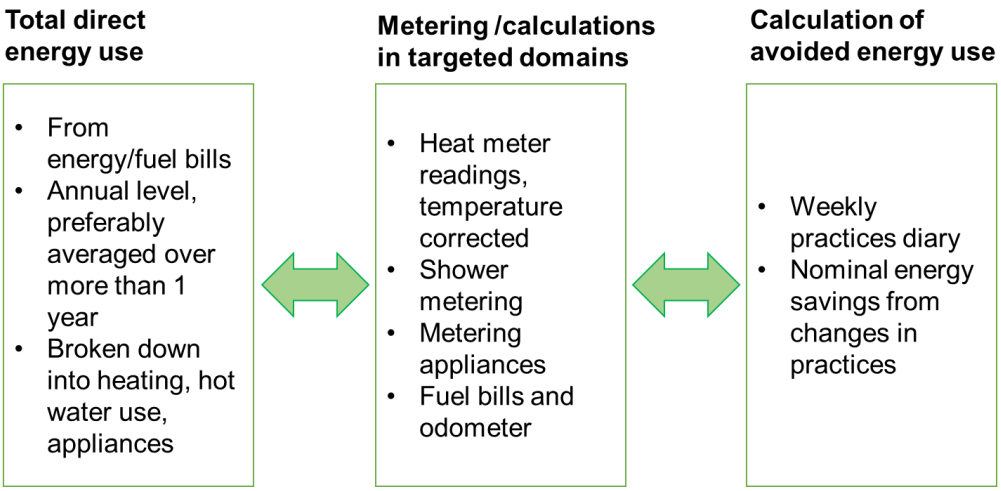


Figure 3. Approaches for calculating energy use in the ELLs.

For the general approach, energy meter readings and/or fuel bills provide the main source of data. **It is imperative that energy bills or meter readings are available, at least on a quarterly basis, for all households, and for all types of energy consumed (gas or other fuels, electricity, district heat).** Through calculations demonstrated in Annex 2, these data can be broken down into energy use for space heating, domestic hot water and use for home appliances.

For the optional domains, the following approaches are recommended (only to be applied in the case of focal domains):

- For space heating it is necessary to have billing or metering data specific to space heating (or to be able to reliably calculate the share of space heating and water heating in these ELL households). Methods for collecting and calculating these data are provided in Annex 2. This includes a tool for breaking down energy use to the components heating, domestic hot water and appliances/lighting (differently for different combinations of fuel use) as well as a tool for calculating temperature-adjusted heating use.

- Domestic hot water can be metered or calculated, if necessary, based on water metering and average share of hot water (if appropriate for the measures, i.e., they do not involve changing the temperature of the water). In this domain, we produce direct metering data on hot water used for showering, using digital meters. Ideally, meter readings are automatically logged and the data can be collected centrally. (CHECK IF THIS IS FEASIBLE)

- For mobility, households need to commit to saving and retrieving all fuel bills. This is easiest if households use a credit card when filling up. Annex 2 provides a template for recording fuel use.

- For cooking we need metering (or reliable calculations) of data used for cooking (electricity or gas for the stove/oven). [5] (CHECK IF THIS IS FEASIBLE) Smaller appliances such as the microwave oven can be either metered or the energy use can be calculated based on nominal power, settings used and usage time

- For laundry, if this is selected, the laundry machines (washing machine and dryer) are to be metered. A meter that logs data is to be used, and can thus be read at the end of the ELL testing period.

Annex 2 presents the tools for collecting data on energy use. These include tools for a rough overall calculation of the breakdown of energy use among heating, domestic hot water and appliances/lighting, calculating heating energy use, as well as a spreadsheet for recording logged meter readings at the start and end of the project, and comparing them to a baseline case (some of these still to be added).

Since the testing period in the ELL is short, it is possible that the testing of new practice variants does not have an impact on total energy use within the active ELL phase. This is because energy use is heavily influenced by several factors outside the control of the ELL (for example, outdoor temperatures and time spent at home). Cheap meters are also not too reliable and can malfunction. If they are logging to a local memory storage, we are not able to monitor whether they are functioning. Because of this, we also need to calculate nominal reductions in energy use and CO_2 emissions to be obtained by changes in practices. The procedure for this can be exemplified for changes in laundering practices (Table 1):

(1) Measure/calculate power consumption of the laundry machine (and potential tumble dryer/drying cabinet) during the mapping period, before the active ELL phase (two weeks)
(2) Collect two-week practice diary data on typical laundering practices (frequency, temperatures, loads, etc.)
(3) Monitor changes in laundering practices over the testing period (eight weeks of practice diaries)
(4) Calculate ‘avoided’ consumption due to the changes in practices

[5] Potential meters:
https://www.smappee.com/be_en/energy-monitor
http://www.earth.org.uk/note-on-clip-on-power-meters-for-the-UK-REVIEW.html

Table 1. Example of calculating avoided energy use for laundry practices (w = week).

°C	Mapping period, number of washes		kWh/ cycle	Total/ week, kWh	ELL testing period, number of washes								Total/ week, kWh	Avoided consumption, kWh
	W1	W2			W1	W2	W3	W4	W5	W6	W7	W8		
30	4	3	0,3	1,00	3	2	2	3	2	3	2	2	0,71	
40	5	6	0,5	2,75									0	
60	0	1	1,3	0,65		1							0,08	
90	0	0	1,9	0									0	
Total mapping period				4,45	Total testing period								0,79	**3,7**

4.2.3 APPLIANCE OWNERSHIP AND USE DATA COLLECTION TOOL

Annex 3 presents a tool for collecting data on appliance ownership and use. This data collection does not need to be repeated in detail at the end of the ELL period, but just checked in the final interview:

- if there have been any major changes in the use of appliances
- if any new appliances have been obtained or any old ones have been disposed of.

This tool helps to provide a picture of the overall level of equipment of the ELL households, which can be compared with the average level in households in the ELL countries. In some cases, this list of appliances is also needed in order to calculate the breakdown of energy use described in Annex 2.

4.2.4 SUFFICIENCY AWARENESS QUESTIONNAIRE

This is to be outlined in Annex 4 (to be added) and administered before and after the ELL. We envisage some simple closed-ended questions, partly drawing on Leuser et al. (2016) and focusing on:

- sufficiency-oriented practices in energy use
- what consumption items and levels of service are deemed necessary
- awareness of escalating expectations
- awareness of planetary boundaries
- willingness to share, reuse, repair
- willingness to cut down on working hours and consumption

4.2.5 SOCIAL CONVENTIONS QUESTIONNAIRE

The ELLs aim to challenge escalating social conventions concerning thermal comfort in the home, cleanliness and cooking. The primary venue for assessing this is via the interviews concerning daily practices. However, since ENERGISE also aims to produce a sustainability assessment toolkit (SAT) that can be used after the project, it is important to at least try to

allow future users to quantify any changes in participants' willingness to challenge conventions.

Most of the sociological research on conventions does not investigate individual differences or short-term changes, but rather, investigates conventions on a broad historical and societal level (e.g. Shove 2003; Woersdorfer 2010). Quantitative measures that work on the individual level have to be drawn from more social psychological research on social norms. Where possible, we have drawn on existing validated measures and scales of social norms (Arild et al. 2003; Freeburg et al. 2010; Niva et al. 2014). In other cases, suitable questionnaire items were not available, but have been developed on the basis of qualitative research (Gram-Hanssen 2011; Munro & Madigan 1999; Strengers 2008) or questionnaire items developed for other than strictly social-norm related purposes (OECD 2011; Stevenson et al. 2009; Urban and Ščasný 2012; Walker et al. 2011), but still offering some comparative data, as well. Annex 5 presents the social conventions questionnaire. If desired, we can also include some more general questions about daily practices (i.e., patterns of and reasons for using the car) in this questionnaire.

It is unlikely that our eight-week interventions would make a difference for these measures, which are about the respondents' perceptions of conventions in their social environment (i.e., more descriptive than injunctive, see Schultz et al. 2007). However, we have added an item that aims to measure participants' willingness to challenge these norms, and we expect to see some difference on this item. We might not need to repeat the entire questionnaire at the end of the ELL testing period, but use the questionnaires filled in at the start as stimulus for asking the last question (willingness to challenge norms) again at the end of the test period.

4.2.6 WEEKLY PRACTICES DIARY

The weekly practices diary (Annex 6) aims to assess the frequency of households' energy-related practices in a quantitative and systematic format, drawing inspiration from time-use diaries, but focusing on the domains targeted in each ELL. Time-use diaries offer an opportunity to investigate the social context of energy use in a way that connects to daily practices of heating, keeping clean and providing meals (Ellegård & Palm 2011). The collection of such data via diaries offers insight into the inconspicuous and non-verbalized aspects of daily practices, as well as to their timing and location.

These data can be used

(1) As a background for the interviews for understanding daily practices (Annex 7).
(2) To trace changes in practices in order to calculate avoided energy use.
(3) To investigate one of the social sustainability criteria, gender division of labour in the home.

Annex 6 offers a first, rough draft of the weekly practices diary. The aim is to collect two weekly diaries in the mapping phase of the ELL, as well as eight weekly diaries over the active phase of the ELLs.

It might be possible to develop a mobile application for this. One option is to use an existing time-use related mobile application, e.g. PODD (Vroutsou et al. 2014). In PODD, the application user interface allows a user to fill in their diary by entering activities as they occur, using a pre-defined hierarchical activity coding scheme and selecting an appropriate activity. Additional details, such as place, company, emotional state and material environment, can also be collected. A complementary calendar view in the interface allows the user to get an overview of their diary and edit it if needed. The PODD data are sent to and logged on a central server. This would also allow for a more nuanced and complete picture of time use. Translating and modifying PODD would however entail a cost. Similar applications have been developed by van Tienoven et al. (2017), and other research teams.

Another alternative would be to use a generic activity logger like Toggl, although in this case, our possibilities to ensure data security are weaker. A third option would be to create a Google form or a survey using e.g. one of several survey apps.

The weekly practices diary could be complemented with some kind of photo diary workbook which would encourage participants to capture daily practices and changes in practices in visual and contextualized form (see Kuijer 214). This would be collected at the end of the ELL.

4.2.7 INTERVIEW SCHEME FOR UNDERSTANDING DAILY PRACTICES

The most important tool for understanding daily practices is a semi-structured face-to-face interview, coupled with observation of the household context. When engaging in qualitative assessment, it should be noted that giving accounts of mundane, routine performances (especially on private actions such as those related to personal hygiene) is not easy for people. The interview templates need to aim at grasping the inconspicuous elements of daily practices. The interaction with households at different phases should support this aim by reverting to a certain level of “naivety” when discussing practices and the relationship between routines and ruptures in shaping practices (see Kuijer 2014).

The first interviews take place before the testing phase of the ELLs, after receiving the survey responses from the households. Together with households, we discuss, expose and learn about the practices that lead to energy use, and map the most energy intensive practices as well as underlying social norms and conventions, required skills and material components, and rules and regulations, with a special focus on the two domains but also acknowledging the other energy-relevant domains. Our aim is to recognise the social embeddedness of many of our practices, and to discuss explicitly the limits of addressing change solely through individual actions and more efficient technologies, without taking into account the social norms, conventions and standards that hold our practices together. We also discuss why the practices have the level of energy use they do and how this is related to the way practices are constituted, how practices have developed in (personal) history, and how to change elements to make practices more energy-efficient. The interviews also focus on participants’ needs, expectations, inspirations and motivations – discussing them and making them visible for both researchers and households themselves and also gaining more understanding on what practices are easier and harder to change (i.e., “stickiness” of

practices) and why and what kind of internal dynamics in households are related to performing practices. From a practice perspective, and when ambitions about reducing energy use are high, initiatives also need to consider how energy related needs are defined.

Additionally, concluding interviews are envisaged to cover themes related to potential monetary costs of practice change, changes in time use, as well as changes in perceived wellbeing due to participating in ELL. These data also serve as partial inputs for the assessment of rebound effects.

An interview scheme for understanding daily practices is provided in Annex 7 (to be added).

4.2.8 SELF-ASSESSMENT OF DIVISION OF HOUSEWORK AND STRESS

Since gender equity is one of the social sustainability assessment criteria, it might be good to additionally and separately assess the division of labour for housework. Moreover, since one of the ideas in the ELLs is to create new practices that are likely to be taken up widely, it is good to assess whether the new practices create more or less stress in everyday life. Annex 8 provides a list of questionnaire items for this purpose, drawn from xxx and xxx (to be added). This questionnaire is to be administered only after the ELL testing period and is based on household members' self-assessment of their experiences with the changed practices.

4.2.9 SOCIAL ACCEPTABILITY ASSESSMENT

One of the aims of the evaluation is to assess the extent to which the new practices tested in the ELLs are socially acceptable and hence have potential for scaling up beyond the circle of ELL participants. Social acceptability refers to acceptance by users, acceptance by other stakeholders and by the general public (Raven et al. 2009; Sauter & Watson 2007; Wüstenhagen et al. 2007). It hence encompasses conventional issues in the acceptance of new technologies or systems (Davies 1998), as well as broader issues of pertaining to the societal embedding of innovations (Raven et al. 2009) and processes of deepening, broadening and scaling up of sustainability transition experiments (van den Bosch & Rotmans 2008).

Since the ELLs aim, in particular, to challenge social conventions, but operate on a very small scale (for example, compared to the acclaimed CoolBiz initiative, Shove 2014), social acceptance is also understood here in terms of the opportunity for these new practice variations to be repeatedly performed by several practitioners and hence become stabilized, routinized and scaled up on a wider societal level (cf. Hargreaves et al. 2013). If the new practice variations emerging from the ELLs are understood as proto-practices, it is relevant to identify stakeholders (companies, NGOs, local and national governments) who promote and make the proto-practice available more widely. Moreover, in order for the new practice to emerge, the components must be integrated in practice by practitioners (Shove & Pantzar 2005).

Because of this, we propose two levels of assessing social acceptance. First, we focus on conventional aspects of innovation adoption and acceptance, such as perceived usefulness,

ease of adoption, intention to use, identification and spill-over effects, drawing on Vandenberg et al. (1994), Stewart et al. (2013), Bizler-Harder et al. (2013), Guerreiro et al. (2014) and Toft et al. (2014). These will be assessed using standard questionnaire items (though complemented with open-ended questions) enabling data to be aggregated across all 16 ELLs. Second, the interviews with participants will be continued with open-ended questions that aim to address the more complex aspects of social acceptability related to opportunities for scaling up the proto-practices emerging from the ELLs, drawing on Shove and Pantzar (2005), van den Bosch and Rotmans (2008) and Raven et al. (2009). These participant interviews will be complemented with similar stakeholder interviews to be conducted with the stakeholders involved in the ELLs as well as members of the ENERGISE Expert Panel.

The questionnaire items and interview questions are provided in Annex 9. The recommended timing is at the end of the ELL period.

4.2.10 FOLLOW-UP INTERVIEW: RETENTION OF PRACTICES TESTED IN THE ELLS

In ELL1, the follow-up interviews cover the participants' own estimation on how much they shared their experiences with their communities, whereas in ELL2, special attention is also paid to the diffusion of practices within and outside the community of participating households. This is also an opportunity to monitor potential rebound effects (use of money saved, use of time saved) and spinoff effects (spread of sustainability aspects in other daily practices within and outside households).

A data collection scheme for follow up interviews and other data collection is provided in Annex 10 (to be added)

4.2.11 FOLLOW-UP INTERVIEW: STAKEHOLDERS

A data collection scheme for follow up interviews and other data collection is provided in Annex 11 (to be added).

4.3 COMBINING SUSTAINABILITY ASSESSMENT DATA TO INFORM EVALUATION AND FURTHER RESEARCH IN ENERGISE

For the participating households, the different tools can be combined in the most convenient way, considering the timing of the data collection (i.e., they do not need to be presented as separate tools). From the perspective of the ELL evaluation, Figure 4 shows how data from the various tools are combined to assess the ELL performance on the output indicators:

- We will collect data on potential rebound effects (use of money saved, use of time saved) and spinoff effects in connection with the follow-up interviews, using a few closed-ended questions. Spinoff-effects are partly addressed through an assessment of spill-over effects in the sufficiency awareness assessment tool and the social

acceptability assessment tool, and partly addressed in the follow-up interviews. Other data to be used in the identification and assessment of rebound, backfire and spinoff effects include the weekly practices diaries, the sufficiency awareness questionnaire, as well as qualitative data collected during interviews and group discussions.

- The influence of the ELLs on gender equity in housework can be assessed on the basis of the data accumulated from the weekly practices diary, complemented with data from the self-assessment questionnaire (Annex 8).

- The influence on the ELLs on conventions – closely related also to gender equity in housework – can be assessed on the basis of changes in participants' willingness to challenge social conventions (Annex 5).

- The influence on the financial stability of the households can be calculated on the basis of changes in direct energy use and costs (Annex 2).

- A procedure for calculating outcomes in terms of CO_2 emissions from direct energy use is exemplified in Annex 12 (to be added). Basically, we will draw on calculations of energy saved by type of energy source/fuel (kWh, m^3) and specific CO_2 emissions per country for each energy source. Average CO_2 emission are obtained from National Inventory Submissions to the United Nations Framework Convention on Climate Change.[6]

- With socio-demographic data from Annex 1 and data on total energy and energy savings from Annex 2, we can calculate whether there are differences among different kinds of households in responses to the ELLs. For example, we can examine whether single-person households respond more strongly to the ELLs than families with children, or vice versa.

- In the social acceptability questionnaire, we ask questions pertaining to changes made in each domains. Moreover, we can add questions pertaining to particular measures and tools used once these have been definitively selected. Social acceptability is also assessed using data from open-ended interviews with ELL households and stakeholders

6 http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/10116.php

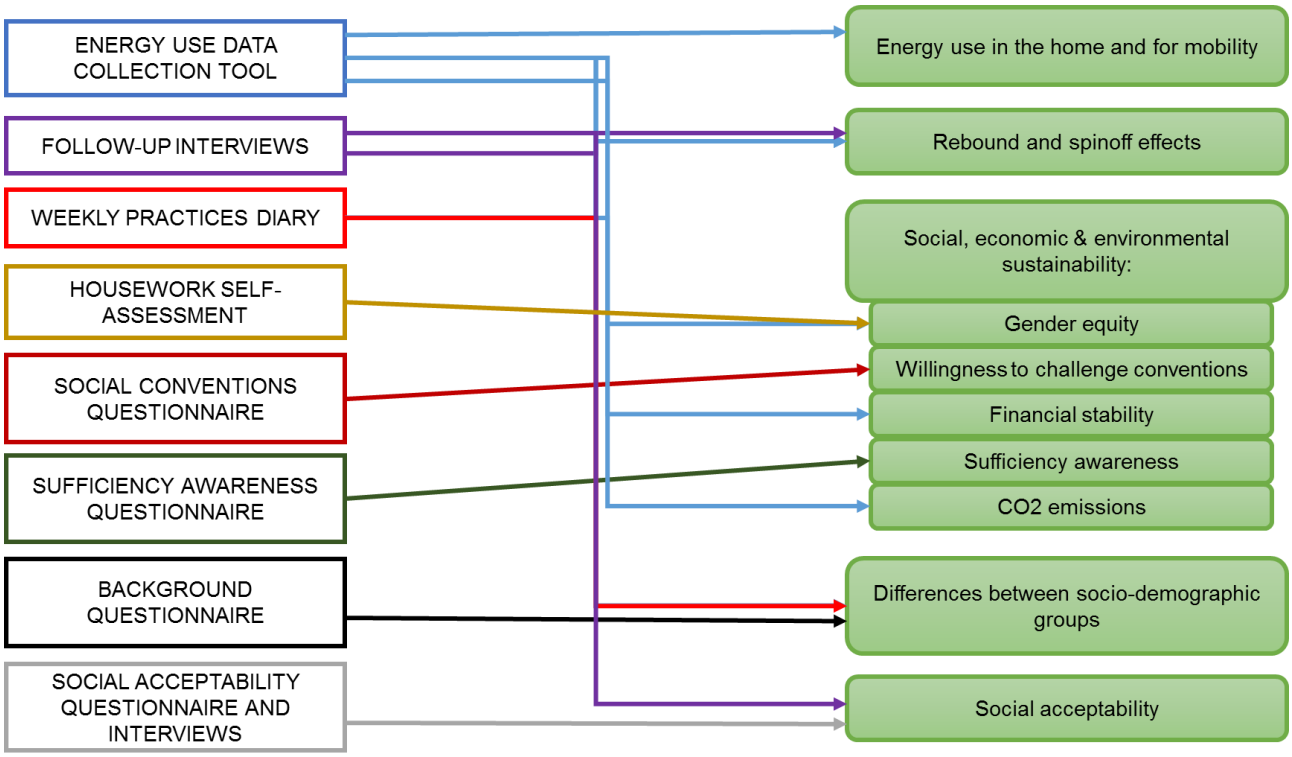


Figure 4. Combining data from the SAT tools to assess ELL performance on outcome indicators.

Some of the data collected for the evaluation can also be used for research purposes in other work packages or for scholarly publications within ENERGISE. To serve this purpose, all of the data will be collected and stored on EMDESK in an appropriate and readable format (xlm, xls, csv) and a data characterization map will be provided.

4.4 ENSURING APPROPRIATE DATA MANAGEMENT PRACTICES

Part of the data will be collected on the Online Monitoring Tool, which will adhere to the data management practices outlined in Goggins and Fahy (2017). In particular:

- ENERGISE researchers will collect primary data only in WP4. Raw data, including interview recordings or analogue weekly practice diaries, will be stored securely (e.g. in a locked cabinet) on the premises of the partner responsible for the ENERGISE Living Labs these data are based on, or on a secure server linked to the Online Monitoring Tool. In a next step, analogue data will be digitalised, e.g. by processing raw data into (translated) interview transcripts or (translated) diary excerpts. These will be shared among all partners for evaluation and analysis in WP5.
- Digital data will be collected to a secure server, either over the mobile network or by physically removing the devices and reading them via cable. We will primarily use digital tools that do not directly interact with household wlans, and hence should not present a data security risk.
- Researchers will be strongly advised to encrypt all sensitive data using public key encryption software, in particular Pretty Good Privacy (PGP), the publicly available

public key encryption application. The private key will be provided by the researcher to the project manager only. Additionally, all data files, especially records connecting ELL participants' identities to the data they provided, will be password protected where possible and saved to an external drive that will remain the property of the project management. Personal details and consent forms will be retained for three years following the study.

Data management practices will be communicated to the participating households and other stakeholders and appropriate consent forms will developed (to be added, Annex 13).

REFERENCES

Arild, A. H., Brusdal, R., Halvorsen-Gunnarsen, J. T., Terpstra, P. M. & Van Kessel, I. A. 2003. *An investigation of domestic laundry in Europe: habits, hygiene and technical performance*. National Institute for Consumer Research, Oslo.

Birzle-Harder, B., Dehmel, C., Marg, O. & Stieß, I. 2013. Ansatzpunkte, Handlungsspielräume und Barrieren für CO2-arme Alltagspraktiken und Lebensstile. Ergebnisse des „KlimaHaushalte"-Feldversuchs. Klima-Alltag. Available at: http://www.isoe.de/uploads/media/klimaalltag-abschlussbericht-ap3-1-2013.pdf

Davis, F. D. 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology, *MIS Quarterly*, 13 (3): 319–340.

Ellegård, K. & Palm, J. 2011. Visualizing energy consumption activities as a tool for making everyday life more sustainable. *Applied Energy*, 88(5), 1920-1926.

Freeburg, B. W. & Workman, J. E. 2010. A method to identify and validate social norms related to dress. *Clothing and textiles research journal*, 28(1), 38-55.

Goggins and Fahy (2017). ENERGISE D8.2 Project Management Handbook.

Guerreiro, S., Batel, S., Lima, M. L. & Moreira, S. 2015. Making energy visible: sociopsychological aspects associated with the use of smart meters. *Energy Efficiency*, 8(6), 1149-1167.

Hargreaves, T., Longhurst, N. & Seyfang, G. 2013. Up, down, round and round: connecting regimes and practices in innovation for sustainability. *Environment and Planning A*, 45(2), 402-420.

Jalas, M. 2009. Time-use rebound effects: an activity-based view of consumption. In *Energy Efficiency and Sustainable Consumption*. Palgrave Macmillan UK, 167-184.

Kuijer, L. 2014. *Implications of Social Practice Theory for Sustainable Design*. Doctoral Dissertation, Technical University of Delft.

Leuser, L., Lehmann, F., Duscha, M., Thema, J. & Spitzner, M. 2016. *Akzeptanz von Energiesuffizienzpraktiken im Haushalt. Auswertung einer quantitativen Befragung*. Heidelberg, Berlin, Wuppertal: Wuppertal Institut & ifeu Institut für Energie- und Umweltforschung Heidelberg.

MECHanisms 2017. *Evaluate and Improve. Make Energy Change Happen Online toolkit*. Available at: http://mechanisms.energychange.info/step/13

Munro, M. & Madigan, R. 1999. Negotiating space in the family home. *At home: An anthropology of domestic space*, 107-17.

Niva, M., Mäkelä, J. Kahma, N. & Kjærnes, U. 2014. Eating sustainably? Practices and background factors of ecological food consumption in four Nordic countries. *Journal of Consumer Policy,* 37(4), 465-484.

OECD 2011. *Greening Household Behaviour. Overview from the 2011 Survey - Revised edition.*

Raven, R. P., Mourik, R. M., Feenstra, C. F. J. & Heiskanen, E. 2009. Modulating societal acceptance in new energy projects: towards a toolkit methodology for project managers. *Energy*, 34(5), 564-574.

Rettie, R., Burchell, K. & Riley, D. 2012. Normalising green behaviours: A new approach to sustainability marketing. *Journal of Marketing Management*, 28(3-4), 420-444.

Sauter, R. & Watson, J. 2007. Strategies for the deployment of micro-generation: Implications for social acceptance. *Energy Policy*, 35(5), 2770-2779.

Schäpke, N. et al. 2017. *Reallabore im Kontext transformativer Forschung. Ansatzpunkte zur Konzeption und Einbettung in den internationalen Forschungsstand.* (No. 1/2017) Leuphana Universität Lüneburg, Institut für Ethik und Transdisziplinäre Nachhaltigkeitsforschung.

Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J. & Griskevicius, V. 2007. The constructive, destructive, and reconstructive power of social norms. *Psychological science*, 18(5), 429-434.

Shove, E. 2014. Putting practice into policy: reconfiguring questions of consumption and climate change. *Contemporary Social Science*, 9(4), 415-429.

Shove, E. & Pantzar, M. 2005. Consumers, producers and practices: understanding the invention and reinvention of Nordic walking. *Journal of consumer culture*, 5(1), 43-64.

Stevenson, R. J., Case, T. I., Hodgson, D., Porzig-Drummond, R., Barouei, J. & Oaten, M. J. 2009. A scale for measuring hygiene behavior: development, reliability and validity. *American journal of infection control*, 37(7), 557-564.

Stewart, R. A., Willis, R. M., Panuwatwanich, K. & Sahin, O. 2013. Showering behavioural response to alarming visual display monitors: longitudinal mixed method study. *Behaviour & Information Technology*, 32(7), 695-711.

Strengers, Y. 2008. Smart metering demand management programs: challenging the comfort and cleanliness habitus of households. In *Proceedings of the 20th Australasian Conference on Computer-Human Interaction: Designing for Habitus and Habitat.* ACM, 9-16.

Thévenot, L. 2014. Enlarging conceptions of testing moments and critical theory. In Susen, S. & Turner, B. (eds.), *The Spirit of Luc Boltanski. Essays on the 'Pragmatic Sociology of Critique'*, Anthem Press.

van Tienoven, T.P., Glorieux, I. & Minnen J. 2017. Exploring the stable practices of everyday life: A multi-day time-diary approach. *The Sociological Review.*

Toft, M. B., Schuitema, G. & Thøgersen, J. 2014. Responsible technology acceptance: Model development and application to consumer acceptance of Smart Grid technology. *Applied Energy*, 134, 392-400.

Urban, J. & Ščasný, M. 2012. Exploring Domestic Energy-Saving: The Role of Environmental Concern and Background Variables. *Energy Policy,* 47, 69–80.

van den Bosch, S. & Rotmans, J. 2008. *Deepening, Broadening and Scaling up: a Framework for Steering Transition Experiments.* Delft/Rotterdam Knowledge Centre for Sustainable System Innovations and Transitions (KCT).

Vandenberg, R. J., Self, R. M. & Seo, J. H. 1994. A critical examination of the internalization, identification, and compliance commitment measures. *Journal of Management*, 20(1), 123-140.

Vávra, J., Peters, V., Lapka, M., Craig, T. & Cudlínová, E. 2016. What Shapes the Temperatures of Living Rooms in Three European Regions? *Sociální studia/Social Studies*, 12(3).

Vedung, E. 1998. *Public policy and program evaluation.* Transaction Publishers.

Vrotsou, K., Bergqvist, M., Cooper, M. & Ellegård, K. 2014, May. PODD: A portable diary data collection system. In *Proceedings of the 2014 international working conference on advanced visual interfaces*. ACM, 381-382.

Walker, J. L., Ehlers, E., Banerjee, I. & Dugundji, E. R. 2011. Correcting for endogeneity in behavioral choice models with social influence variables. *Transportation Research Part A: Policy and Practice,* 45(4), 362-374.

Woersdorfer, J. S. 2010. When Do Social Norms Replace Status-Seeking Consumption? An Application to the Consumption of Cleanliness. *Metroeconomica*, 61(1), 35-67.

Wüstenhagen, R., Wolsink, M. & Bürer, M. J. 2007. Social acceptance of renewable energy innovation: An introduction to the concept. *Energy policy*, 35(5), 2683-2691.

ANNEX 1 CONTEXT AND RECRUITMENT DATA COLLECTION TEMPLATE

Background information	Name	
	Place of residence	
Each (adult) household	Age	
Member to fill separately	Gender	
	Number of adult household members	
	Number of child household members	
	Highest education	Basic education
		Secondary level
		Secondary vocational education and training
		Higher (third level)
	Employment status	Student
		Employed full-time
		Employed part-time
		Unemployed
		Retired
		Other
	Income	Low
		Medium
		High
	Net monthly income	
	Life stage	Student
		Single
		Couple
		Family with small children (<6)
		Family with older children (>7)
		Elderly
		Other
		Mix
Housing	Home ownership status	Tenant
		Owner
		Rent-free tenant
		Community/communal property
		Mix
	Building type	Detached
		Semi-detached
		Attached
		Apartment building
		Student housing
		Senior housing
	Age of the building	
	Year of the latest major renovations	
	Apartment type	Dormitory
		Studio
		Two bedrooms
		Three bedrooms
		Four or more bedrooms
	Total floor area (square meters)	
Cooking	Do you have a kitchen?	
	Cooking a hot meal	Several times a day
		Daily
		Couple of times a week
		Less often
Mobility	Car ownership status	No car
		One car
		Two or more cars
		Leasing or car sharing
	Ownership of a bicycle	

	Frequency of bicycling	Daily
		Weekly
		Occasionally
		Never
	Distance to work (km)	
	Main mode of mobility in commuting	Walking
		Cycling
		Public transport
		Car
	Distance to grocery shop mainly used (km)	
	Main mode of mobility in grocery shopping	Walking
		Cycling
		Public transport
		Car
	Cycling infrastructure	Poor
	(e.g. cycling lanes, bicycle parking facilities)	Sufficient
		Good
		Don't know
	Public transport infrastructure	Poor
	(e.g. routes, timetables)	Sufficient
		Good
		Don't know
Heating	Home heating system	Individual
		Collective (central heating in building)
		District
	Type of energy used for heating	Gas
		Oil
		Biomass
		Electricity
		District heating
		Other
	If electricity or district heating, how is it produced	
	Name of the energy company	
	Ownership of renewable energy sources	Heat pump(s)
		Solar panel(s)
		Solar heaters
		Wind turbines
		Other
	Average room temperature at home	
	Can you regulate the room temperature?	
	Do you turn down the heating for the night or when you are not at home?	
	Do you heat unused rooms?	
	Do you turn down the heating when you air the rooms?	
	Amount of energy used for heating in year 2017	
	Amount of energy used for heating in October 2017	
Electricity use	Type of energy used for electricity	Renewable
		Non-renewable
	Name of the energy company	
	Amount of electricity used in year 2017	
	Amount of electricity used in October 2017	
Laundering	Ownership of a washing machine	
	Access to shared washing machine (e.g. laundry room)	
	Ownership of a dish washer	
	Frequency of washing laundry	Twice or more a day
		Daily
		Couple of times a week
		Weekly
		Less often
Water use	Do you have an own boiler or water heater?	
	Temperature set for boiler or water heater	
	Showering	Twice a day
		Daily

		Every other day
		Couple of times in a week
	Amount of water used in year 2017	
	Amount of electricity used in October 2017	
Communities and group memberships	Place of residence	Rural
		Semi-urban
		Urban
	Types of communities of place (e.g. housing or neighbourhood associations)	
	Types of communities of practice (e.g. sport clubs, community gardens)	
	Types of communities of interest (e.g. environmental associations, parents' associations)	
Engagement with energy	Prior experience in energy saving initiatives	
	Prior experience in prosumer initiatives	
	Prior experience in other environmental initiatives	
	Knowledge on local climate (/sustainability) targets	
	Own efforts to save energy or use energy more efficiently (investments in renewable energy, energy efficient appliances, observing energy use etc.)	
	Maintenance of the heating system (settings, venting, cleaning etc.)	
Internet and smart phones	Internet access at home	
	Smart phone ownership	
	Use of smart phone apps	

ANNEX 2 ENERGY CONSUMPTION TOOL

(demonstration of part of it)

All ELLS: Rough calculation of household energy use for primary residence

Primary system for heating domestic hot water (DHW)	tick one option only	
Connected to the primary heating system (gas, electric or wood boiler, district heating)		use sheet A
Separate gas boiler		use sheet B
Separate electric boiler		use sheet C
Solar collectors		use sheet D
Other		contact WP3 for further advice

Primary heating system	tick one option only	
Gas, central heating		use sheet A
Electricity, room-based		use sheet A
Electricity, central (central boiler, heat distribution via water radiators)		use sheet A
Wood or other solid fuel, room-based		use sheet B
Wood or other solid fuel, central (log boiler, pellet boiler, heat distribution via water radiators)		use sheet E
District heating		use sheet F
Fuel oil (central boiler, heat distribution via water radiators)		use sheet A
Ground-source heat pump (central boiler, heat distribution via water radiators)		use sheet A
Air-source heat pump		use sheet B
Other		contact WP3 for further advice

System for cooking	tick one option only	
Electricity		use sheet A
Gas		use sheet A
Wood		use sheet B
Other		contact WP3 for further advice

SHEET A (Example)

GENERAL INSTRUCTIONS

1) Obtain energy bills for the entire year (monthly, quarterly). Ideally, several years should be available, in which case you should calculate averages across years.

2) Subtract sum of energy consumption (kWh, m3 etc.) of non-heating season months (e.g. June-August) from sum of energy consumption (kWh, m3 etc.) for heating season months (e.g. September to May)

3) Enter here the difference = energy consumption for heating

4) Subtract the difference for the entire year's consumption = non-heating energy consumption

5) If the remainder is only used for hot water, this completes the calculation

6) If the remainder also supplies electricity or gas for appliances, calculate the consumption of appliances using the Appliances and usage table, nominal consumptions of appliances (if not available, you can use average annual consumption data from your national energy agency/authority).

EXAMPLE: House with electrical heating and DHW production		
	kWh/year	kWh/average per month
Electricity consumption, June-August 2016, per month*	300	100
Electricity consumption, Sept-May 2016	4 000	444
Total electricity consumption 2016	4 300	358
Approximate electricity consumption/space heating	3100	344
Electricity use for appliances (from Appliances table)	480	40
Electricity use for DHW	720	60

* if the household was away for an entire month, please omit that month and calculate average from the remaining months.

Calculator for temperature-adjusted heating energy demand

Instructions

1. Find data on the heating energy consumption for three months during the heating period in 2017 and 2018 (here: September, October, and November).

2. If heating and domestic hot water share the same meter, you can estimate the share of heating by comparing to summer months (see sheet A)

3. Insert the monthly heating energy use into the green cells (column C).

4. Insert the monthly average temperature into the corresponding cells (column B)

6. Insert temperatures for the test reference year of the months and locations in question (column E). You can also insert the degree days figure for the month in question (column F) if you wish to calculate the normalized heating energy demand for the entire year.

5. Find out the degree days figure for the location in question for the test reference year. The basic temperature is 17 degrees C, i.e., heating above that temperature is assumed to derive from internal (appliances, people) or external heat loads (sun).

6. The program calculates the nominal heating demand in a normalized year. This is calculated from the relations between the heating degree days.

7. NB: the annual heating demand is corrected 10% upward from that calculated directly from the figures. This is because the share of heat loads is greater in the autumn than in the winter, thus the direct calculation renders a lower figure than when calculated with more sophisticated tools. The monthly calculations do not have or need this correction factor.

2017	Average temp	Heating energy demand	Heating degree days	Test reference year	Heating degree days	Calculated consumption		
	°C	kWh	temperatures from 2017	average temp °C	test reference year	using TRY temperatures, kWh		
September	9,1	454	237	10,5	195	374		
October	3,4	889	422	6,2	324	706		
November	0,8	1236	486	0,5	495	1259		
Heating degree days, test reference year	4832							
Calculated heating demand in test reference year, kWh	**11976**							
2018	Average temp	Heating energy demand	Heating degree days	Test reference year	Heating degree days	Calculated consumption	Difference 2018/2017	
	°C	kWh	temperatures from 2017	average temp °C	test reference year	using TRY temperatures, kWh	%	
September	7,6	511	282	10,5	195	353	-5	
October	4,8	776	378	6,2	324	687	-3	
November	1,1	1112	477	0,5	495	1154	-8	
							-6	(average weighted by heating demand)
Heating degree days, test reference year	4832							
Calculated heating demand in test reference year, kWh	**11213**							

ANNEX 3 APPLIANCES AND USAGE TOOL

Refrigerator	How many refrigerators and/or wine chillers are plugged-in and turned on?
	The size of the most used refrigerator?
	How many doors are in the most used refrigerator?
	Is there a freezer in the most used refrigerator and if there is, is it next, above, below or inside the refrigerator?
	How many months a year is the most used refrigerator used?
	How old is the most used refrigerator?
	What is the energy rating of the most used refrigerator?
	What is the temperature in the most used refrigerator?
	Same questions about the second most used refrigerator/wine chiller and where it is located.
Freezer	How many stand-alone freezers are plugged-in and turned on?
	Is the most used freezer upright or chest?
	The size of the most used freezer?
	How many months a year is the most used freezer used?
	How old is the most used freezer?
	What is the energy rating of the most used freezer?
	What is the temperature in the most used freezer?
	How often is the freezer defrosted?
	Same questions about the second most used freezer and where it is located.
Stove/range	Does the household have an electric stove?
	Is the stove cast iron stove, glass-ceramic stove or induction stove?
	Does the household have a stove, which uses town gas, liquefied gas or wood?
	Does the household have an oven?
	Is the oven fan assisted oven or conventional oven?
	Does the household have a baking oven?
	How many times is the cooktop part of the most used stove/range used in a week?
	How many times is the oven part of the most used stove/range used in a week?
Microwaves	How many microwaves?
	How many times is the microwave used in a week?
Small kitchen appliances	Does the household use toaster, coffee maker, electric kettle, blender, juicer, mixer, waffle iron or other small kitchen appliance least once a week?
	Electrical power of small kitchen appliances?
Outdoor grill	Does the household use a natural gas, propane or/and charcoal grill?
Cooking	How often hot food is cooked at home?
	How often hot drinks is made at home?
Dishwashing	Does the household have a dishwasher?
	How many times the dishwasher is used a week?
	Does the household usually use full loads?
	Which programme is used most of the time when running the dishwasher?
	How old is the dishwasher?
	How often does the household wash the dishes by hand?
	Does the household wash the dishes in running water?
	Does the household wash the dishes in a sink full of water or using bowls?
Clothes washer	Does the household have a clothes washer?
	Is the clothes washer a washer-dryer?
	What is the electrical power of the clothes washer?
	What is the energy rating of the clothes washer?
	Is the clothes washer top loading or front loading?
	How many times is the clothes washer used in a week?
	What water temperature setting is typically used?
	How old is the clothes washer?
Clothes dryer	Does the household have a separate clothes dryer?
	How many times is the clothes dryer used in a week?
	Does the household usually use full loads?
	How old is the clothes dryer?
Drying cabinet	Does the household have a drying cabinet?
	How many times is the drying cabinet used in a week?

	How old is the drying cabinet?
Television	How many televisions are used in the household?
	The size of the most used television?
	The type of the most used television, LDC, plasma, LED, projection or standard tube?
	How many hours is the most used television turned on each day? How about on weekends?
	What is the size of the second most used television?
	What type of display does the second most used television have, LCD, plasma, LED, projection or standard tube?
	How many hours is the second most used television used on weekdays and on weekends?
	Does the household have cable/satellite boxes without or/and with DVR, DVRs, video game consoles, DVD players, Blu-ray players, VCRs, Internet streaming devices, home theater or audio systems or subwoofers and how many?
	How many hours previous electronic appliances are used in a week?
Computers	How many computers are used in the household?
	The type of the most used computer, desktop computer with crt monitor, desktop computer with flat-panel display, laptop computer, laptop computer with crt monitor or laptop computer with flat-panel display?
	How many hours is the most used computer used in a week?
	How often is the most used computer in sleep mode, when the computer is not used, usually or randomly?
	How often is the most used computer turned off by the power switch, when the computer is not used, usually or randomly?
	The type of the second most used computer, desktop computer with crt monitor, desktop computer with flat-panel display, laptop computer, laptop computer with crt monitor or laptop computer with flat-panel display?
	How many hours is the second most used computer used in a week?
	How often is the second most used computer in sleep mode, when the computer is not used, usually or randomly?
	How often is the second most used computer turned off by the power switch, when the computer is not used, usually or randomly?
	Does the household have inkjet or laser printers, scanners, copiers or multifunction machines and how many?
Internet	Does the household access the Internet?
	Is a wireless router used in the household for accessing the Internet?
Other electronics	How many radios, stereos, tablet computers, e-readers, fax machines, smart phones or cellular phones are in the household?
	Are the mobile phone chargers always plugged in, usually plugged in, always unplugged when they are not in use?
	Does the household have a waterbed?
	Does the household have an aquarium or a terrarium for a pet?
	Does the household have home nursing equipments, for example nasal cannulas?
	Does the household use power tools once a week or more often?
	Does the household have an air dryer?
	Does the household have a hot tub, a steam jet or/and a swimming pool?
Lighting	How many light bulbs are installed inside and the outside the home?
	How many of them are energy efficient?
	How many of these are LED?
	How many light bulbs inside and the outside the home are used at least 4 hours per day?

ANNEX 5 SOCIAL CONVENTIONS SURVEY

Cleanliness, clothes	**SCALE**
Clothes should always smell as if newly washed[7]	Likert scale agree-disagree
It is embarrassing to wear clothes with a body odour	Likert scale agree-disagree
Most people think that washing clothes in cold water is unhygienic	Likert scale agree-disagree
Among my friends/colleagues/neighbours it is normal to[8]	Likert scale agree-disagree
• wear the same top or shirt two days in a row?	Likert scale agree-disagree
• wear the same skirt or pants two days in a row?	Likert scale agree-disagree
• wear the same underclothes two days in a row?	Likert scale agree-disagree
Cleanliness, personal	
Everyone should take a daily bath or shower, change underwear daily, and use an underarm deodorant.[9]	Likert scale agree-disagree
If children are not clean, it is a sign of neglect	Likert scale agree-disagree
It shows respect toward oneself and others to be clean at work	Likert scale agree-disagree
Among my friends/colleagues/neighbours it is normal to	Likert scale agree-disagree
• go without a wash, shower or bath two days in a row?[10]	Likert scale agree-disagree
• start the morning with a shower	Likert scale agree-disagree
• have a daily shower of about 20 minutes?[11]	Likert scale agree-disagree
Indoor comfort	
What indoor temperatures do you believe to be recommended in your country?[12]	temp degrees
What indoor temperatures do you consider to be normal in your country?	temp degrees
What indoor temperatures do you consider to be normal in your neighbourhood?	temp degrees
What indoor temperatures do you consider to be normal for your (type of) building?	temp degrees
It is impolite toward guests to invite them to a cold home	Likert scale agree-disagree
Among my friends/colleagues/neighbours it is normal to	
• Check and adjust thermostat settings	Likert scale agree-disagree
• Turn down the heating when airing the room	Likert scale agree-disagree
• Turn down the heating when leaving the room	Likert scale agree-disagree

[7] from Arild et al. 2004
[8] from Stevenson et al. 2009
[9] from Freeburg and Workman 2010
[10] from Stevenson et al. 2009
[11] adapted from Strengers 2008
[12] adapted from Vavra et al. 2016; Urban & Ščasný, 2012

• Turn down the heating when leaving for the day	Likert scale agree-disagree
• Turn down the heating when leaving for a week or more	Likert scale agree-disagree
• Be concerned about energy use for heating	Likert scale agree-disagree
• Not care too much for how much energy one uses for heating	Likert scale agree-disagree
Cooking	
Think about an ordinary day, at home. If you were to eat a proper hot meal, what needs to be included? (Tick of as many as relevant)[13]	a. Meat or fish, b. Potatoes, rice or pasta, c. Bread, d. Cooked vegetables, e. Salad or raw vegetables, f. Condiments (e.g. sauces), g. Starter, entree, h. Dessert, i. something else, what ____ (open response), j. Don't know.
It is important to family life that everyone sits down together and has a proper meal whenever possible[14]	Likert scale agree-disagree
When people have busy lives, you can be more flexible about meals: Individuals can please themselves and eat when it suits them[15]	Likert scale agree-disagree
It is important for your health to have a proper lunch break and eat a hot lunch	Likert scale agree-disagree
Among my friends/colleagues/neighbours it is normal to	Likert scale agree-disagree
• to make an effort to prepare something nice when having people over	Likert scale agree-disagree
• for women to spend an hour or more a day cooking and baking	Likert scale agree-disagree
• put together a meal by heating various leftovers	Likert scale agree-disagree
• use prepared ingredients and ready meals to speed up to cooking process	Likert scale agree-disagree
Mobility	
Other people at my workplace use public transport for commuting[16]	Likert scale agree-disagree
Other people in my income category own and use a car	Likert scale agree-disagree
Among my friends/colleagues/neighbours it is normal to	Likert scale agree-disagree
• Take the car to work because it is the quickest way	Likert scale agree-disagree
• Drive one's children to school because it is safest	Likert scale agree-disagree
• Drive one's children to hobbies because it is safest	Likert scale agree-disagree
• Go shopping by car in order to get a lot done at once	Likert scale agree-disagree

[13] from Niva et al. 2014
[14] from Munro and Madigan 1999
[15] adapted from Munro and Madigan 1999
[16] adapted from Walker et al. 2011

• Commute to work using public transport	Likert scale agree-disagree
• Try to avoid driving the car and bike to work instead	Likert scale agree-disagree
Challenging social norms	
On a scale of 1-10, how concerned would you be about deviating from social norms in (a) focal domain 1 and (b) focal domain 2	Scale of 1-10

ANNEX 6 WEEKLY PRACTICES DIARY

To be filled in over a 10-week period.

Thermal comfort

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
time spent at home	start time-end time (e.g. 00:00-08:00 18:00-00:00)						
temp setting daytime	temp degrees (e.g. 18°)						
temp setting evening	21°						
temp setting night	21°						
rooms used (> 5 min.)	kitchen: yes/no living room: yes/no bedroom 1: yes/no bedroom 2: yes/no, etc.						
turned off heat when leaving home	yes/no + who is doing it						
turned off heat when leaving rooms	always/ sometimes/ never + who is doing it						
number of new practices tested, [added & itemized once measures selected]							

Showering

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
number of minutes in shower	+ who is doing it						
number of minutes in bath	+ who is doing it						
number of minutes in	+ who is doing it						

sauna/hot tub							
number of minutes other bathing practices: bathtub, sauna etc.	+ who is doing it						
number of new practices tested, [added & itemized once measures selected]	+ who is doing it						

Laundering

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
number of washes 30 °C	+ who is doing it						
number of washes 40 °C	+ who is doing it						
number of washes 60 °C	+ who is doing it						
number of washes 90 °C	+ who is doing it						
use of tumble dryer, minutes	+ who is doing it						
use of drying cabinet, minutes	+ who is doing it						
number of new practices tested, [added & itemized once	+ who is doing it						

measures selected]							

Cooking

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
hot meals cooked on the stove, time of cooking min.	+ who is doing it						
hot meals cooked in the oven, time of cooking, min.	+ who is doing it						
total time spent preparing food	+ who is doing it						
keeping certain items in the fridge/not (tomatoes, peppers, etc.)	+ who is doing it						
washing/rinsing dishes by hand, min.	+ who is doing it						
use of dishwasher, min.	+ who is doing it						
number of new practices tested, [added itemized once measures selected]	+ who is doing it						

Mobility

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Km driven by car for work/school	+ who is doing it						
Km driven by car for shopping/ errands	+ who is doing it						
Km driven by car for hobbies/leisure	+ who is doing it						
Km biking for work/school	+ who is doing it						

Km biking for shopping/ errands	+ who is doing it						
Km biking for hobbies/leisure	+ who is doing it						
Km walking for work/school	+ who is doing it						
Km walking for shopping/ errands	+ who is doing it						
Km walking for hobbies/leisure	+ who is doing it						
Km public transport for work/school	+ who is doing it						
Km public transport for shopping/ errands	+ who is doing it						
Km public transport for hobbies/leisure	+ who is doing it						
number of new practices tested, [added & itemized once measures selected]	+ who is doing it						

Perhaps add here some items pertaining to time used cleaning the home and making home repairing things to account for the main categories of time use for housework. Or combine with time-use diary (PODD).

ANNEX 7 INTERVIEW TEMPLATE

ANNEX 8 DIVISION OF HOUSEWORK AND STRESS QUESTIONNAIRE

ANNEX 9 SOCIAL ACCEPTABILITY QUESTIONNAIRE ITEMS AND INTERVIEW QUESTIONS

Questionnaire items for household interview	
Perceived usefulness	Likert scale: agree-disagree
The new practices of (a) cleanliness or (b) [insert domain] that I tested in the ELL	to be repeated for both domains
· make my everyday life easier	
· make my everyday life more enjoyable	
· help me to have a more satisfying family life	
· help me to be healthier	
· help me to save time	
· help me to save energy	
· help me to save money	
· help me to reduce my carbon footprint	
· contribute to making the world a better place	
Open comments: _____	
Compared to other ways of saving energy and reducing CO2 emissions, the practices tested in the ELL were	Likert scale: much easier-more difficult
Compared to other ways of making my everyday life easier, the practices tested in the ELL were	Likert scale: much easier-more difficult
Ease of use	Likert scale: agree-disagree
It was easy for me to experiment with the new practices tested in the ELL	
It was difficult to learn to do things in new ways in the ELL	
It was difficult to the change my way of doing things at home at first but it got easier	
It was easy to experiment with new ways of doing things but difficult to continue doing so for several weeks	
I expect that continuing to do things at home in the new ways we tested will not require a lot of effort from me	
Open comments: _____	
Intention to use	Likert scale: agree-disagree
I think my household will go on with trying to apply the new practices until the end of the year	
This was an interesting experiment but I don't think my household members and I will continue doing the new practises	
My household and I plan to continue applying some of the new practices in the future	
I don't think my household and I will do any of the new practices after the project ended	
Identification	Likert scale: agree-disagree
I have told my friends about this project as a positive experience	
I am proud to tell others that I am a part of this project	
I am not willing to make an effort to help spread the results of this project	
I feel this project does not contribute to values that are important to me	
I would like to help my friends adopt the new practices tested in the ELLs	
I don't feel these new practices would be helpful anyone I know	
Spillover effects	5-point scale: have already done- might do-not sure- not likely-no
How likely do you consider yourself in the future to	
engage with energy and climate concerns in my home	

join an organization working with energy/climate issues	
take climate and energy into account when voting	
pay more attention to the climate impacts of the food you eat	
given advice to others about energy, climate and lifestyle issues	
Questions for participants AND stakeholders:	
Have you shared your experiences in the ELLs with anyone	scale: never – once or twice – now and again – regularly/not applicable
Spoken to	
friends	
relatives	
neighbors	
co-workers	
my children's school	
groups/associations in which I participate	
other	
Shared on	
Facebook	
Twitter	
Blog post	
Newspaper article	
other	
Would you consider sharing your experiences in the ELL in the future	scale: never – once or twice – now and again – regularly/not applicable
Speak to	
friends	
relatives	
neighbors	
co-workers	
my children's school	
groups/associations in which I participate	
other	
Share on	
Facebook	
Twitter	
Blog post	
Newspaper article	
other	
Open comments on sharing experiences:_____	
If the opportunity were to arise, would you participate again?	
Would you recommend participating in this kind of project to your friends, neighbours, co-workers?	
What did you see as the main benefits/weaknesses of the project?	
Have you gained any new insights on energy-related household practices while participating in this project? Which ones?	
Could this project be repeated in another community? Where? Why?	

Should the (a) local government (b) national government and (c) EU support some of the practices tested in this ELL? Which ones? Why? How?
What opportunities do you see for wider dissemination of the practices developed in the project within your (a) community and (b) country?
What barriers do you see for wider dissemination of the practices developed in the project within your (a) community and (b) country?
What positive/negative impacts might wider dissemination of the practices developed in the project have within (a) your community and (b) your country?
What should be changed and who should be involved if we want to disseminate these practices more widely within (a) your community and (b) your country?

ANNEX 10 FOLLOW-UP INTERVIEW TEMPLATE/ HOUSEHOLDS

ANNEX 11 FOLLOW-UP INTERVIEW TEMPLATE/ STAKEHOLDERS

ANNEX 12 CO_2 EMISSIONS CALCULATION TOOL

ANNEX 13 DATA MANAGEMENT INSTRUCTIONS