ENERGISE

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

# LIVING LAB COUNTRY REPORT - HUNGARY

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# SUMMARY

ENERGISE Living Labs (ELLs) employ practice-based approaches to reduce energy use in households while co-creating knowledge on why energy-intensive practices are performed and how they depend on the context in which they are performed. Altogether 16 living labs were implemented in eight European countries in 2018.

The Hungarian ELLs were located in the town of Gödöllő in Central Hungary in order to provide a better opportunity to make comparisons between the individual (ELL1) and the community or group approach (ELL2). The final number of households participating in the ENERGISE Living Labs in Hungary was 41. Out of this number 21 participated in ELL1 and 20 in ELL2. It is notable that all 41 households remained engaged in the ELLs up until the end.

In Hungary, about 50% of the participants took on the common laundry challenge of reducing the weekly number of washing cycles by half; the rest formulated an individual challenge. The common heating challenge of reducing daytime indoor temperature to 18 °C - which was exceptionally challenging in Hungary where indoor temperatures are generally considerably warmer - was undertaken by 30% of the participants.
Based on laundry diary data, the average number of laundry cycles was reduced by 21%, and was also accompanied by a reduction in washing temperature. This lead to a 22% reduction in average weekly laundry-related energy consumption in participating households.
Based on data from temperature loggers, indoor temperatures were reduced by 1 °C on average.

These changes occurred as a result of participating households paying careful attention to their washing and heating practices, and with inspiration gained from challenge kits, tips and metering equipment, learning to apply various practices to keep clean or warm without washing and turning on the heating, respectively. With information collected through before (baseline) and after (closing) surveys we can see a definite rise both in the number of such practices applied by participants, and the number of participants applying several of them parallel.
What is especially encouraging is that based on information gathered through a follow-up survey administered three months after the ENERGISE Living Labs ended as well as meter readings, changes appear to have continued even after the conclusion of the labs both in terms of changed practices and energy saved.

As for differences between the individual (ELL1) and the group format (ELL2), although our analysis is still ongoing, based on the results that we already have the group format seems to be more motivating for participants. This is supported by various factors, for example how their mood changed during the process, the higher level of commitment by ELL2 participants, and the many reported positive aspects of participating in group meetings such as confirmation of sustainable practices, learning opportunities as well as a sense of belonging to a group of like-minded individuals.

In terms of policy implications, the Hungarian ELLs point to the importance of drawing attention to the role and responsibility of households in the energy transition, including the fact that even seemingly small changes in daily practices like reducing the temperature or the number of weekly washes can have big effects if each and every household makes them. Related to this and regarding methodology, combining qualitative and quantitative programme elements is a very effective way of helping participants change their practices.

To conclude, we should also underlie the significance of embedding initiatives like the ENERGISE Living Labs locally in order to contribute to their longer-term impact. The fact that GDI was known in the local community made recruitment easier, helped to keep participants involved in the programme, and will also make their continued change and engagement part of a natural process.

# 1. ELL DESCRIPTION

The Hungarian ELLs were both located in the town of Gödöllő (35.000 inhabitants) in Central Hungary in order to provide a better opportunity to make comparisons between the individual (ELL1) and the community or group approach (ELL2). At the same time, the local partner, GreenDependent (GDI), took great care to keep the two groups separate, which was successful as even until the common celebratory event held after the final focus group, ELL1 participants were left guessing who the other households participating in the living labs were. Thus, GreenDependent is satisfied that no interaction took place between the two ELL groups.

The recruitment process in Hungary started in June 2018 and was completed in August. More than 90 households started to fill in the recruitment survey and about 70 of them completed it. Out of these households about 55 satisfied the requirements for participation, thus 45 were selected to potentially allow for people to withdraw for various reasons. This indeed happened, so **the final number of households participating in the ENERGISE Living Labs in Hungary is 41. Out of this number 21 participated in ELL1 and 20 in ELL2.** It is notable that all 41 households remained engaged in the ELLs up until the end.

In the sections below we first present the socioeconomic and demographic characteristics of the Hungarian ELL participants. Then the characteristics of their dwellings and living environments are presented, and finally, their prior engagement with energy initiatives. These data are based on a survey used when recruiting participants and complemented with observations made when visiting the households for the first time. For these data we only present the data of those households that started the ELLs (n=41).

## 1.1 SOCIODEMOGRAPHIC AND SOCIOECONOMIC CHARACTERISTICS OF THE ELL PARTICIPANTS

During the recruitment process GDI strived to have a diverse composition of participant households as much as possible.
At this point, it is important to mention that Gödöllő has a more favourable social and economic situation than the Hungarian average. This occurs for various reasons, among them the fact that the town is situated in Central Hungary, and it is host to a well-known university as well as several prestigious secondary education institutions.

As for the number of households the proportion of single households is 33% in Hungary (HCSO, 2017), by comparison the ratio of one-person households in the Hungarian ELLs was 10%. Two-member households include almost entirely couples and only one single parent with an adult child. Most of the ELL households were with two adults and more than one child, the proportion of four member households is more than 50% among the participants. Besides, there were some three generation households participating in the project as well. (Table 1)

In terms of the age of the contact person, among Hungarian ELLs the share of the age groups is the following: most of the contact persons (59%) were between 30-49 years old, and the ones in the 50-69 age bracket were making up the remaining 41% (Table 1).
There were no contact people in the other two categories (29 or younger and 70 or older), but, naturally, there were participating household members who belonged to these groups.

Table 1 shows the employment status of participating households. The contact persons in most of the households are employed (full-time or self-employed: 68%, part-time: 5%); besides, the proportion of the unemployed was 0% and economically inactive people made up all in all 27%.

As for the educational level of participants, they all have qualifications higher than primary. Most of the households' contact persons (83%) had completed tertiary education as well, which a lot higher than the national average, 22% (HCSO, 2016). 17% of the participants had secondary or vocational education.

**Table 1. Socio-demographic and socioeconomic characteristics of participating households Source: recruitment survey (n=41)**

| **Household size (n=41)** | **1 member** | **2 members** | **3 members** | **4 members or more** |
|---|---|---|---|---|
| **%** | 10 | 20 | 15 | 56 |
| | | | | |
| **Age of contact person (n=41)** | **29 or younger** | **30-49** | **50-69** | **70 or older** |
| **%** | 0 | 59 | 41 | 0 |
| | | | | |
| **Employment status of contact person (n=41)** | **Full-time employed or entrepreneurs** | **Part-time** | **Student//Unemployed** | **Retired** |
| **%** | 68 | 5 | 15 | 12 |
| | | | | |
| **Educational level of contact person (n=41)** | **Tertiary** | **Secondary/vocational** | **Primary** | **Other or unknown** |
| **%** | 83 | 17 | 0 | 0 |

## 1.2 REASONS FOR PARTICIPATING AND PRIOR EXPERIENCE OF ENERGY INITIATIVES

The main methods used for recruitment in Hungary were the following:

1. Advertisements in the 2 local papers:
   - one of the papers is delivered to every household in Gödöllő for free,
   - the other paper is available online as well as in a paper-based format, but it is not free in its printed format)
2. Advertisement on social media (Facebook)
3. Advertisement using the NGO network mailing lists available in the town

The advertisements were carefully written and designed to target people with different messages, highlighting different aspects of the benefits of participating in the ELLs (e.g. being able to participate in European research and contributing to climate policy making, learning about energy consumption, doing something to reverse climate change, receiving energy advice, becoming part of a group, etc.).

In the second part of July 2018 GDI reviewed the people answering the advertisements (and filling in the recruitment survey). The plan was to continue recruitment in August to make sure that there are cc. 45 households selected for participation (and thus allow for some households to withdraw during the process), and to make sure that a varied group of households are selected in terms of

socio-economic status. However, there was no need for this second stage of recruitment as a sufficient number and variety of households applied to participate. As stated in the introduction, **the final number of households participating in the ENERGISE Living Labs in Hungary is 41: 21 participating in ELL1 and 20 in ELL2.** It is notable that all 41 households remained engaged in the ELLs up until the end.

The hard-to-reach group in the case of Hungary comes from the upper-middle-class in the country, whose members rarely participate in similar programmes (see also Table 2), but were recruited successfully for the ELLs. The socioeconomic, demographic and building characteristics data presented here show that the households selected in Hungary are better educated than the Hungarian average, live in newer and larger homes, in the majority of cases in detached homes.

Although we did not directly ask participants why they decided to apply to participate, during the various meetings with them at household visits, interviews, focus group meetings, etc., they mentioned various reasons. Among these reasons were

- the wish and to some extent, curiosity, to actively participate in a European research project;
- the wish to learn about energy use and to save energy;
- motivation to get to know the local partner, GDI more as several of them had heard about the organization before and were interested to find out more about their work.

Participants also reported that they felt lucky and honoured to be selected to participate, and were also thankful to receive the incentives, the metering equipment to begin with (i.e. thermometers, energy meters, thermologgers) and some small accompanying presents such as cloth bag, fridge magnet to strengthen the feeling of belonging to the living lab and ENERGISE project.

As shown in Table 2, only a small share of households mentioned having been involved in information campaigns, having made use of incentives for energy investments, or having previously participated in a challenge or discussion to change everyday routines. A few participants, however, mentioned having been involved in some other type of initiative. Overall, the participants selected had a very limited prior experience with energy or sustainable lifestyles initiatives, and if they did, it was mostly with information campaigns or incentives, thus not programmes focusing on everyday practice change at home.

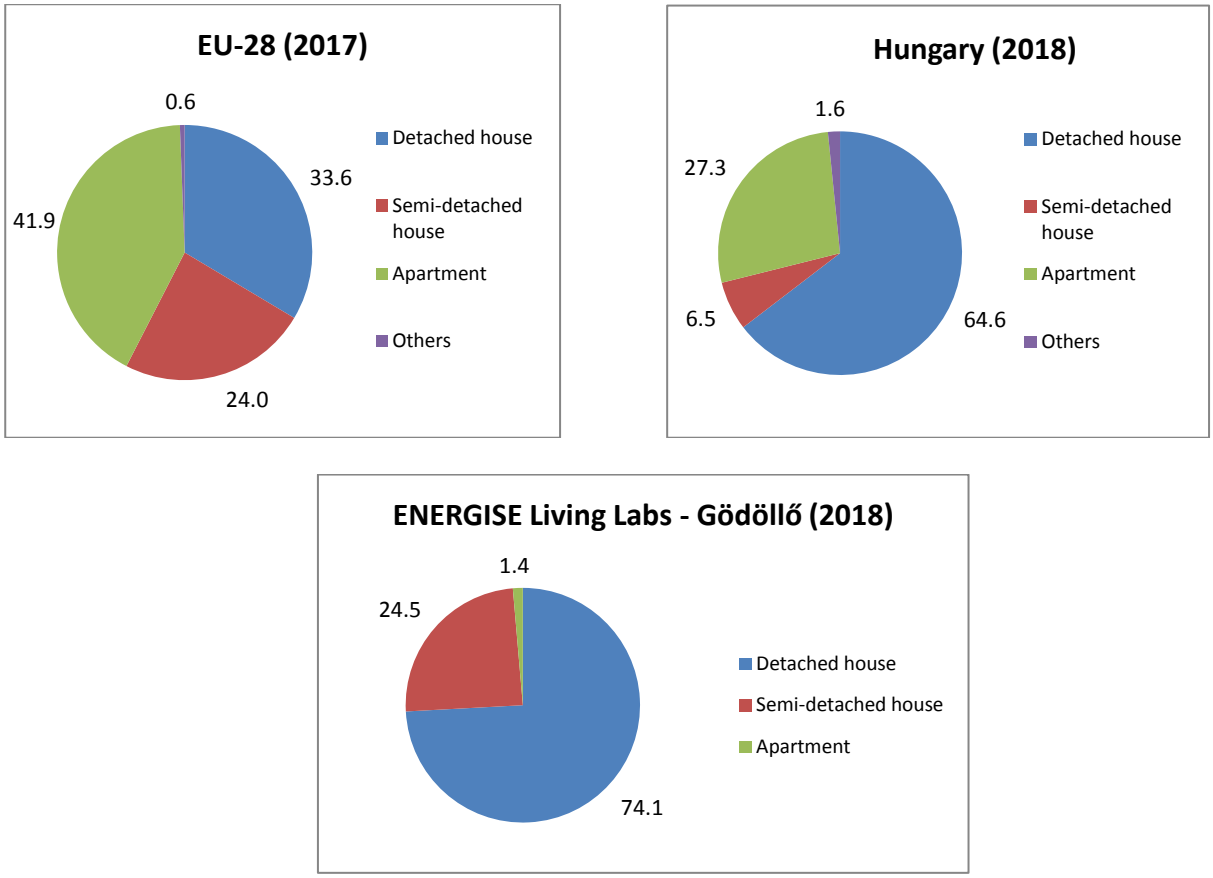
**Table 2. Share of participants having prior experience of energy initiatives, in %**
**Source: recruitment survey (n=41)**

| | At home, % | At work, % | At school, % |
|---|---|---|---|
| **Information campaign, tips for saving energy** | 2 | 7 | 2 |
| **Incentive to buy efficient appliances (including light bulbs)** | 2 | - | - |
| **Incentives to invest in renewable energy** | 2 | - | - |
| **Incentives or support for energy efficiency** | 2 | - | - |
| **Challenge/discussion to change habits and everyday routines** | - | 2 | - |
| **Other** | - | 5 | 2 |

## 1.3 BUILDING CHARACTERISTICS OF ELL PARTICIPANTS

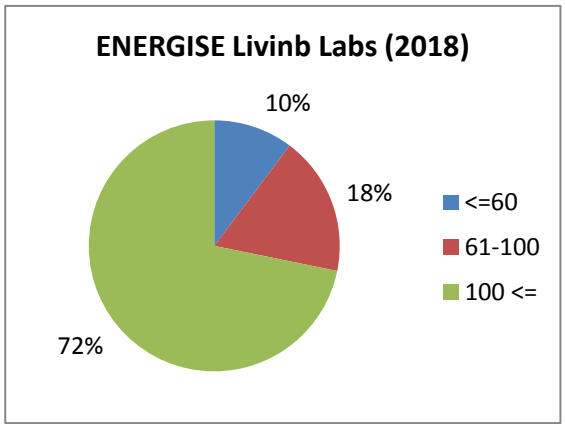
In terms of type of dwelling both ELL1 and ELL2 participants in Hungary mainly live in detached houses (74%), but terraced/semi-detached houses are also typical (24%). Besides, there was only one participant who lives in an apartment. As shown in Figure 1, this share is somewhat different from the national average of Hungary; people living in apartments are slightly underrepresented in the ELL households of Gödöllő. To compare, in Hungary 65% of the population live in a detached house, 7% of them live in a semi-detached house and the proportion of apartments is 27%. Another interesting aspect is comparing the Hungarian data to the EU-28 average. The proportion of apartments (42%) and semi-detached houses (24%) is higher in the EU than in Hungary (Eurostat, 2018).

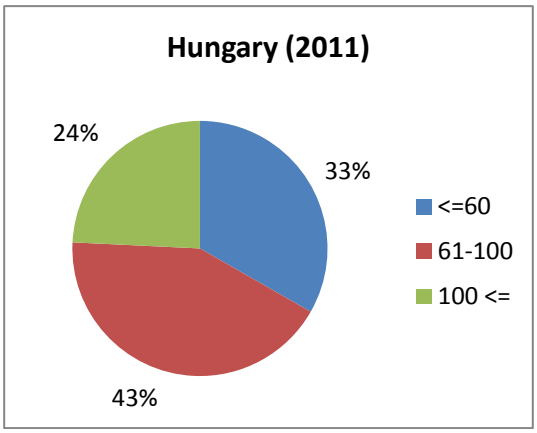
**Figure 1. Distribution of population by type of dwelling, % – EU-28 (2017), Hungary (2018), ENERGISE project (2018)**
**Source: Eurostat (table code: ilc_lvho01); recruitment survey (n=41)**




The valuable of size of dwelling is somewhat related to household size. As shown in Figure 2, the Hungarian ELL households with four or more members live in a house of at least 70 $m^2$, and 77% of them live in homes that are over a 100 $m^2$.
Most of the participants (72%) live in a house that is larger than 100 $m^2$ (39% of them live in a house with a size over 140 $m^2$), 18% of participants have 61-100 $m^2$ living space and 10% live in a house or apartment under 60 $m^2$. The distribution is quite different from the national data. In Hungary 24% of the population live in a house or flat that is larger than 100 $m^2$, the ratio of the 61-100 $m^2$ category is 43%, and 33% of inhabitants live in a house or apartment under 60 $m^2$ (HCSO, 2011a). This difference underlies the fact that ELLs in Hungary managed to involve the harder-to-reach group of more well-off households.

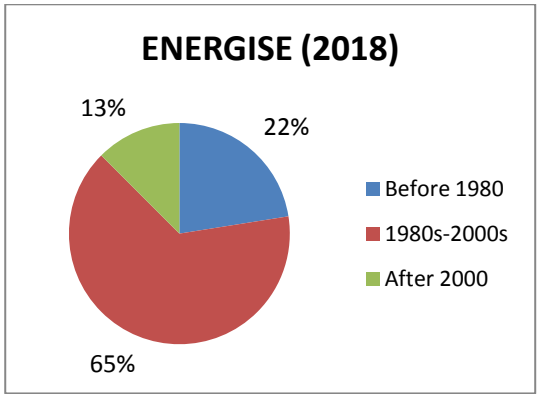
**Figure 2. Share of households by size of dwelling, ELL households (2018) and national average of Hungary (HCSO, 2011a)**
**Source: recruitment survey (n=41) and HCSO, 2011a**

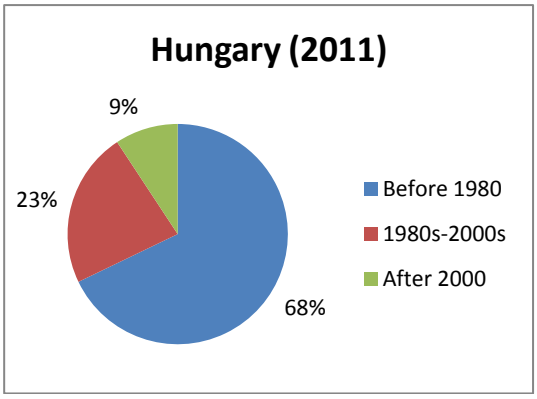



As for the age of dwellings, Figure 3 shows that most of the Hungarian participants live in a house built after 1980 (78%), which is much higher than the national average (32%). 65% of them have a house or apartment built between 1980 and 2000 and 13% of them live in a house built after 2000. Besides, the proportion of houses built before 1970 is lower, all in all 23%, of which 20% live in a house built between 1920 and 1980, and the remaining 3% have an old house built before 1920.

**Figure 3. Distribution of households by age of dwelling, ELL households (2018) and national average of Hungary (2011b)**
**Source: recruitment survey (n=41) and HCSO, 2011b**




There is an important dimension connected to the age of dwelling that is the decade when participants' building last underwent a major renovation (that influenced its energy consumption). However, the proportion of households that could not answer this question is high (41%). Still, based on the responses available, the proportion of ELL participants who had a major renovation after 2000 is more than 50%. There is only one person who had his/her home renovated between 1990 and 2000.

Last but not least, the data on the energy efficiency performance of ELL participants' buildings is very incomplete. 78% of participants were not aware of having an energy certificate. There were only 9 participants who were able to provide this information. Out of these, 3 households have A or A+ class homes, and 6 participants have homes that are between the B and C classes.

**Table 3. Characteristics of the participants' dwellings**
**Source: recruitment survey**

| **Type of dwelling (n=41)** | **Apartment** | **Terraced/semi-detached** | **Detached** | **Other** |
|---|---|---|---|---|
| **%** | 2 | 24 | 73 | 0 |
| | | | | |
| **Size of dwelling (n=39)** | **<=60 m$^2$** | **61-100 m$^2$** | **101-140 m$^2$** | **>140 m$^2$** |
| **%** | 10 | 18 | 44 | 28 |
| | | | | |
| **Age of dwelling, built (n=40)** | **before 1920** | **1920s-1970s** | **1980s-2000s** | **After 2000** |
| **%** | 3 | 20 | 65 | 13 |

Most of the Hungarian ELL households are served by a combined heating system and all of them have an individual system (mainly natural gas based). Generally people prefer to have complex heating systems in Hungary, i.e. systems that are built up of various components, preferably run on different fuels. Thus, a large share of participating households also has additional wood heating because it provides independence from the international and national energy grid (i.e.: electricity, gas, oil).

Based on 2011 data, the proportion of dwellings with central heating system was 16% in Gödöllő, which was a little higher than the national average (15.5%). (Local Agenda 21 of Gödöllő, 2013; HCSO, 2011c)
Central heating can be divided into two main types in Hungary: central heating from a community heating centre and central heating from an installation in the building or in the dwelling.

As for the primary heating source (Table 4), gas heating is the most typical for Hungarian ELL households (78%), which reflects well the share of dwellings with a gas heating system in Gödöllő (84%). (Local Agenda 21 of Gödöllő, 2013) The second most popular is biomass heating (15%), and there were two participants (5%) with fully electronic technology (solar panels) too.
In the case of secondary heating systems, the picture is different and more diverse. Among secondary heating sources wood and gas heating are the dominant (with 10 and 9% share, respectively). They are followed by electricity – mixed source – (6%) and last but not least some households also have solar collectors (3%).

In relation to wood heating as a secondary heating source, it is interesting to mention that wood- burning tile stoves constitute one of the traditional heating methods, and are still fairly popular all over the country. It came up during interviews with ELL1 participants and at the focus group discussion with ELL2 participants that many of them still have very fond memories or positive experience about having a tile stove in their childhood, and, in fact, now in their homes. The role of the tile stove or similar stoves (see picture from the home of one of the participants) became emphasized as a result of the heating challenge as well in relation to which several participants mentioned that they would be fine with lower indoor temperatures if there was one warmer spot, i.e. a stove in their home.

**Table 4. Heating sources of ELL participants**
**Source: recruitment survey (n=41)**

| | Primary heating source, % | Secondary heating source, % |
|---|---|---|
| **Gas** | 78 | 9 |
| **Oil** | 0 | 0 |
| **Coal** | 0 | 1 |
| **Electricity – solar panel** | 5 | 0 |
| **Electricity – mixed system** | 0 | 6 |
| **Biomass** | 15 | 10 |
| **Solar collectors** | 0 | 3 |
| **Heat pump** | 0 | 0 |
| **District heat** | 0 | 0 |
| **Other/don't know** | 2 | 0 |

As for laundry (Table 5), there were several different criteria applied at recruitment. One of them was that in order to participate, households had to have their own washing machine. Thus, all of the participants own a washing machine, but some of them (10%) also use a shared washing machine (shared with another household) on a regular basis (more than twice per month). During the socialist regime, and when hand-washing was still the most widespread way to launder clothes, the use of common laundry rooms in housing estates was typical in Hungary. However, with washing machines becoming more available, nowadays this option almost disappeared from the social norms. Shops with several washing machines that can be used by anyone are pretty rare and rather expensive, and there are only a few even in the capital, Budapest.

73% of the ELL households have a washing machine that has an eco-programme; however, interviews and focus group discussions revealed that people are confused about the eco-programme (there was confusion in general about the eco programme: why is it eco? how is it eco?). As a consequence, most of the people were happy to have the opportunity to test their eco-button during the challenge with the energy meter.

In terms of the equipments, 29% of the households have the most energy efficient washing machine (A++ rated machines) and 15% of them have a tumble dryer or drying cabinet. There were no participants who use a shared tumbler-dryer or drying cabinet on a regular basis (more than twice per month).

**Table 5. Laundry equipment owned or used by the households**
**Source: recruitment survey (n=41) and baseline survey[1] (n=41)**

| | Households with this equipment, feature or service, % |
|---|---|
| **Tumble dryer or drying cabinet (n=41)** | 15 |
| **A++ rated washing machine (n=41)** | 29 |
| **Washing machine with eco-programme(n=41)** | 73 |
| **Regular use of laundry room (n=41)** | 10 |

[1] Data on AA+ rated washing machine and washing machine with eco-programme are from the baseline survey.

## 1.4 TOOLS AND APPROACHES USED FOR ELL1 AND ELL2 OUTREACH AND COMMUNICATION

In Hungary GDI made a special effort to implement ELL1 and ELL2 in as similar a way as possible except for using the individual or the group approach. Thus, all the materials distributed and the communication methods used were the same:

- participants were recruited using the same approach and materials;
- participants received the same newsletters (GDI created a newsletter for ELL participants);
- the same person conducted the first visit to all ELL1 and ELL2 households to ensure that they all receive the same welcome to and information about the project;
- they all received exactly the same challenge kits, tips, etc.;
- as shown in Figure 4 they all had the same laundry and heating challenge periods;
- etc.

Within this framework, there were some methods and actions that were different depending on whether the participant was involved in ELL1 or ELL2. Apart from conducting the deliberation and closing phases differently, i.e. participants having individual interviews in their homes in ELL1 and participants gathering in a community venue to take part in a focus group discussion in ELL2, in Hungary the following activities were undertaken to emphasize and strengthen the group approach:

- an additional group meeting was held halfway through the living lab active period (see Figure 4) to provide an opportunity to meet and discuss experience, and also for GDI to facilitate group development processes;
- a social media (Facebook) group was set up to allow for more exchange of information and experience.

Based on feedback from participants, the halfway meeting was really useful and provided additional motivation for people to stay involved as well as to try out some extra ideas that they heard from their peers.

**Figure 4. The timeline and activities of the ELLs in Hungary**

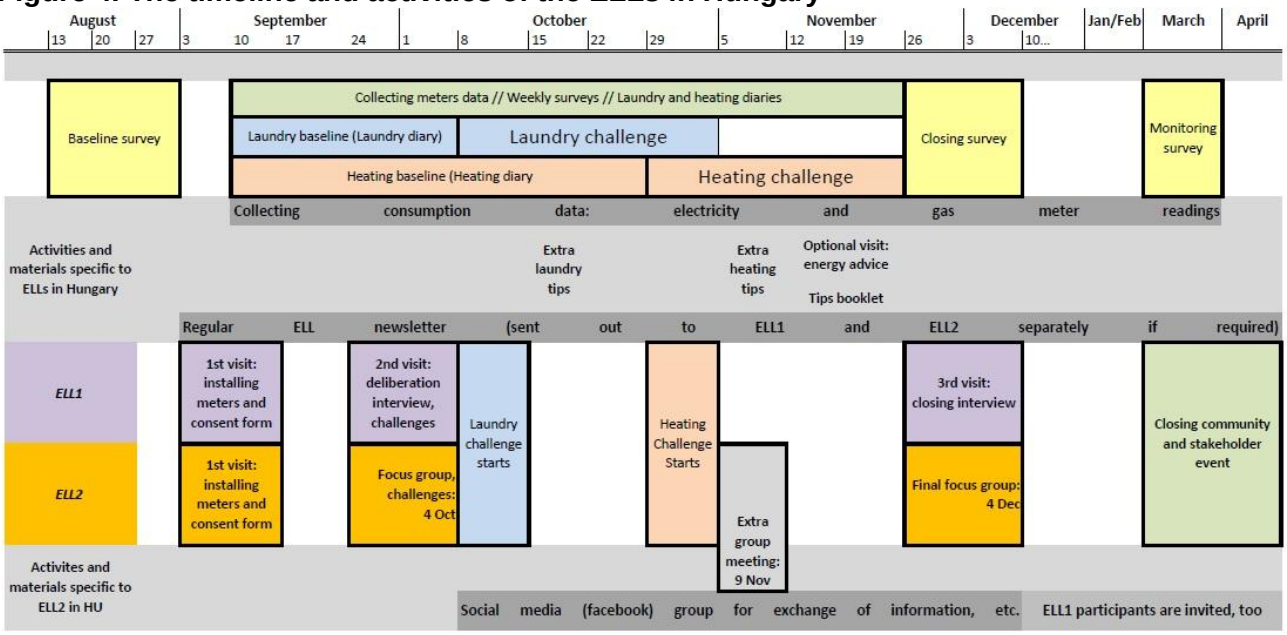



Figure 4 also highlights the activities and materials that were specific to ELLs in Hungary (see lines with grey colouring). For example, GDI created a newsletter for ELL participants to use as a means of communication. A newsletter format was selected in order to allow for creating a specific design to strengthen identification with the project. The newsletter was then used to provide all kinds of

information to households: reminders about challenge dates, invitation to events, provision of extra materials, useful information about participation, etc. Thus, the newsletter was used to provide extra laundry and heating tips to all participating households halfway through each challenge to ensure that each household could find some new information and thus have an opportunity to learn.

Households were also offered the chance to sign up to energy advice visits in the framework of which they could receive household-specific behaviour and practice change based saving tips. To facilitate these meetings, GDI also prepared household energy saving tips booklets that provided tips for all household areas, not only laundry and heating (e.g. lighting, cooking, maintenance and settings, mobility, involving household members in energy saving, etc.).

Finally, as part of the weekly surveys, once every month ELL participants in Hungary were asked to provide their meter readings in order to facilitate the calculation of energy saving.

As stated above, all households were visited by the same representative of GDI at the beginning of the project when consent forms were signed, meters were installed and diaries distributed. The 'welcome pack' - packed in to an ELL bag as shown in the picture - distributed to all households included the following items:


- Information about data collection and metering: consent form;
- Guidelines for using the meters;
- Meters (thermologger, thermometers, energy meters);
- Various diaries;
- Printed copy of ELL timeline with tasks, interviews, meetings, etc. Separate one for ELL1 and ELL2 participants;
- Fridge magnets (3) to help display the diaries as well as facilitate identification with the project/living lab.

As evidenced by information collected at closing/exit interviews and focus group meetings, households found the metering equipment and diaries really useful for becoming more aware and conscious of their daily practices, the temperature in their homes as well as the energy use of various programmes on their washing machine and driers. Participants also commented that following their consumption with the help of energy meters and writing the diaries helped them get a bit away from their comfortable life.
While 75-80% of participants found the diaries were really useful, about 20-25% said that they were a burden, especially that they also needed to report the same data in weekly surveys.

Laundry and heating challenge kits (see Table 6 and Figure 5) were received with great enthusiasm both at the end of deliberation interviews and at the focus group meeting. Participants were really excited about opening them, and then found the contents very useful (see Table 6 for the contents of the kits). From the laundry kits the most liked item, the absolute favourite was the stain remover with orange oil[2], and then the other stain remover. The apron and the brush were also mentioned. And some people remarked that they were just about to get a hanger like the one GDI provided. Participants also mentioned that it was good to receive good quality items.
As for the heating challenge kit, the most favourite items were the woollen socks, the hot chocolate and the ENERGISE mugs. People liked the yahtzee as well, which one of the participants started using in teaching.

Apart from helping participants to think about alternative ways of doing laundry and heating themselves (rather than the whole space), challenge kits were also useful for increasing

[2] Please note that participants received 2 different kinds of stain removers in Hungary.

identification with the ENERGISE ELLs and motivate participants to persevere in their efforts. In addition, because of the timing of the ELLs, the content of the challenge kits provided ideas for Christmas presents.

**Table 6. The contents of laundry and heating challenge kits in Hungary**

| Laundry challenge kit | Heating challenge kit |
|---|---|
| • Instructions and tips flyer<br>• Stain remover: orange oil<br>• Stain remover: designed for spot cleaning<br>• Apron (with project / living lab logo)<br>• Brush<br>• Clothes hanger | • Instructions and tips flyer<br>• Board game: yahtzee<br>• Hot chocolate<br>• Coffee<br>• Fruit/herbal tea<br>• 2 ENERGISE ELL mugs<br>• 1 pair of warm (woollen) socks |

**Figure 5. Laundry and heating challenge kits**

- Laundry challenge kit (without and with the apron and info sheet):


- Heating challenge kit (in and out of the challenge box):

# 2. PRACTICES BEFORE THE CHALLENGE (FROM THE DELIBERATION PHASE)

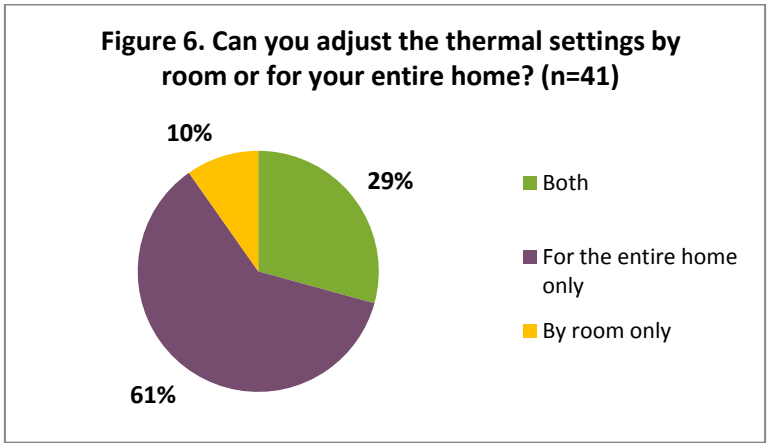
This section examines the practices existing in the households before the challenges. It is based on a survey (baseline survey) sent to all participants and on qualitative individual interviews (ELL1) or focus group discussions (ELL2) conducted before the start of the challenges. These datasets are complemented, where relevant, with observations made during home visits when metering equipment was installed and diaries distributed. In the following, we first discuss practices related to thermal comfort, and then, practices surrounding laundry patterns in the participating Hungarian ELL households.

## 2.1 PRACTICES RELATED TO THERMAL COMFORT

Home heating is often viewed as a gendered practice, where control of home heating systems is often ascribed as a male activity (e.g. Offenberger and Nentwich, 2013). Among the Hungarian ELL participants, however, the difference in who looks after temperature settings is not as large as one might expect. In households where both a male and a female adult were present, **the male household member looked after the temperature settings in 61% of the cases**. If we analyse the data for all households, we find that this number drops down to 52%, i.e. the male household member is responsible for setting the heating system in a bit more than half of the homes.

Home heating practices are different in different countries, and also depend on the heating system, for example, whether it can be easily adjusted. As shown in Figure 6, only about a third of the participants in Hungary are able to adjust the temperature for both their entire home and in their rooms. 10% of them can only adjust the temperature in the rooms, which usually means that they heat their homes with natural gas and have gas convectors in the rooms.

**Figure 6. ELL participants' ability to regulate temperature in their homes**
**Source: baseline survey (n=41)**




Furthermore, on the one hand, as it was mentioned above in Chapter 1, many participants have complex and complicated heating systems. At the focus group meeting and during interviews several participants mentioned a learning process related to their heating system, especially when moving to a new home or renovating a home and installing a new heating system. This means that they need to learn to use it and also need to learn how to set the heating system so that they have the thermal comfort they wish to have. On the other hand, participants did not seem to be particularly worried about adjusting the temperature or that is it too difficult to do. Some of them seemed to be highly proficient and explained the programming of the thermostat in detail.

Furthermore, it is worth mentioning that quite a few participants reflected on the freedom their individual and individually adjustable heating system gives them.

Reflecting a broader Hungarian culture where in recent years there has been a considerable move towards heating systems that could be adjusted individually even in apartment blocks, many Hungarian ELL participant households turn down their heating when they are not at home (59%), for the night (54%) or in unused rooms (41%) (Table 7). Based on the individual interviews and focus group discussion it needs to be noted that on weekdays several households like to have warmer temperature in the morning when people get up and in the evening when everyone is at home.

**Table 7. Frequency of various heating-related practices among the ELL participants in winter-time before participating in the ENERGISE challenges**
**Source: baseline survey (n=41, more responses were possible by each household)**

| | **Share of households, %** |
|---|---|
| **Turn down heating for the night** | 54 |
| **Turn down heating when not at home** | 59 |
| **Turn down heating in unused rooms** | 41 |
| **Has program to automatically turn down heating at certain times** | 39 |
| **Air rooms for more than a few minutes per day** | 7 |
| **Turn down heating when airing rooms** | 27 |

Further to the above, as revealed by the individual interviews and focus group discussions, **there are big differences in how people regulate their indoor temperature**. Some of the most typical approaches and methods that were mentioned are the following:

- some people programme their thermostats very carefully, and program it based on their daily routines, and have different temperatures for when they are at home and when they are not, for the night, for when they are away, etc.;
- others do not programme the thermostat so much, they set it to a certain temperature (e.g. 21 °C), and then have it there all the time and do the fine tuning by setting the thermostatic valves on their radiators in the different rooms;
- still others program their thermostats for a day and for a night temperature, and then do not worry about changing it more;
- finally, in some households the way of setting temperatures is through using a portable thermostat and placing it in the room that they wish to use as the base (e.g. the room of the youngest kid or the coldest room), and do the rest of the temperature adjustment by manually changing the temperature through the thermostatic valves on radiators.

As revealed by Table 7, the **airing of rooms** by keeping windows open for longer than a few minutes is not very common among Hungarian ELL participants, and a little less than the third of participants (27%) turn down heating while airing.
Interviews and focus group discussions revealed that people air rooms quite differently. First of all, some people air rooms regularly, opening all windows wide for a short time. Then, others air irregularly, whenever they feel like their home needs to be aired. Still others are more careful about opening windows as they keep indoor plants there and do not want them to die as a result of too much cold air. Finally, some participants do not really air their homes as they have an automatic ventilation system.

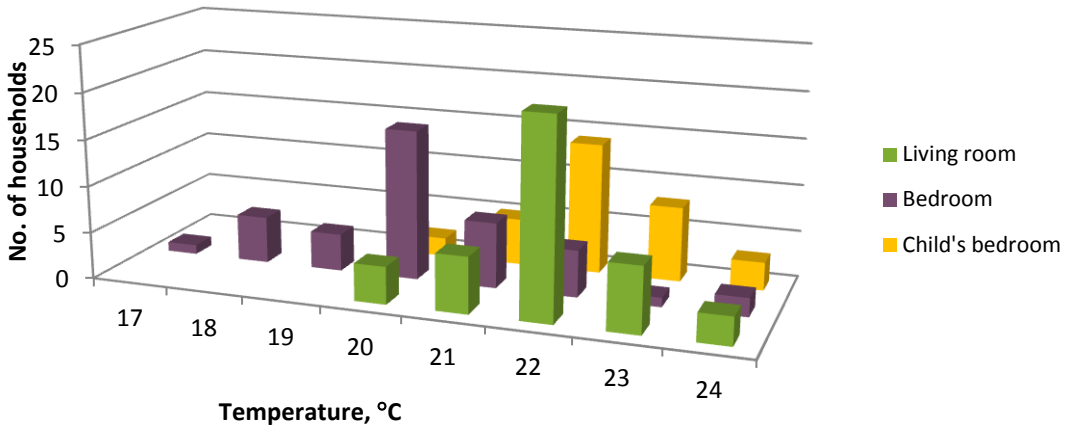
Hungarian ELL participants' perceptions of **desirable winter-time indoor temperatures** are shown in Table 8, showing that people on average prefer about 22°C in the living area, 20°C in the

bedroom and 22°C in the child's bedroom (Table 8), albeit with quite some variation as illustrated by the distribution of preferred temperatures for various rooms in Figure 7.

**Table 8. ELL participants' perceptions of desirable temperatures in the winter during daytime before taking part in the ENERGISE challenges**
**Source: baseline survey (n=41)**

| | Average all | Lowest | Highest |
|---|---|---|---|
| **Living area, °C** | 22.0 | 20.0 | 24.0 |
| **Bedroom, °C** | 20.3 | 17.0 | 24.0 |
| **Child's bedroom, °C** | 22.2 | 20.0 | 25.0 |

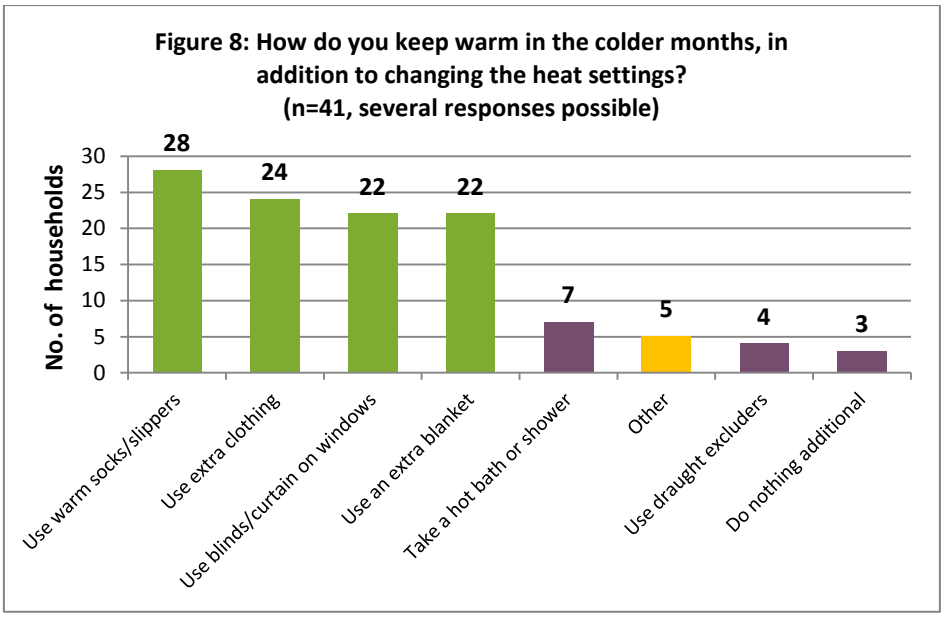
**Figure 7. What do you consider a good indoor temperature in the living area/bedroom/child's bedroom in winter during daytime? (n=41)**



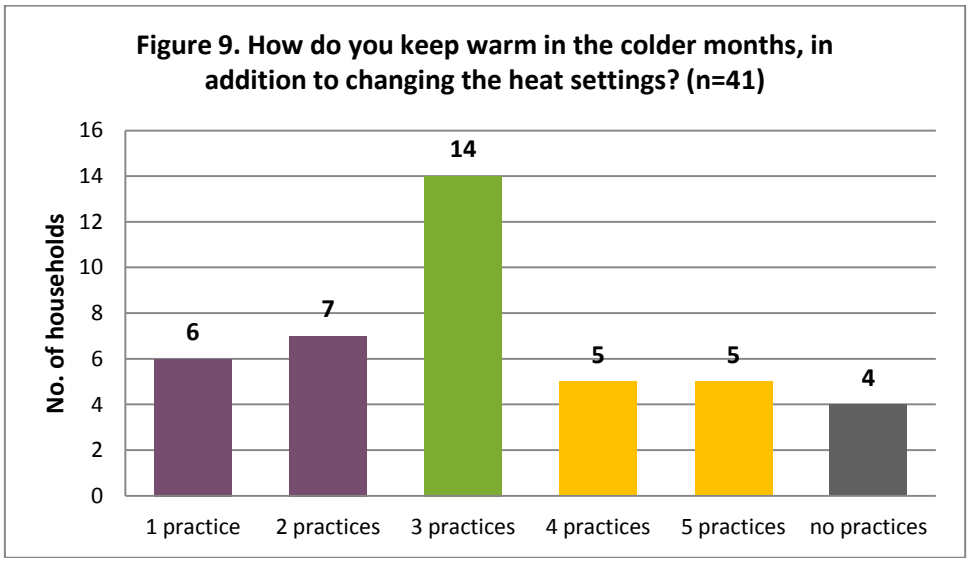

Participants were rather satisfied with their current indoor living-room temperatures, which may or may not be the same as the ideal temperature stated by them: about 83% felt their indoor living-room temperatures were just right, while the rest felt the temperature to be too cold. Nobody reported feeling too hot in their current living-room temperature.
About 70% also felt that other household members had the same view on the indoor living-room temperature as the respondent did. Open-ended comments suggested that spouses or children - either female or male - might feel colder than the respondents did.

Based on responses given to the baseline survey (Figure 8), ELL participants in Hungary had several ways to keep warm without turning up the heating, even before the start of the heating challenge. The most common ways were using warm socks or slippers (68%), using extra clothing (58.5%), using extra blankets as well as blinds or curtains on windows (both 54%). In addition to these methods during individual interviews (ELL1) and focus group discussions (ELL2) participants also mentioned several other ways of keeping warm:

- baking a cake or cooking more dishes;
- making sure that the humidity level is appropriate (in winter it is often too low and then we experience the same temperature to be cooler);
- arranging and planning the home so that they can use the passive heat from the sun;
- using more rugs/carpets in winter;
- doing exercises when they are cold (e.g. while watching TV);
- sleeping by the tile stove in the living room (and not in their bedroom);
- etc.




In addition to getting information on which methods households use to keep warm, it was also interesting to see whether they use several of these methods simultaneously already before taking part in the challenges. Our analysis revealed that there are 14 households (34%) that use 3 practices simultaneously, and 24% of households use 4 or 5 practices (Figure 9).
At the same time, it is interesting to note that even though we did not include them in this calculation and figure, several households mentioned using an extra, secondary heating source (most often a wood-burning tile stove in addition to gas heating) as a practice to keep warm without turning the temperature up. Thus, it appears that there is some confusion in people's minds about what constitutes as keeping warm with or without using energy.




As for social norms around indoor comfort, at the focus group meeting with ELL2 participants there was also a lot of discussion about the changing of heating infrastructure, and how people were more often cold when they were kids as a result of not having heating in all their rooms or a central heating system. They also mentioned that kids should never have to feel cold.
Furthermore, it was discussed that in the past people did not have good insulation, good quality windows and doors, so they needed to start heating their homes earlier than now. As a result of

insufficient insulation, etc., it was also more difficult to heat homes, and generally there was a lower level of thermal comfort.

At the meeting it was also discussed that it is the changing of the main heating fuel that usually results in the changing of heating infrastructure and brings about a change in heating practices. This usually needs to be accompanied by a lot of learning. A similar process happens when people renovate their heating systems or move into a new home that has a heating system different from the one they used to have.

Relating specifically to Hungarian circumstances, participants brought up the heating system during communist times in housing blocks. These housing blocks had district heating that could not be regulated. The only way to regulate temperature was to open windows, and as a result energy was wasted, and people started wearing T-shirts and shorts indoors in winter. This is generally considered wasteful now and there are several jokes and sayings about "heating the street".

It also needs to be mentioned that ELL participants have contradictory opinions about the traditional tile stove. On the one hand, many of them love them and believe that tile stoves are great to have; they are efficient and provide a special, warm and friendly atmosphere in the home. They also believe that the heat provided by these stoves is different, somehow better in quality from the heat provided by modern heating devices. On the other hand, they admit that it is difficult to regulate the temperature of the heat provided by the stove, and it is also less comfortable to use the tile stove as the main source of heating as bringing in the wood, cleaning the stove, etc. can be work intensive and also create dirt. Thus, quite a few households among ELL participants use a tile stove as a secondary source of heating (see also Chapter 1.3).
Participants in both the interviews (ELL1) and focus group meetings (ELL2) also discussed underfloor heating. It is mostly associated with modern, clean and very comfortable heating. For some people it is also something like a dream to have underfloor heating and not have cold feet in winter. At the same time, participants also discussed its disadvantages, potential health hazards, and great material needs when creating the system, etc.

## 2.2 PRACTICES RELATED TO LAUNDRY

Generally women are more responsible for the laundry, based on responses given to the baseline survey in 95% of ELL households. However, during interviews and focus group discussions we discovered that in several households members of the household share the tasks, e.g. the wife puts in the washing, but the husband and/or the kids hang out the wet clothes and/or fold the clothes and put them away.
In other households the wife and husband have an agreement about sharing household chores, according to which the wife does the laundry, but the husband does the cleaning (e.g. vacuuming, etc.). Even though the husband does not take part in the laundry tasks, he does take part in other chores.
Other male participants remarked that even though they cannot help with the laundry during the week, they help at the weekend (even if it is their wife who generally does the laundry).

In terms of why participants decide to wash a piece of clothing, the most often selected reason in the survey was the length of wear (51%), although stains (27%) or smell (22%) were also important criteria among Hungarian households.

All in all, the number of weekly laundry cycles washed by ELL households varied between 1 and 10, with an average of 4 cycles per week, depending mainly on the number of household members (Table 9). Generally, very few people (only 15% of ELL households) have driers, and used for almost every laundry or rarely dryer/drying cabinet. Some even express that driers are not useful, they use a lot of energy and it's possible to dry clothes very well without driers. Ironing is more popular than drying, 51% of households regularly used to iron. Some people mentioned that

ironing is a good technique to avoid washing clothes. There are also some - but they are definitely in minority - who like driers and think they are useful. They also help with putting clothes away faster. And there was some discussion on when it is useful to have a dryer (e.g. in very small or humid homes) or how much energy they may use. At this point some participants also remarked that it will be interesting to measure how much energy driers use.

Hanging out wet clothes to dry in the garden or the terrace (but still in the fresh air) is a practice several participants do and have always done. They often vary this in the following way: dry outside when the weather is warm enough (i.e. from spring to autumn) and then dry inside using a clothes horse in winter.
Participants also mentioned that drying clothes inside in winter helps them regulate the humidity inside (homes are often too dry) and the nice smell of clothes gives a nice smell to the whole house.

**Table 9. Laundry practices in different types of households before participating in the ENERGISE challenges**
**Source: baseline survey (n=41)**

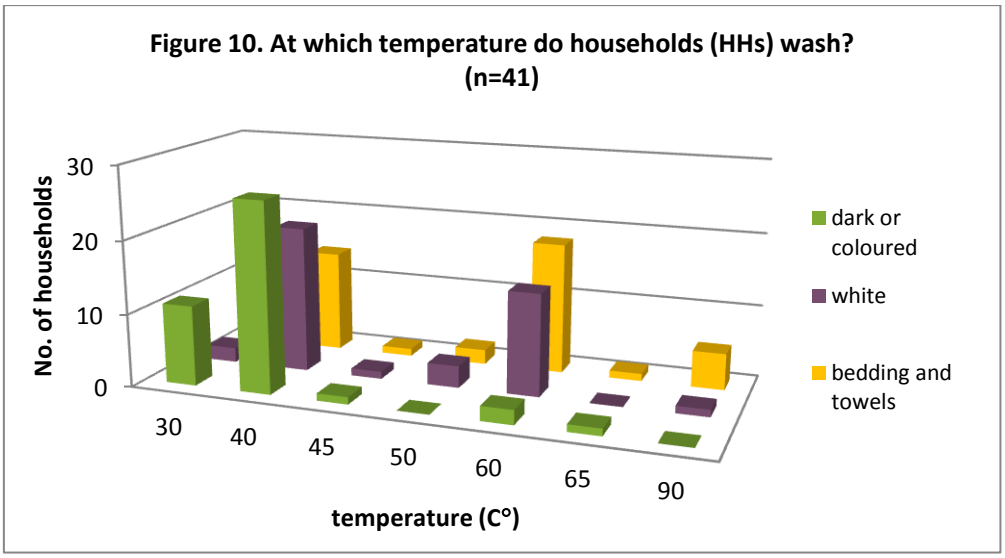
| | Number of household members | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4+** |
| **Average laundry cycles/week** | 2.3 | 3.1 | 4.3 | 5.3 |
| **Share using clothes dryer regularly,%** | 0 | 13 | 0 | 13 |
| **Share ironing regularly, %** | 25 | 75 | 50 | 48 |

Some participants like to select and wash colours separately and for this reason have half loads as there is not enough laundry to always have full loads with different coloured clothes. Others like to have full loads and for this reasons wash colours together more. These people often use a colour catcher cloth.
Almost everyone changes their underclothes every day, and outer wear and shirts less often unless demanded by their job (e.g. in bank, as a doctor, etc.).

Households in most cases washed their dark and white clothing at 40°C and bed linen at 60°C (Table 10). However, there is a big difference between the lowest and highest values, and washing temperatures are spread on a wide scale (Figure 10). It is important to note that almost all households usually wash bedding not every 2 weeks, but rather every 3-4 weeks.
The share of frequency of cold washes (30° or lower) is the following: 29% of households wash at cold temperatures regularly, 22% of them rarely, and the most frequent option was sometimes (34%). 15% of participants never wash at cold temperatures.

**Table 10. Washing temperatures among the ELL participants before participating in the ENERGISE challenges**
**Source: baseline survey (n=41)**

| | **Mode** | **Mean** | **Lowest** | **Highest** |
|---|---|---|---|---|
| **White clothing, °C** | 40 | 48 | 30 | 90 |
| **Dark clothing, °C** | 40 | 38 | 30 | 65 |
| **Bed linen, °C** | 60 | 55 | 40 | 90 |

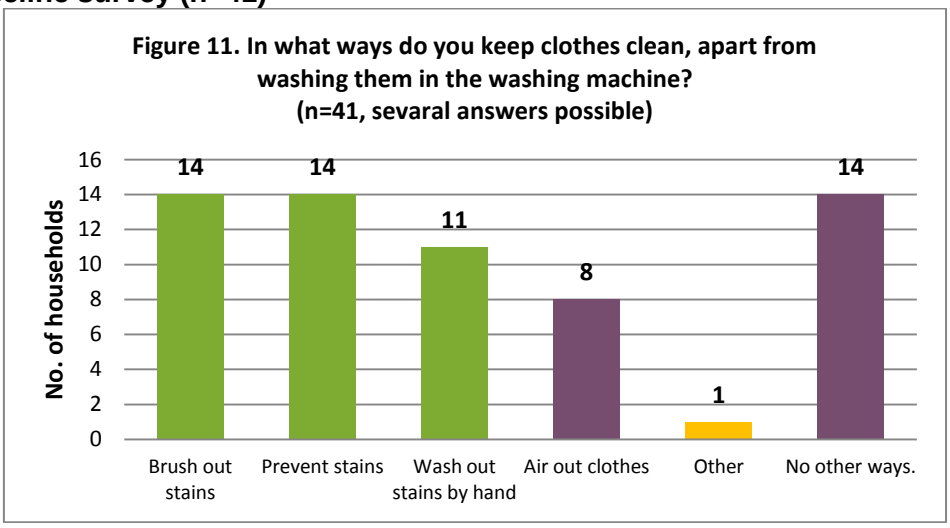



Participants have very different habits concerning the choice of programmes used: some use 2 or 3 programmes all the time, some experiment with programmes, others study the manual when they buy the machine and decide then which programmes to use.

Many people mentioned that they have an eco programme (73%) on their washing machine, several, that they do not (10%), and several that they do not know if they have it or not (17%). Some people also said that it is not them that select the eco programme but the machine itself, automatically. 44% of those who have an eco-program used that almost always and 31% of the households used this option sometimes or rarely.
Before the laundry challenge, at interviews and focus group discussions, people also remarked that the programme could also be considered eco when it is short or run at a low temperature. Other people mentioned that the eco programme is not really eco in their view as it takes a long time.

Participants already apply several methods to keep clothes clean apart from washing them. Although 32% of the households did not use any methods at the beginning of the challenge, most of the households used even more methods. The most popular methods were to prevent stains (e.g. by wearing an apron) and brush out stains (34-34%). Removing stains by hand-washing was also mentioned often (27%) and 20% of households applied the method of airing out clothes.

**Figure 11. Methods to keep clothes clean apart from washing them in the washing machine**
**Source: Baseline survey (n=41)**

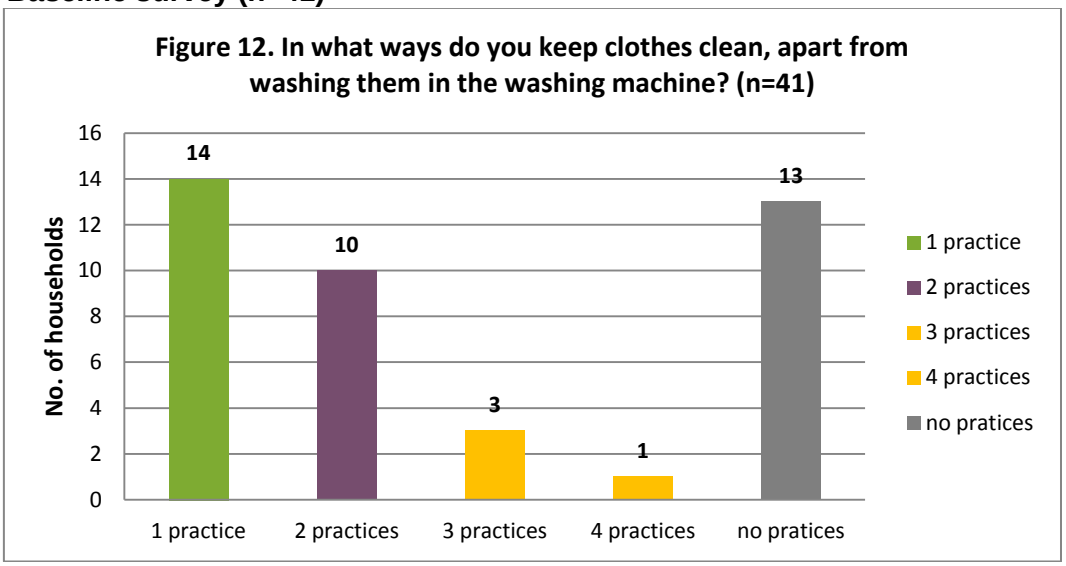


During interviews and focus group discussion, participants mentioned some other ways of avoiding washing their clothes that they apply:

- changing into different clothes ('play clothes') after arriving home from work and school;
- wearing different clothes for different tasks (e.g. having different clothes for gardening or mending the car, and then wearing it more often, even if they are a little dirty as these are generally dirtier tasks);
- wearing clothes again, but not immediately on the following day (it is important that colleagues see that we change our clothes regularly);
- already buying clothes that need less washing and/or are easy or easier to wash (e.g. buying coloured clothes for kids instead of whites to make it easier to keep them clean);
- clothes that are not very dirty just need to be refreshed are only put through a rinse programme;
- drying towels in a proper place (i.e. after taking a bath/shower) in order to avoid having to wash them often.

Just like in the case of heating, it was also interesting to see whether participants used more of these methods in parallel (Figure 12). We found that 34% of the households used only one method, 24% used 2 methods, 7% used 3 methods and 2% used 4 methods from these. In addition, quite a few participants did not use any methods for avoiding washing before the ELLs started.

**Figure 12. Methods by keep clothes clean apart from washing them in the washing machine Source: Baseline survey (n=41)**




Almost all households have their washing machine in the bathroom or have a separate laundry room in the house. Before the spread of modern washing there were washing machines without a built-in spin-dryer, so many households had in fact two machines, a washing machine and a spin-dryer too as participants remembered during interviews and the focus group discussion.

Furthermore, some participants mentioned that before the availability of throw-away-nappies (or with small kids and the conscious decision to not to use throw-away-nappies), people had to wash more as nappies needed to be washed regularly.

Based on the interviews and focus group discussions, there is a conclusion that households with small kids or small pets (dogs or cats) had relatively more laundry cycles per capita than others. In most cases hand washing and removing stains were also more typical in these households compared to those without kids or pets.

In terms of washing by hand, while 20% of the households did not wash by hand at all, most of the households regularly do it, mainly to remove stains and/or to wash delicate items.

As for the energy class of the washing machine, 27-27% of households have A+ and A++ class machines, 10% of the participants have A class machine, there was only one household who have a C class machine. At the same time, 17% of participating households did not know the energy class of their own machine.

Use of laundry machine at a specific day/night to save energy is an existing option in Hungary, but among ELL households this was not a typical practice, nobody mentioned taking advantage of it.

As for social norms related to laundry, having 'sparkling white clothes' is an expectation for some households, one of the Hungarian participants mentioned about the relevant visual used at the interviews and focus group discussion:

> "*This is the basic requirement! Clothes should be bright and fresh!"*

At the same time, several households mentioned that it is not an expectation they have, e.g.:

> *"The fresh white shirt is nice but I have no expectation to keep the clothes so sparkling white."*

Furthermore, there were a lot of households with more children among ELL participants. Most of these households mentioned that because of the heavily stained clothes of the children it is a great challenge to have 'sparkling white' clothes, so most of these families do not care too much about it, e.g.:

> *"The t-shirt in the picture looks fresh, white, and bright. It's good to look at the picture."*

For some households it was more important to have a good smell of clothes instead of having them sparkling white. Most people really like the smell of clothes like from the sun and fresh air, and therefore dry them outside when the weather is warm enough.

Furthermore, in relation to the time-consuming nature of doing laundry, some people mentioned that doing the laundry itself does not take too much time (i.e.: putting clothes into the washing machine from the laundry basket), but hanging them out, folding, sorting and ironing clothes are really time-consuming.

Finally, it is interesting to note that in Hungary there is a routine for the seasonal change of clothing and cleaning, i.e. 'big autumn cleaning' by which we refer to the fact that households change their clothing from summer to winter and it is also the time for the seasonal washing of curtains, rugs, bedspreads, blankets, etc. This results in a higher number of washing cycles, and since this seasonal change of clothing coincided with the first weeks of the laundry challenge, it probably had an impact on the number of washes done by households.

# 3. PRACTICES DURING AND DIRECTLY AFTER THE CHALLENGES (FROM WEEKLY AND EXIT PHASE)

## 3.1 THE CHALLENGES

Chapter 3 describes the changes that occurred in the households participating in the ELLs during and directly after the two times four-week challenges, or altogether 7 weeks as the laundry and heating challenges overlapped for one week (see Figure 4). These challenges were to reduce indoor temperatures to 18°C, or if deemed impossible, determine an individual challenge, as well as to cut the number of laundry cycles by half, or if infeasible, determine an individual laundry challenge. Table 11 shows the share of households signing up to the common challenge, and provides examples of individually defined challenges. As there was an unexpected difference between ELL1 and ELL2 participants signing up for the common challenge, we also indicated the numbers by living lab.

**Table 11. Share of households signing up for common or/and individual challenges**
**Source: challenge cards filled in by participant at the end of the deliberation interviews (ELL1) and the deliberation focus group meeting (ELL2)**
**n=39 (ELL1=20, ELL2=19) as 2 participants did not fill in their challenge cards. Nevertheless, they participated in the challenge and attempted to reduce laundry cycle numbers and indoor temperature.**

| | **Common challenge,** Number and % households signing up | | **Individual challenge,** Number and % of households selecting an individual challenge | | **Examples of individual challenges in Hungary** |
|---|---|---|---|---|---|
| | Number, by ELL | % | Number, by ELL | % | |
| **Laundry challenge** | ELL1: 16 | 54 | ELL1: 4 | 46 | Washing at 30 °C throughout the challenge.<br>Reducing energy used for laundering in other ways (e.g. only full loads, reducing spinning speed, selecting clothes more carefully) |
| | ELL2: 5 | | ELL2: 14 | | |
| **Heating challenge** | ELL1: 8 | 33 | ELL1: 12 | 67 | Reducing temperature by 2 °C<br>Reducing the temperature for night from 24 to 20 °C<br>Reducing temperature to 20 °C |
| | ELL2: 5 | | ELL2: 14 | | |

As Table 11 shows, in the case of both the laundry and heating challenge more ELL1 participants took on the common challenge than ELL2 participants, especially in the case of the laundry challenge. To some extent this is contrary to our expectation in Hungary that the group setting in the case of ELL2 may provide extra pressure from the group to take on the challenge. However, the group setting had an effect to the contrary in this case as many participants expressed uncertainty about taking on the common challenge because their family members were not present and they were reluctant to undertake something that impacts them without their consent.
In the case of ELL1 it was often the case that some family members were present at the interview in addition to the main contact person, so challenges could sometimes be undertaken with some discussion between family members. This, however, was not always the case and then at times

challenges occurred in implementation because the partner of the interviewee did not agree with the challenge and thus did not support its implementation, as exemplified by the following quote from a female participant:

> *"I don't remember if I took on the 20 or the 21 challenge, but it was something like that. My husband got a shock and asked me how I dared taking this on, there is a small child here and she will get cold especially at bathing time. At the beginning we were paying attention, then the temperature started to go up… we managed to reduce it by 1-1.5 degrees compared to where we were before. But it was hard that my partner/husband wasn't a partner in this challenge."*

Secondly, in case of the individual interviews for ELL1 participants, the pressure on participants to agree to do the common challenge could have been stronger due to the presence of the interviewer.

As can be seen from Table 11, a higher percentage of ELL participants took on the common laundry challenge (54%) than the common heating challenge (33%). Part of the reason for this is the fact that the average daytime temperature in the living room is rather high (22 °C) compared to the 18 °C defined in the challenge. To reduce the temperature to 18 °C within 4 weeks is indeed a rather ambitious challenge, and few participants were ready to undertake it. There were several participants who commented on the shortness of the challenge period for the heating challenge at the closing/exit interviews and focus group discussion. The quote below from a male ELL2 participant with 3 young kids is a good illustration of this:

> *"We agreed to the common challenge, to reduce to 18 °C, which was quite a brave decision for us. So far, we haven't reached it, but we're not giving up, we'll get there by the end of January. At the moment we're at 19.5 - 20 °C, but there's still some potential. The challenge period was too short for us to reach 18 °C; we'd have needed more time to get there."*

At the deliberation focus group meeting, participants struggled with the laundry challenge, and there was also some discussion as to what could be a challenge if participants felt they could not take on the common challenge. The following quote exemplifies this struggle:

> *"I really don't know what kind of challenge to undertake. We have a lot of kids and thus wash a lot, every day, often several washes a day. I'm looking at my laundry diary and I can see that we usually wash at 40 °C, but the 30 °C washes use a lot less energy. So, perhaps we can try to wash at 30 °C instead of 40 °C. Because the detergents are quite efficient, so they'll probably work well at 30 °C as well." (female participant)*

Alternative challenge options were discussed, participants studied the baseline data in their individual laundry diaries that they all brought along to the meeting, and they also attempted to help one another with ideas, e.g.:

- you could reduce the washing temperature if you already have very few washes;
- you could sign up to only start full loads;
- you could sing up to use your drier less or only for certain types of laundry;
- you could undertake to use shorter cycles;
- you could reduce the laundry by a different amount, e.g. by 30% or 25%;
- you could undertake to do a lot of measurements and metering so you can later make better informed decisions;
- etc.

As mentioned above, the most important reason for struggling and being indecisive about the challenge was that several people felt they could not make a laundry decision without their wives

or other members of family. However, the fact that some of them have a lot of kids (in some cases as many as 5) or have young kids, also played a role as they were worried that they will not have enough clothes or clean enough clothes if they reduce their laundry cycle numbers too much.

Furthermore, while thinking about the challenges, participants also started discussing some other issues as well, e.g.

- what it means to have a full load (how full can it be and how to test it?);
- some more techniques to avoid washing clothes (e.g. specific ways of ironing and airing them);
- how they can soak clothes before washing and reduce the temperature and length of washing this way.

Most of the ELL2 participants also struggled with the heating challenge. While a few of them found it easy and were happy to undertake the common challenge, mostly because their daytime living room temperature was already around 18-19 °C, most of them thought quite a lot about what to do about the challenge and what exactly they could undertake to do, e.g.:

> *"Reduce to 20 °C? Well, that's quite something with such a small child! My kids are older but I'm still worried about undertaking it... Perhaps I can do 21 °C, OK, I'll do that!" (male participant)*
>
> *"It's 23 °C now, so if I sign up to reduce to 21 °C, my family won't like it... (Perhaps I'll end up with getting divorce papers or I'll get a visit from child protection...)" (male participant)*
>
> *"We have 20 °C at home, and no way am I reducing it further!" (female participant)*

The following short quotes are examples of alternative challenge ideas and associated questions and worries that came up:

- *"Could we reduce the temperature step by step, like by 0.5 - 1 °C a week?"*
- *"I can perhaps reduce by 2 °C from where we are now..."*
- *"I can perhaps start programming the thermostat and reduce to 20 or 18 °C for the night..."* [in a household where it is 24 °C all the time]
- *"I'll only reduce the temperature if my wife does not notice it... But as soon as she notices it, she'll turn it up, I'm sure."*
- *"I'm a bit worried that my family members will sneakily turn up the temperature..."*
- *"OK, I'll try the 18 °C; I've just bought an electric blanket anyway..."*
- *"I am a bit sceptical about reducing the temperature; doesn't it take more energy to heat the house up again?"*

The last but one bullet point indicates that when reducing the temperature rebound effects only need to be considered. Although it may be less energy intensive to use an electric blanket than heat the whole home, its energy consumption still needs to be considered and households still need to be made aware of it.

In the following, we first discuss the changes in heating practices, and then turn to discussing changes in laundry practices. The data for this section is derived from various data sources:

- a weekly survey sent to households;
- laundry and heating diaries kept by households;
- a concluding or closing survey sent directly after the end of the challenges to all households; as well as
- a closing interview (ELL1) or focus group discussion (ELL2).
- Moreover, indoor temperatures were monitored with a temperature logger and electricity use for laundry machines (washing machine and dryer, if used) with an energy meter.

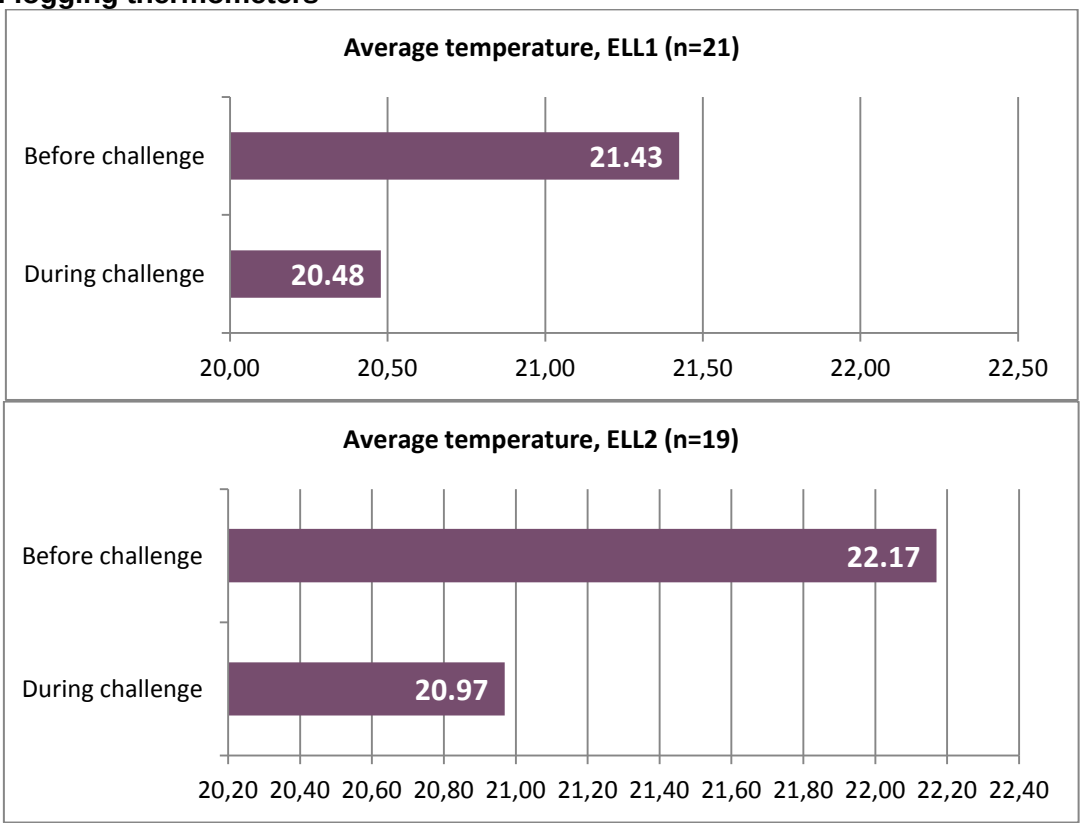
## 3.2 CHANGES IN HEATING PRACTICES

The heating challenge started on October 29th in the Hungarian ELL households. Figure 13 presents differences in indoor temperatures, based on temperature logger data from the participants' living rooms, during the baseline period (September 10 to October 29th) and during the challenge period (October 29th to November 25th). The changes are greater in ELL2 (-1.20 vs. -0.95 °C), but only by about 0.2 °C.
The average reduction for the entire sample of participants was 1.06 °C. While we are aware that in some cases, indoor temperatures might drop in response to changes in outdoor temperatures, in the Hungarian case at least a part of it is due to actions taken by our participants (see also Figure 27).

As for the common challenge of reducing the temperature to 18 °C, as shown in Table 11 only 13 participants undertook it. From among these participants 3 managed to fully meet the challenge, and a further 2 almost, based on data from thermologgers. Even though this challenge was not met, in 39 households out of the 41 the average indoor temperature decreased, and a lot of other changes occurred.

Before we discuss the changes in more detail, it is interesting to see whether the data from the temperature loggers corresponds to data collected by the participants themselves in their heating diaries and weekly surveys, both of which are based on weekly thermometer readings. All participants had exactly the same thermometers installed by GreenDependent at the beginning of the Living Labs. Table 12 shows the comparison data.

**Figure 13. Changes in indoor temperatures before and after the heating challenge (starting October 29th). The upper figure depicts ELL1 (n=21) and the lower one, ELL2 (n=19[3]).**
**Source: logging thermometers**




[3] Please note that although there were 20 participants throughout ELL2, one household had a faulty logging thermometer so no data could be downloaded from it.

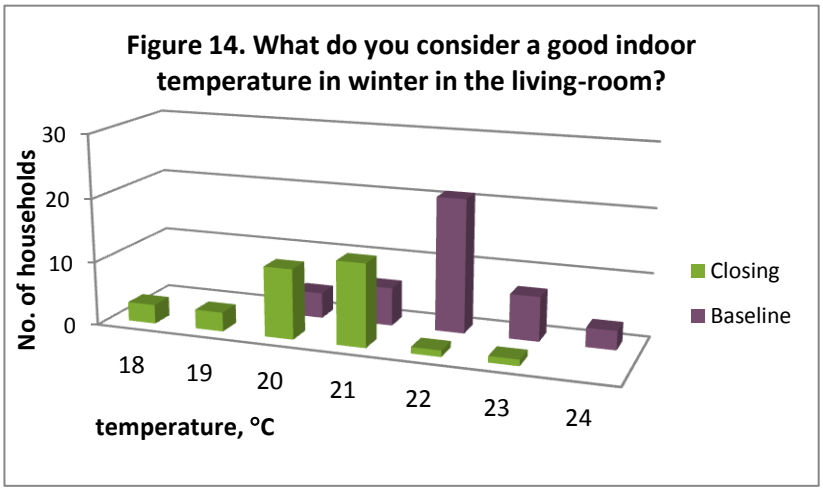
**Table 12. Comparison in the change of temperature between own estimation (based on baseline and closing survey), heating diary, weekly survey and temperature logger data**

| Average temperature in the living-room | Baseline/ Closing survey | Diary | Weekly survey | Thermologger |
|---|---|---|---|---|
| Before challenge | 21.94 | 21.79 | 21.38 | 21.79 |
| During challenge | 20.61 | 20.92 | 20.65 | 20.71 |

Table 12 also shows that our data gained from the different sources is comparable.

In relation to indoor temperature, it is also notable to recognize how the **expectation of what is the right or comfortable temperature** changed during the challenge. Figure 14 shows the distribution of this temperature based on baseline and closing survey data for the living-room. A move towards lower temperatures can be clearly seen, and temperatures not mentioned in the baseline survey like 18, 19 °C are now mentioned by several participants, while higher temperatures like 24 °C disappeared.

**Figure 14. What do you consider a good indoor temperature in the living area bedroom in winter during daytime?**
**Source: Baseline (n=41) and closing (n=41) survey**




Although only about a third of the ELL participants (33%) agreed to take on the common heating challenge, i.e. reduce daytime temperature in their living area to 18 °C, most of the participants were open to experimenting with cooler temperatures. In the interviews and focus group discussion several of them commented that they were surprised how well they could handle reduced temperatures, for example, as a female participant remarked:

*"It was a surprise for me to feel good at 19 degrees. I'm happy to have this experience."*

However, even though they were participants who felt happy at 18 or 19 °C in both ELL1 and ELL2; generally, reducing the indoor daytime temperature to 18 °C was considered too much by most participants. As shown in Figure 14 as well, 20 or 21 °C is considered the most acceptable indoor temperature at the end of the heating challenge or the living lab, which, from a sustainability point of view is an improvement on the 22-23 °C at the beginning of the challenge (see Chapter 2.1).

Several participants also remarked that they were fine with cooler temperatures but it helped them to have a warmer spot in the house where they could go to warm up. For example, this happened in several homes that had a central gas heating for which they set the thermostat lower, but they also have a wood-burning tile stove in the living room which gives off extra heat, but only at a specific place, usually the living-room, in the house. So, the family could gather there to warm up. This is illustrated well by a quote from a female participant:

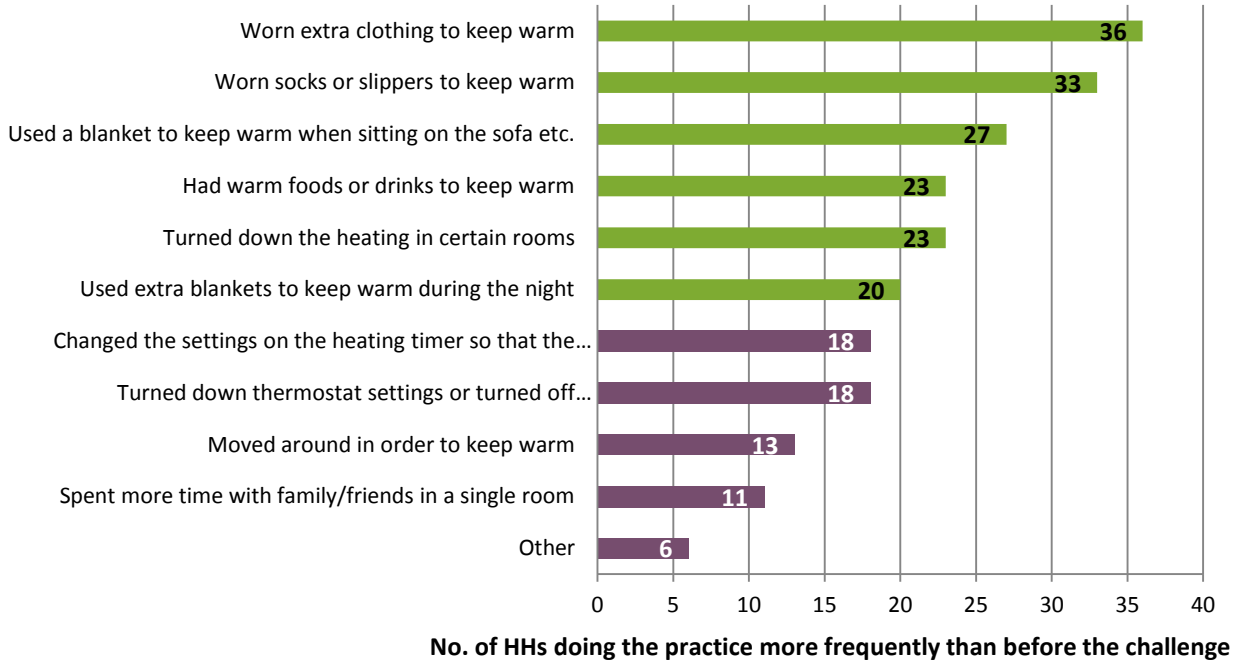
> *"I'm quite confident I've managed to do the common challenge. We have a tile stove and gas convectors for heating. People who visited us said that I must have lost my mind and that I will fall ill for sure and will need to pay a lot for medicine. But I reduced the temperature to 18 ℃ and I didn't get ill. I had to put on several layers. But I've done it! Now there's a kind of race with the cats to the tile stove, to see who gets there first and gets to sit in the warm spot. But reducing the temperature works well. We put on more clothes, 2 pairs of warm socks, drink tea, play games, exercise. All in all, we're into it, it works."*

All in all, even though participants were quite open to experimenting with staying warm at lower temperatures, there appeared to be more family disagreements about the heating challenge than the laundry. Mostly female members, but in some cases male members of households, and sometimes the kids, were unhappy about reducing the temperature. They did not like the fact that their partners and/or parents agreed to trying it.

In terms of **habits and routines** in Chapter 2.1 relying on baseline survey data and deliberation interviews and focus group discussion we observed that ELL participants already at that stage were aware of various methods to keep warm without turning up the heating. As a result of the challenge, they did start doing a lot of these things more frequently as illustrated in Figure 15.
Those actions that were done more frequently by at least half of all participating households are indicated in green in Figure 15. It can be seen that wearing extra clothing, wearing warm socks and slippers, and using a blanket to keep warm when sitting at one place are the actions that have been done more frequently by the highest number of households as compared to before the challenge. It is also notable to mention that none of the actions listed were done less frequently than before the challenge.

**Figure 15: The number of ELL households doing various sustainable heating practices at the end of the ELLs**
**Source: closing survey (n=41)**

**Figure 15. Have you or other members of your household done more or less of the following as a direct result of participating in the heating challenge? (n=41)**




In addition to the actions the ENERGISE consortium asked about in the closing survey, during individual interviews and focus group meetings participants mentioned other changes in their routines, or other everyday activities that they started doing differently. For example:

- some participants bought new warm pyjamas, having been inspired by the warm socks in the challenge kit;
- some people remarked that before the challenge they kept changing the settings of the thermostat, but they stopped doing it for the challenge;
- participants also liked the idea of drinking tea and hot chocolate; and
- inspired partly by the heating challenge kit (see Chapter 1.4) they also liked the idea of playing board games and being together in the same room this way.

There were also some people who reported that they did not really change their heating habits. Instead, they **became more conscious about the things they were doing anyway** to keep warm. This actually was quite a general conclusion in the group; a lot of participants mentioned it both in ELL1 and ELL2.

Participants also reported that they simply got used to being in cooler temperatures, and after a while they even started feeling too warm in it.

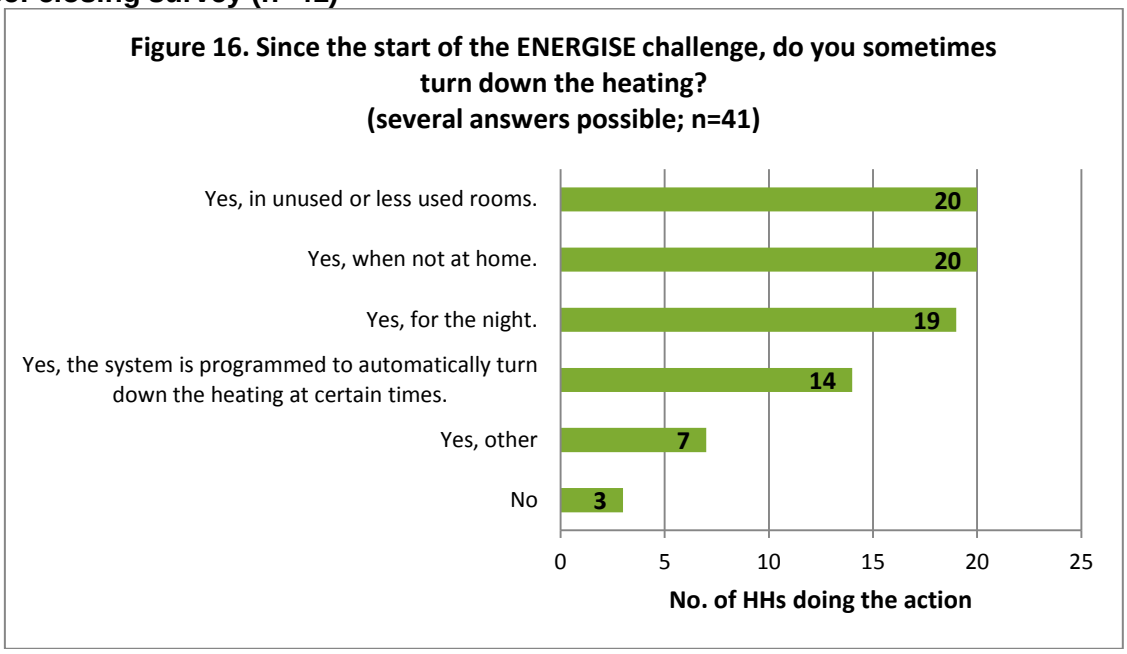
As for **skills and competencies**, at interviews and focus group discussions some participants mentioned that they learnt to feel the temperature in their homes, i.e. learnt to know by feel how warm or cold it was in their home. They also became more conscious about the temperature and how warm or cool each room was. Receiving the thermometer, which at the same time functioned as a humidity meter helped them a lot.
People reported learning about the link between experiencing temperature and the humidity level in their homes as well.

In relation to this, participants in general (but in different ways) **realized that thermal comfort depends on a lot of factors:** age, gender, activity, house characteristics, etc.

As a result of having thermometers in two or three places in their home - installed as part of the ENERGISE Living Lab during the first visit to households (see Chapter 1.) - a lot of participants also realized how warm their homes were, or that rooms that they had thought to be cold should not be cold based on measured temperature results, but perhaps due to some other factors (e.g. too much draught, uneven temperature in the room). There were a lot less participants who realized that their homes were cooler than expected as a result of having the thermometers.

As a result of the heating challenge, participants also reported having become more knowledgeable about their own heating system and how to regulate it better. In fact, as evidenced by responses given to the closing survey, they started turning down the heating more (Figure 16). However, it is important to note here as well that some participants, in this particular case 35% of them, already had their heating systems programmed in a way that the temperature is turned down automatically.

**Figure 16: The number of participating households turning down the heating in different situations at the end of the ELLs**
**Source: closing survey (n=41)**

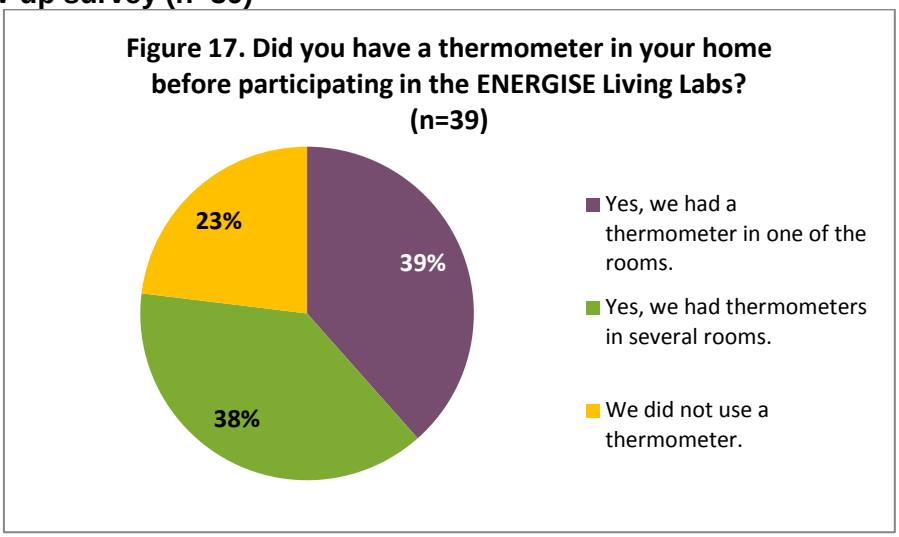



In terms of **material arrangements**, it is important to note again the importance of having a thermometer. In the follow-up survey conducted three months after the completion of the living labs, we asked participants whether they had a thermometer in their homes before joining the experiment[4]. As shown in Figure 17, around a quarter of participants did not have a thermometer prior to the ELLs. To some of these participants having the thermometer installed brought new information about their home as exemplified by the following quotes from an interview with a female participant:

> *"And it turned out that what is very warm in my place is 20 degrees in winter, so it is not so warm at all. This was a real revelation.*
> *[...]*
> *It turned out my flat is usually … 17-18 degrees warm in general, and I did not even know about it. You know, I did not know about it."*

[4] Please note that this question was only asked in Hungary.

**Figure 17. The ratio of ELL participant households who had a thermometer installed in their homes before joining the ELLs**
**Source: follow-up survey (n=39)**




As a result of recognizing the link between thermal comfort and the energy efficiency characteristics of their homes during the ELLs, and also because of already having such plans before joining the ELLs - partly even motivating them to join the ELLs, quite a lot of participating households reported that they:

- want to get a smart thermostat so that they can get better in regulating indoor temperature;
- have more concrete plans now for doing energy efficient retrofits on their homes (e.g. having good quality insulation);
- have become interested in alternative energy solutions (e.g. installing solar panels);
- wish to create a winter garden, etc. to utilize passive solar heat;
- wish to check how much it would cost them to renovate their tile stove so that they could have a generally lower temperature in their home but a warmer spot around the tile stove;
- want to build a fire place or tile stove; etc.

Participants realized that they could keep lower temperatures in their homes with these solutions, and at the same time have better thermal comfort.

Several people also said that the challenge helped them become more knowledgeable about their heating system and regulating temperature, and more conscious about their heating practices.
A participant mentioned that ever since they have moved to their current home they kept track of their meter readings, and during the challenge they noticed that their consumption went down. Partly it is probably because of the warmer better, but for sure not all of it.

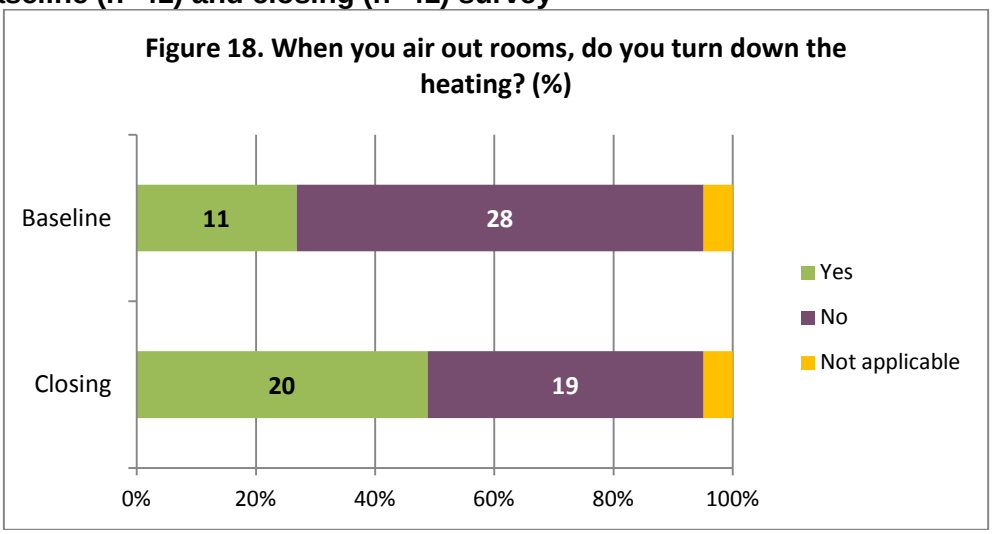
Some ELL participants also reported a change in how they air their rooms. They now open their windows for shorter periods of time and pay more attention to how long they leave their windows open for. Furthermore, they open the windows at a different time, when it is perhaps already warmer outside.
As shown by responses given to the closing survey, more participants turn down their heating when they air the rooms (Figure 18). This is especially important for people who heat their homes with gas convectors, as windows are often placed above the convector, so if the heating is not turned down, harmful emissions may enter the room when airing. A female participant with such a heating system realized this during the ELL:

> *"I always tried to turn it down when I change the air. Now that I talked to X [from GreenDependent, at the energy advice meeting], and I haven't realized this before, this is good also to do this [i.e. turn down the convector] because if you do not do this, then*

*the air with the emissions from the convector burning gas will come back through the window. I mean what goes out, comes back with the parapet convector, so this information was useful."*

In relation to windows it also needs to be mentioned that participants started using their blinds more consciously as well as conscientiously.

**Figure 18: The ratio of participants turning down their heating when airing their home at the beginning and end of the ELLs**
**Source: baseline (n=41) and closing (n=41) survey**




As for **social norms**, it appears that **the ENERGISE Living Lab functioned as confirmation of existing good practices**, or in other words, confirmation of existing sustainable good practices such as different ways of heating bodies instead of spaces. As mentioned above, many participants reported that although they feel they did not learn many new practices, they did receive confirmation that the practices they already had are good and it is worth carrying on with them, and even do more of them.
In addition, participants also changed their expectation of what was a comfortable indoor temperature (see Figure 14 above), and **learnt to feel comfortable at lower temperatures**.

At this point, the question may arise whether participants will carry on with their changed practices and sustain the new, more sustainable norms of keeping warm. While we analyze this further in Chapter 4 below, based on individual interviews and focus group discussion we can state that most participants would like to go on with what they started in the challenge, and are planning to continue with their new practices. Most of them also said that they will try to keep the temperature at a lower setting, like at the end of the challenge. However, for most of them this is at least 20 °C. There were only a few exceptions to this, participants who commented that they will increase their indoor temperature once the challenge finishes; however, not as high as it was before joining the Living Labs.

Furthermore, it is important to note that several participants commented both during individual interviews and focus group discussions that it would have been useful to have a longer heating challenge period, perhaps for the whole heating season. They thought they could get used to lower temperatures but would need a step-by-step adjustment process, i.e. to lower the temperature degree by degree or half degree by half degree over several weeks. And since they started from a rather high temperature (as compared to 18, see Figure 7 in Chapter 2.1), 4 weeks were not enough. The following quote from a male participant is a good illustration of this opinion:

*"We agreed to the common challenge, to reduce to 18 °C, which was quite a brave decision for us. So far, we haven't reached it, but we're not giving up, we'll get there by the end of January. At the moment we're at 19.5 - 20 °C, but there's still some potential. The challenge period was too short for us to reach 18 °C; we'd have needed more time to get there."*

## 3.3 CHANGES IN LAUNDRY PRACTICES

All in all, people reported learning a lot about their washing machines and consumption of their machines during the laundry challenge. They remarked that they realized what makes a difference in terms of how much energy is consumed by the washing machine, i.e. how important the temperature of washing, the speed of spin-drying, the length of the programme and using the eco button are.
People also reported realizing that they are not as environmentally friendly as they thought they were, e.g. they washed at too high temperatures and used more energy than necessary.

All participants were enthusiastic about the **challenge kits**. The most liked item, the absolute favourite was the stain remover with orange oil, and then the other stain remover. The apron and the brush were also mentioned. And some people remarked that they were just about to get a hanger like the one GDI provided.
According to interviews and focus groups experiences, quite a few people did not remember the challenge they set themselves (even though they had the challenge cards).

Most of the ELL participants did not manage to decrease their number of laundry cycles by half (nor had all agreed to this commitment, due to various personal circumstances, such as a little baby or the need to have clean clothes at work), but there were 7 households out of the 41 (17%) who managed to completely meet the challenge and a further 22% of participants mostly reduced laundry cycles to a great extent.
Based on the baseline and closing survey data the average **number of cycles** decreased by 27% during the challenge (Figure 19). Half of the households undertook the common laundry challenge, which meant that they attempted to reduce the number of laundry cycles by 50%, and a further 17% of ELL participants tried to reduce their cycles by 20-30%. The other 32% of households undertook a different kind of commitment (see above in Table 11).

It is also interesting to observe (see Figure 20) how the distribution of the number of laundry cycles changed during the challenge: there is a definite move towards doing less laundry cycles per week.

**Figure 19. Number of laundry cycles**
**Source: Baseline and closing survey (n=41)**

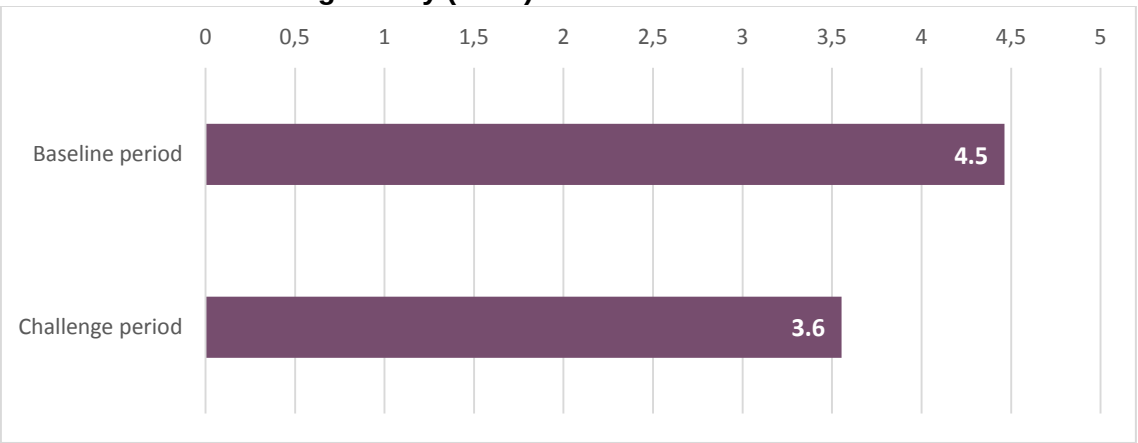
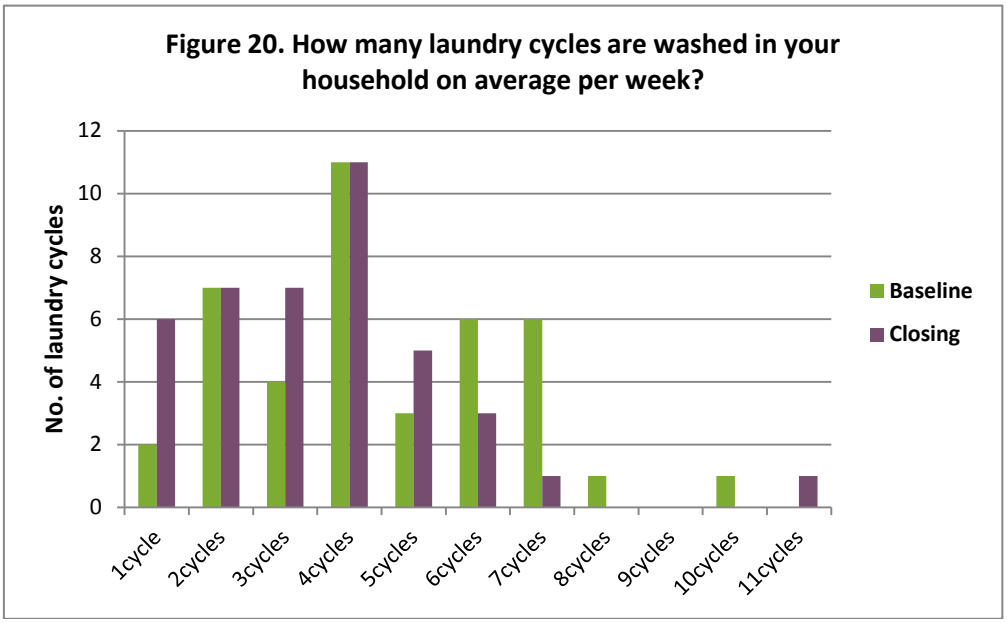


**Figure 20: Number of laundry cycles washed during baseline and challenge periods**; **Source: baseline and closing surveys (n=41)**




It is important to note that there are some differences between the results gained from the different data sources. As illustrated by data presented in Table 13, all results show improvement (i.e. reduction) in the number of laundry cycles done per week. However, not surprisingly, data from self-reported sources (major surveys), which were presumably filled in without a careful look at diary data, show more favourable results than data from diaries and weekly surveys. In addition, there is an interesting fact that diary data and weekly survey data differ from each other even though participating households were instructed to fill in weekly surveys based on their diary data. Range of weekly survey data are more significant than diary data (dropping from 5.2 to 4.2 if the diary data is considered, and from 5.6 to 3.7 if the weekly surveys). This difference can be due to the fact that households filled in weekly survey data from memory so most of them did not compared weekly data with diary data.

It is also important to note that based on data from diaries and weekly surveys, the change achieved during the challenge is maintained by participants. In other words even after the laundry challenge period ended, participants washed less than before starting the challenge.

**Table 13. Number of laundry cycles per week by type of data source**
**Source: Major surveys (baseline, closing), diaries, weekly surveys**

| Number of cycles | Baseline/Closing survey | Diary | Weekly survey |
|---|---|---|---|
| **Before challenge** | 4.5 | 5.2 | 5.6 |
| **During challenge** | - | 4.1 | 4.0 |
| **After challenge** | 3.6 | 4.2[5] | 3.7[6] |

[5] Data is from after the laundry challenge, which means during the remaining 3 weeks of the heating challenge and 1 or 2 weeks after the active phase of the living lab up until the point when laundry diaries were collected from households (for ELL1: when they were interviewed, for ELL2: when the closing focus group meeting took place).

[6] Data is from after the laundry challenge, which means during the remaining 3 weeks of the heating challenge and 1 week after the end of the active phase of the living lab.

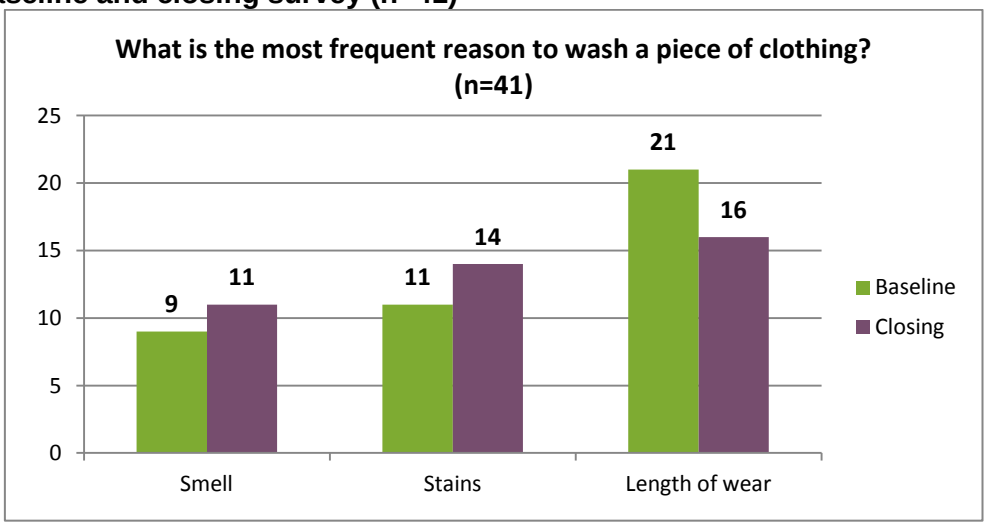
As for the **changes in power consumption** (Table 14) data – both average and lowest and highest values – decreased during the challenge. The average of energy consumption was reduced by 22%. It is important to note that the range of the lowest and highest consumption data is more significant when we examine the averages of each week and not the averages calculated for the three main periods, namely before, during and after the challenge period.

**Table 14: Weekly electricity consumption for laundry appliances during baseline and challenge periods[7]**
**Source: laundry diaries (n=38)**

| Power consumption for laundry appliances, kWh/week | Average | Lowest | | Highest | |
|---|---|---|---|---|---|
| | | Considering the average/HH *of each week* | Considering the average/HH *for the 3 main periods* | Considering the average/HH *of each week* | Considering the average/HH *for the 3 main periods* |
| **Baseline** | 2.74 | 0.17 | 0.36 | 9.93 | 6.01 |
| **During challenge** | 2.13 | 0.20 | 0.27 | 8.37 | 5.94 |
| **After challenge[8]** | 2.14 | 0.19 | 0.28 | 6.93 | 5.15 |

In terms of **skills and competencies**, generally, **removing stains** was a relatively new experience in the Hungarian ELL group, especially using the removers GDI provided. People thought that the one with the orange oil was absolutely marvellous, they never thought that something could take out stains as effectively as this material (which is otherwise environmentally friendly, and people noted this as an added bonus).
Some people even started adding this orange oil stain remover to every washing, with the washing liquid (driven by one of the participants presenting this idea at the informal group meeting), and this way they found that they could wash at cooler temperatures without having stains remaining in the clothes.

**Figure 21. The most frequent reason to wash**
**Source: Baseline and closing survey (n=41)**

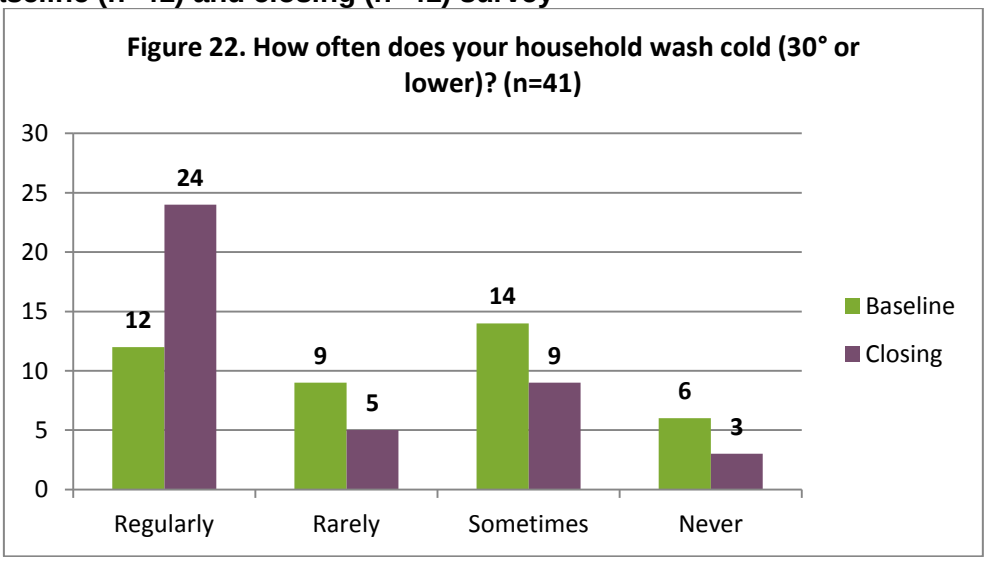



[7] Data are indicated without dryer and ironing diaries data. Most of the participating households In Hungary do not use a dryer (corresponding to data for Hungary).
[8] 'After challenge' means the weeks after the laundry challenge, but still within the ELL period, and in the case of a number of HHs also for an additional week.

As for **habits and routines**, based on the baseline survey length of wear was the **most frequent reason to wash**, but during the challenge the distribution of the main reasons became more equal. By the end of the laundry challenge smell and stains were a bit more important than before, and the ratio of length of wear decreased. This means that households started washing clothes that really needed washing more instead of simply putting clothes in the wash because they have worn them for some time (but did not necessarily needed washing).
In parallel with this trend the number of cycles also decreased, consequently the proportion of unnecessary washing was reduced and people washed their clothes when they were dirty or overused. In addition, in interviews and focus group meetings participants also reported becoming more tolerant towards dirt/staining and the practice of washing out stains by hand became more general (before they put even the only little stained clothes into the washing machine right away).

Based on diary data the average **washing temperature** decreased by almost 4°C during the challenge, and even continued to decrease afterwards (Table 15). A lot of participants started washing at cooler temperatures: 40 °C for sure, and a lot of them experimented with washing at 30 °C as well. This is supported by data from the baseline and closing surveys (Figure 22), positive changes were only observed in terms of answer wash cold 'regularly' and number of households significantly decreased who replied that 'rarely', 'sometimes' or 'never'.

**Figure 22. Changes in the frequency of cold (30° or lower) wash**
**Source: Baseline (n=41) and closing (n=41) survey**




Some people started washing more by hand or started soaking clothes before washing so that stains would come out more easily at lower temperatures as well.

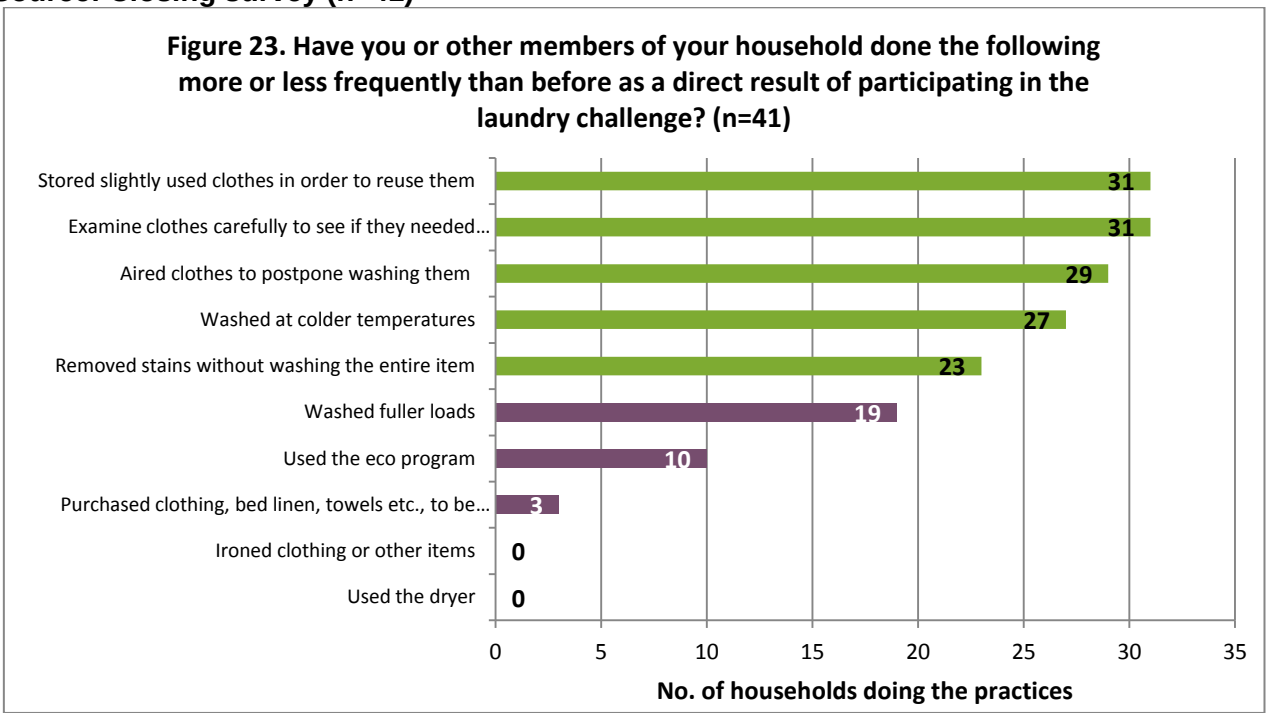
Participants also started doing full loads only. Related to this, some participants mentioned that they needed to buy more clothes in order to be able to wait until they can do a full load.

**Table 15. Average of washing temperature by major surveys and diary**
**Source: Baseline survey, laundry diaries**

| Washing temperature (°C) | Baseline survey | Diary |
|---|---|---|
| Before challenge | 48.0 | 41.5 |
| During challenge | | 38.6 |
| After challenge | | 37.6 |

In terms of laundry there were a lot of practices that participants did start doing more frequently during the challenge (Figure 23).
Those actions that were done more frequently by at least half of all participating households – removed stains without washing the entire item, washed at colder temperatures, aired clothes to postpone washing them, examine clothes carefully to see if they needed washing or stored slightly used clothes in order to reuse them – are indicated in green in Figure 23.
It is important to mention that the practices of 'ironing clothing/other items' and 'using the dryer' options were done less frequently than before the challenge.

**Figure 23. Changes in frequency of the activities in terms of laundry**
**Source: Closing survey (n=41)**




Based on interviews and focus group most of the households mentioned that participation in the project was really useful for them because they **gained a lot of new knowledge, ideas and experiences**, e.g.: systematic management of washing, relevance of full loads, usefulness of stain removers, energy consumption of their machine, etc.

In terms of **material arrangements** some people mentioned that they experimented with their machine more (e.g. with using different programmes, temperature and spin-dryer settings), and they discovered some **extra saving options**, which they were quite happy and proud about.

Some participants mentioned that they washed little already before the challenge and were not able to reduce that further. A male participant mentioned that his wife did not let him meddle with selecting clothes, but she was OK with measuring electricity use. They checked the consumption of the eco programme, concluded that it indeed used less energy, so since then they have only been using this programme.

During closing focus group meeting people also discussed **getting a new washing machine** in order to reduce consumption (if their current one is old). And in relation to this they brought up the carbon footprint concept, as well as the overall environmental impact of machines. They discussed the pros and cons, also in terms of energy use and overall environmental impact, of buying a new machine. Some of them mentioned that they bought a used but young machine, and that is also a good solution: smaller carbon footprint and impact than buying a completely new machine.

Another change was that many participants used the **meter to check the consumption of various programmes and settings**, and as a result were able to make a more informed choice. A lot of them did enjoy seeing the reduction in consumption, and even the big difference between washing at 40 °C vs. washing at 30 °C.
Participants also mentioned taking out the manual of their machines to study it again.

At the focus group meeting among ELL2 participants there was also a discussion about when to **select the clothes by colour**: immediately before washing or collect the laundry already in different baskets, based on colour. Several participants thought that collecting the laundry already by colour makes more sense and reduced the amount of time spent on doing laundry. An additional idea from one of the participants is to have a laundry basket that takes exactly as many clothes as a full load. Several people liked this, and want to purchase baskets like this. There are participants who do not select by colour, but wash everything together and use a colour catcher cloth.

During the closing focus group participants also discussed the **merits of reducing the spinning speed**: it obviously saves energy, and it is fine to do in summer, but in winter it may make the drying period too long. The question also arose whether this has any impact on heating energy use. Many participants reduced the speed of their spin-driers, and did also measure the change in consumption. They concluded that it is worth doing it.

As for the **amount of time** participants **spent on laundry,** based on the closing surveys and interviews most of the households mentioned that they spent as much time as before for washing but many participants remarked that it took less time than before and there were only a few households who washed a bit more than before the challenge. There was one female participant who mentioned that she thinks she spends a little less time on doing laundry.

There were several households where the reduced of number of washing cycles caused a general change during the challenge. One of them reported that she is really happy about reducing the number of cycles as she now has a full washing free weekend every second week:

> *"I can spend more time with the puppy, we walk more outdoors or I now have time to go to the solarium or beauty salon." (female participant, 2-person household)*

In another household the wife mentioned that she spent less time directly with washing, as she washed fewer cycles and she spent less time on additional tasks as well. She calculated saving 7*20 minutes, so about 2 hours in a month which comes up to watching one movie.

In terms of **continuity** of the outcomes, all participants seem to be very positive about continuing with their practices in the future. They expressed a belief that it is good for the environment, their budget as well as the clothes themselves.
Some of them remarked that for changes in laundry, two months were enough for them to get used to the changes, and the new practices have now become part of their routine.

Based on the interviews almost all households mentioned that they can keep these changes and most of them will continue to try new tips and techniques. Some participants said that they would like to try some of the things from the tips that they have not tried yet or they still want to try some things that they heard from others in the group.

## 3.4 POTENTIAL RUPTURES AND SUFFICIENCY POTENTIAL

### 3.4.1 RUPTURES

**Signing up for participation** in the ELLs was the first rupture for Hungarian households as it started their thinking about energy efficiency, and they also started wondering what might happen during the ELLs and how they could save energy. They were also happy to be selected for the ELL, they thought this was an honour to be part of this programme, and since they signed up, they wanted to complete it, do it as well as they could.

**The first visit** (see Chapter 1, receiving their welcome pack and installing meters) and then the first discussion (either focus group of individual interviews) helped motivate participants further. They were quite enthusiastic to start doing things, and having the challenge kits contributed to this a lot. They could see that the challenge kits were well-planned, and they included a lot of very useful ideas and objects.

**The diaries and metering** - that they started following the first visit -, were really very useful according to most participants. During interviews and focus group discussions they reported that they helped them understand their laundry-related consumption, helped them realize how much energy they used for washing, and also helped them get away from their comfortable life. As for indoor comfort, several participants commented that it was the first time they measured temperature in their home. All in all, being able to gather facts and data on their laundry and heating related energy consumption was found useful, and at the same time helped participants look at their daily practices from a new angle.

It appears that for several people metering was definitely a rupture as it changed their use of programmes on the washing machine as a result of them realizing how much electricity their washing machine was using when run on different settings and programmes. Several people commented on this both during the interviews (ELL1) and focus group discussion (ELL2), for example:

> *"The diaries were especially useful during the challenges. We never observed our washing routines before and now realized how many of them we do and at which temperatures. So, we received a picture of the daily 'operation' of our home." (female participant)*

Most people reported that the **weekly surveys** were also useful - albeit sometimes annoying and a nuisance -, as they helped summarize results, and it was also good to get reminders for filling them in. Most participants usually filled in the surveys after getting the first reminder.
Some participants also mentioned that in their view the small rupture of receiving the weekly survey helped their new actions become habits:

> *“It takes more time to pay attention to these things, but I think if it becomes part of everyday life, the time requirements decrease and it becomes easier to do these things and we won't need to pay attention to them so much or have to remind each other so much...” (female participant)*

Finally, **the challenges** themselves:
Some people applied to participate because they already had motivation and interest in green and energy efficient living, and they were happy to see the ELL advertisement in the local paper.

In Hungary, participants generally took the challenges very seriously, and they wanted to succeed. As a result, not being able to achieve what they had undertaken in the challenge was a source of frustration to them as evidenced by the following quote:

*"I am happy that it is over, and it is not depressing me anymore that we are not succeeding with the heating challenge." (female participant)*
*"The challenge seemed to me to be unachievable, the heating due to the grandparents, and the washing due to the size of the family.... this was not so motivating for me, to try to do something that I know that I cannot achieve, it is frustrating. I am a good student type of person; I would like to reach what I take on. If challenges are easier to reach, it would be more motivating for me, I would have a better feeling, probably I would have done the same though, in the end..." (same interviewee)*

Other participants - even though they took the challenges seriously - still looked at them more as a learning opportunity, and an invitation to experiment with their limits, as expressed by a participant:

*"You can get used to it (i.e. being at lower temperatures), for the first week it was dramatic, we had no mood for it, really, for the second week it wasn't so bad, it was OK, not as cathartic as at the beginning. The heating challenge was more difficult as compared to the laundry challenge." (female participant)*
*"There is an emotional barrier, you don't need to invest half a million forints to start saving, so there can be no excuses, but there was a big emotional resistance on our part. I had it, and my husband had it, twice as much resistance than me, he didn't even know what to do with the laundry challenge." (same interviewee)*

Or:

*"The 18 degrees is stretching our limits. [...] "It was good to try it for my education, to know for myself, to be able to feel where my limits are. Now I experienced how far I can go so that it is still bearable." (female participant)*

For ELL2, it is interesting to consider **being part of a group as both a rupture and motivation for moving towards sufficiency.** The experience of being part of a group was discussed more spontaneously at the midterm group meeting, and in a more structured way at the closing focus group discussion.

The most important comment from participants is that people gained confirmation, support and inspiration for leading environmentally friendly lifestyles as well as reducing their consumption. A lot of participants were quite vocal about this.
Moreover, participants welcomed the opportunity to and gained positive energy and inspiration from belonging to the ELL2 group. They generally loved being part of the ELL2 group and nobody had any regrets about joining.

For some the informal group meeting organized by GDI halfway through the ENERGISE Living Lab did help and did provide extra motivation, tips and ideas, especially because they had an opportunity to hear stories and experience from others. At this informal meeting it was good for them to share their own story, feelings, and also to hear from ideas, hear about tips, get inspiration. Some went even as far as to say that without a group they would not have participated, it was great to have it. They were also curious to see if other people took up their ideas.

ELL2 participants underlined how great it was for people to see and hear that there are others who do similar things, and that they are not on their own. Another aspect of this was that they were also happy to get confirmation that they were on the right track, they were doing things almost right. At the same time, quite a few of the participants mentioned that they had to recognize during the ELL that they were not as green as they had thought they were. But this was a positive realization for them and they welcomed the opportunity to learn.

A lot of participants also expressed frustration at how difficult it is to convince others to lead an environmentally friendly lifestyle, even their own family members are often difficult to convince.

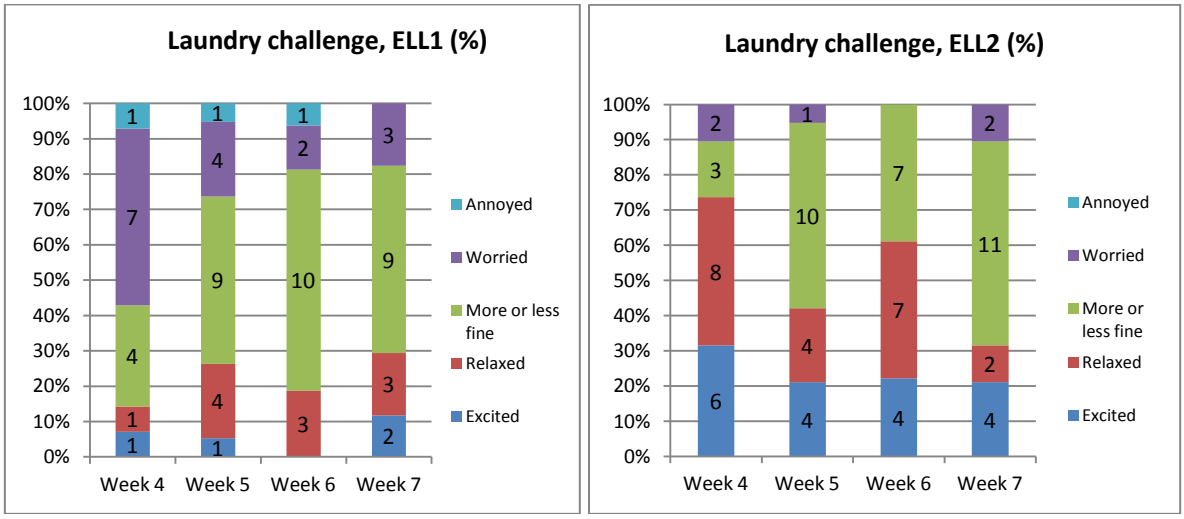
Thus, in this context it was great for them to belong to a group where people did want to change or at least were happy to actively consider change.

Based on weekly surveys it can be compared **how participants felt during the challenge** (Figure 24). Differences between the ELL1 and ELL2 group can be detected for both the laundry and heating challenge. **For the laundry challenge** the results show that among ELL2 participants the feeling of 'Excited' and 'Relaxed' were more typical than in ELL1. For the most part, participants in both ELL1 and ELL2 reported feeling 'More or less fine' during the challenge and the proportion of this answer increased continuously. The most significant difference between ELL1 and ELL2 participants was to do with feeling 'Worried'. Among ELL1 participants 'Worried' and 'Annoyed' were more typical than in ELL2.

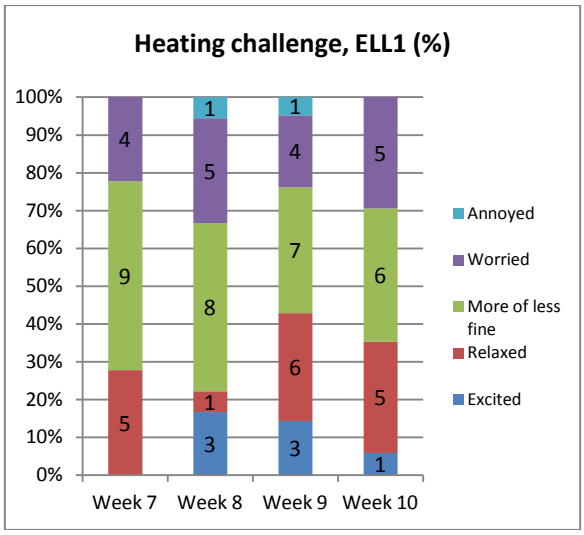
**For the heating challenge**, unlike laundry, the most significant difference was to do with feeling 'Excited' because this feeling was much less common among ELL1 participants. However, feeling 'Worried' was present and to a similar extent in both ELL groups. This is probably due to the fact that in general participants felt more concerned about being able to reduce indoor temperature than washing cycles.
Somewhat more participants in ELL1 appear to have felt 'More or less fine', whereas 'Relaxed' represented a considerable proportion in both ELL1 and ELL2 groups.

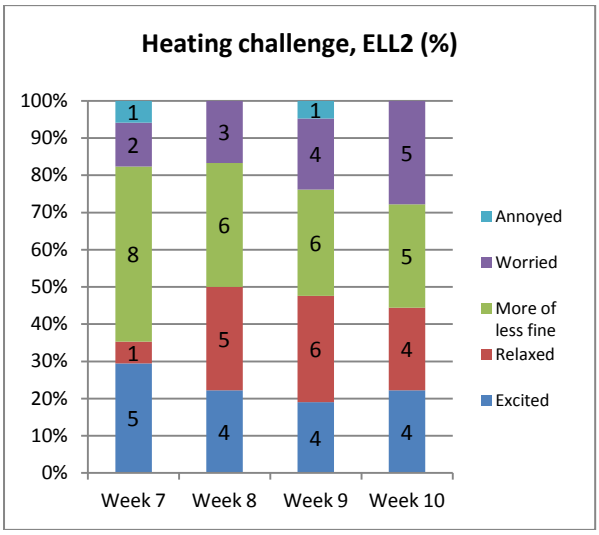
Finally, it is interesting to note that the performance rate (i.e. how many participants provided a response) for the questions about emotions (in weekly surveys) was quite a lot higher among ELL2 participants, which fact is probably due to the difference in methodology and interaction among participants between the two ELL groups.

**Figure 24. How participants felt during the laundry and heating challenges, % of number of answers with different feelings during the active part, i.e. weeks 4-10 of the ELLs**
**Source: Weekly surveys[9]**




[9] Without category of „Other" as there were not very many participants selecting it or providing a meaningful explanation.

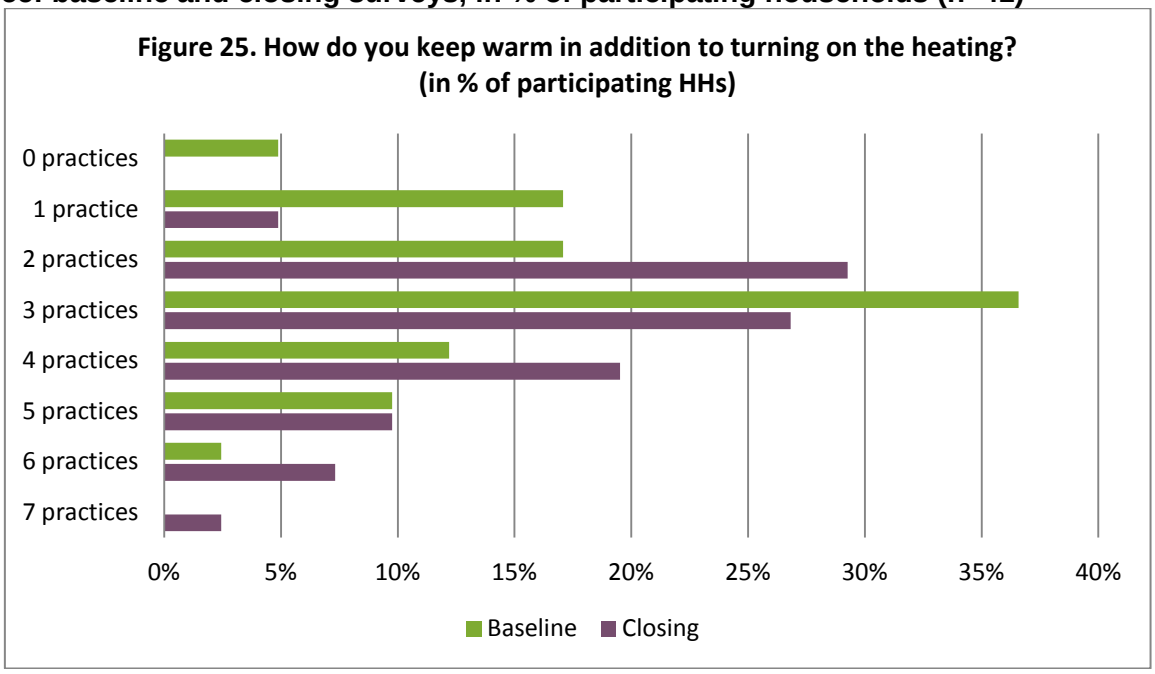



## 3.4.2 SUFFICIENCY POTENTIAL

One indication of sufficiency measures in the ELLs would be if alternative, more adaptive practices of thermal comfort and avoiding washing have increased. Figure 25 shows changes in the number of adaptive practices for keeping warm without turning up the heating used by participants before and after the heating challenge. The vertical axis shows the number of adaptive practices applied, whereas the horizontal axis shows the ratio of participants using these practices. The most common adaptive practices both before and after the challenge were to use warm socks or slippers and to use warm clothing. After the challenge, the use of blankets and blinds/curtains decreased while the use of draught excluders, hot baths and other methods increased along with an increase in the use of warm socks, slippers and warm clothing.

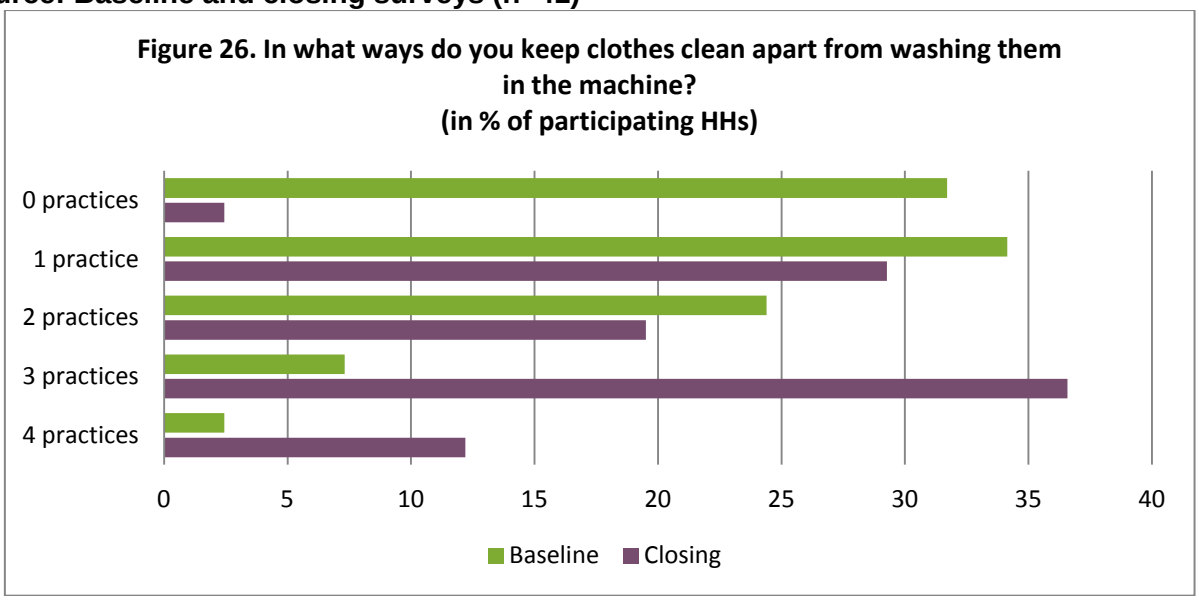
**Figure 25. Changes in the number of adaptive practices of thermal comfort**
**Source: baseline and closing surveys, in % of participating households (n=41)**




As for the several practices to keep clothes clean apart from washing them, compared to the baseline survey the use of practices significantly increased during the living lab. The number of participants using 3-4 methods grew considerably (Figure 26). The greatest improvement was in

the case of airing out clothes, 71% of households used this practice at the end as opposed to 20% at the beginning. However, preventing stains (59%), washing out stains by hand (51%) and brushing out stains (41%) were also popular, although the change there was not quite so big. At the same time the ratio of those not employing any methods to prevent washing dropped from 34% to 2%.

**Figure 26. Methods to keep clothes clean apart from washing them in the washing machine**
**Source: Baseline and closing surveys (n=41)**




It is also worth noting that as shown in Chapter 4 below, the number/ratio of households doing more practices both to avoid having to turn up the heating and to avoid having to put clothes in the washing continued to grow even after the Living Labs were concluded (see Figures 29 and 30).

# 4. PRACTICES THREE MONTHS AFTER THE LIVING LAB

This section explores the extent to which changes in practices arising as a result of the laundry and heating challenges persisted. These observations are based on a comparison between the baseline and closing surveys as well as a follow-up survey administered approximately three months after the end of the challenges. In the follow-up survey, we also asked households which practices they felt they had retained, explored potential rebound effects, and in Hungary asked how they would prefer to participate in similar initiatives in the future: in a group or individually.

## 4.1 PERSISTENCE OF CHANGES IN HEATING PRACTICES

Table 16 shows the change in measured temperature for before and during the challenge (T1 and T2 respectively), and for 3 months after the challenge based on data collected from the follow-up survey (T3). In the follow-up survey participating households were asked about measured as well as desirable temperatures, and as they still had the thermometers that they received at the beginning of the living lab, we had a certain level of expectation that they would read the thermometers when providing their responses. Obviously, this expectation cannot be confirmed.
While Table 16 shows averages for the whole period before and during the challenge, Figure 27 depicts the change in averages week by week. In the figure it can be seen how average indoor temperatures were reduced week by week during the challenge, which happened between weeks 7 and 10.

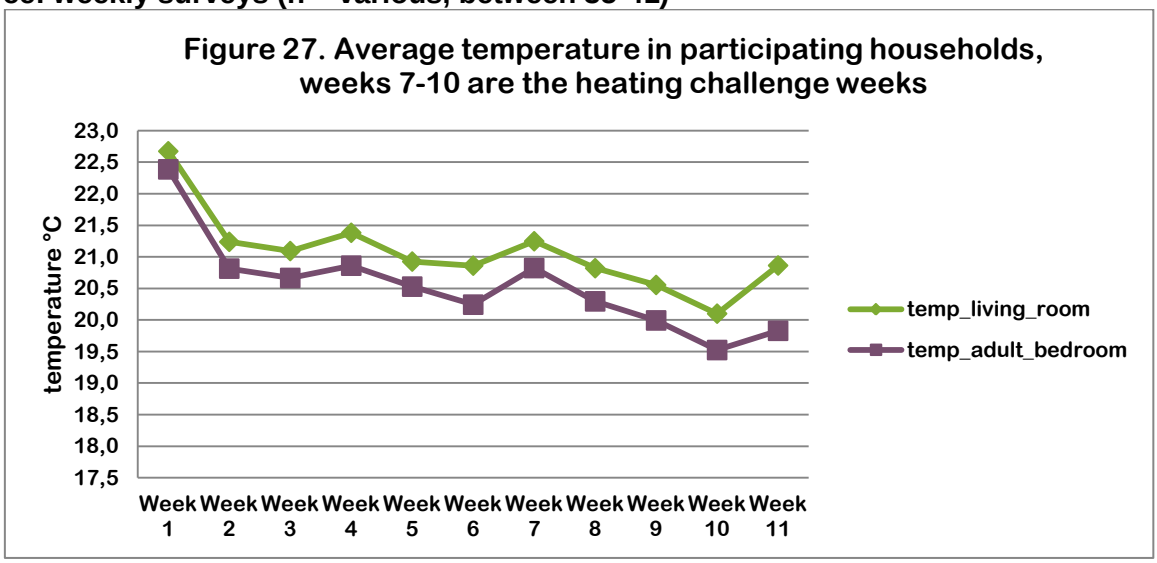
These are considered in relation to outdoor temperatures (see Figure 27).
From comparison with average outdoor temperatures it can be seen that there is some correlation between indoor and outdoor temperatures, especially up until Week 7 (when the heating challenge started). At this point outdoor temperatures started to drop considerably, and the 'real' heating period started. As a result, part of the drop in indoor temperatures can probably be attributed to the change in outdoor temperatures, and part to the efforts made by households.

**Table 16. Indoor temperatures before and after the challenge**
**Sources: Data for T1 and T2 are from weekly surveys completed by households based on their temperature diaries and the thermologger (n=40), and for T3 from the follow-up surveys (n=39) surveys.**

| | **Average temperatures before and after the challenge** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **T1: Before the challenge** | | **T2: During the challenge** | | **T3: 3 months after** | **Difference T3-T1** | |
| | Weekly surveys | Thermo-logger[10] | Weekly surveys | Thermo-logger | | Weekly surveys | Thermo-logger |
| **Living area, °C** | 21.4 | 21.8 | 20.7 | 20.7 | 20.6 | -0.8 | -1.2 |
| **Bedroom 1, °C** | 20.9 | - | 20.2 | - | 19.6 | -1.3 | - |
| **Bedroom 2, °C** | 21.4 | - | 21.1 | - | 19.7 | -1.7 | - |

[10] Thermologger data is only available for the living area.

**Figure 27: Change in average indoor temperature in participating households as compared to the change in average outdoor temperature[11]**
**Source: weekly surveys (n = various, between 35-41)**



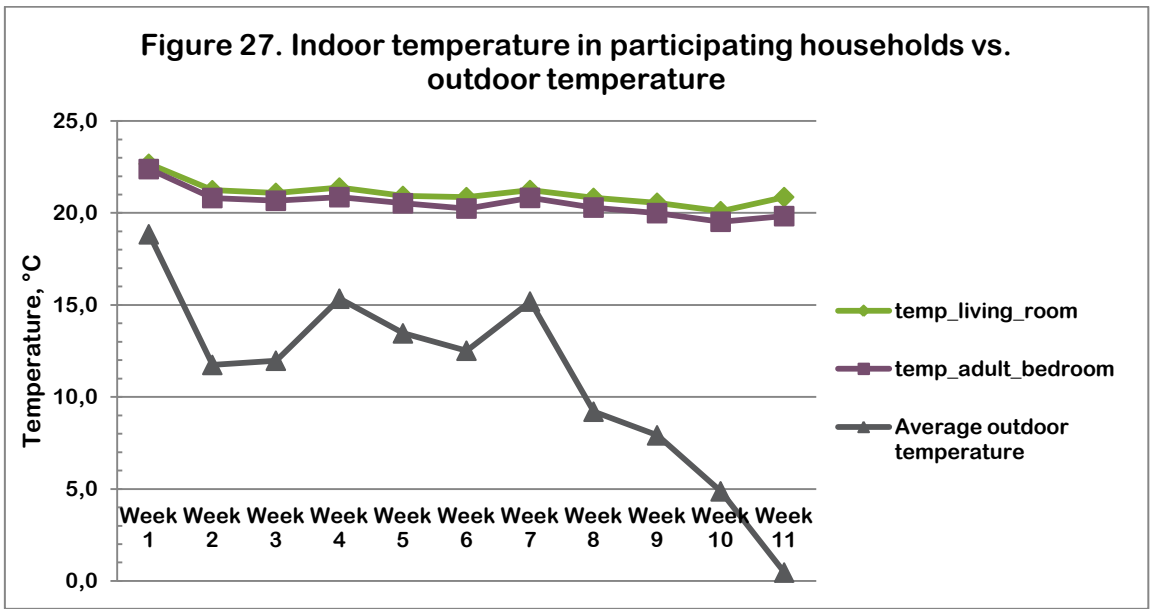




Table 17 explores the persistence of alternative practices of keeping warm. ELL participants in Hungary had several ways to keep warm without turning up the heating, even before the start of the challenge (see Chapter 2.1 for details). During the examined periods the most common ways of keeping warm were using warm socks or slippers, using extra clothing, using blinds or curtains on windows as well as using extra blankets. Most of the households – based on follow-up survey more than 60% of them – used these all four of these methods; moreover, the proportion of those using warm socks was more than 90% at the end of the challenge. One of the reasons for this may be the warm woollen socks given to participants as part of their heating challenge kits. The socks were found to be the one of the most popular items as revealed in individual interviews and focus group discussions, with several households resolving to buy more of these socks so that more members of their households could have them.

[11] Average daily temperature data was retrieved from a weather station. Average weekly values were calculated from these data.

All in all, as a result of the challenge, participants did start doing a lot of these things more frequently as illustrated in Table 17. In addition, the number of participants doing some of these practices continued to grow even after the challenge, e.g. taking a hot bath or shower.

**Table 17. Persistence of alternative practices of keeping warm.**
**Source: Baseline (n=41), closing (n=41) and follow-up (n=39) surveys**

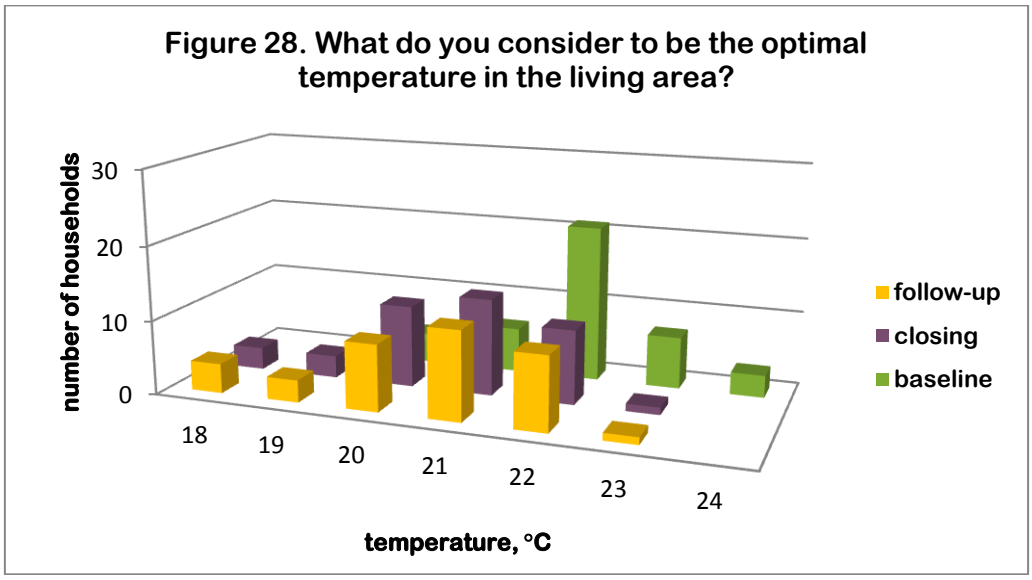
| Practices | % of participants taking these measures, **before taking part in the challenge** | % of participants taking these measures **immediately after** | % of participants taking these measures, **3 months after** |
|---|---|---|---|
| Use warm socks/slippers | 68.3 | 92.7 | 89.7 |
| Use extra clothing | 58.5 | 87.8 | 84.6 |
| Use blinds/curtain on windows | 53.7 | 36.6 | 66.7 |
| Use an extra blanket | 53.7 | 36.6 | 61.5 |
| Take a hot bath or shower | 17.1 | 24.4 | 30.8 |
| Use draught excluders | 9.8 | 24.4 | 30.8 |
| Other | 12.2 | 26.8 | 5.1 |
| Do nothing additional | 4.9 | 0.0 | 0.0 |

Table 18 examines the persistence of potential changes in expectations toward indoor comfort. It shows average desirable temperatures based on baseline, closing and follow-up survey data for the living-room, bedroom and child's bedroom. A decrease in expected temperatures can be clearly seen, and the move towards lower temperatures is shown in Figure 28. As illustrated by the figure, in terms of the temperature in the living area values not mentioned in the baseline survey like 18, 19 °C are mentioned by several participants in the closing and follow-up surveys, while higher temperatures like 24 °C disappeared.
As for desirable temperature of bedrooms the averages were under the living area's temperature and a promising trend that reduction of child's bedroom was really great, and the decrease in living area continued after the Living Lab was completed, as comparison with data between the closing survey and the follow-up survey completed about three months after the Living Lab shows.

**Table 18. ELL participants' perceptions of desirable temperatures in the winter during daytime before and after the challenge**
**Source: baseline (n=41), closing (n=41) and follow-up (n=39) surveys.**

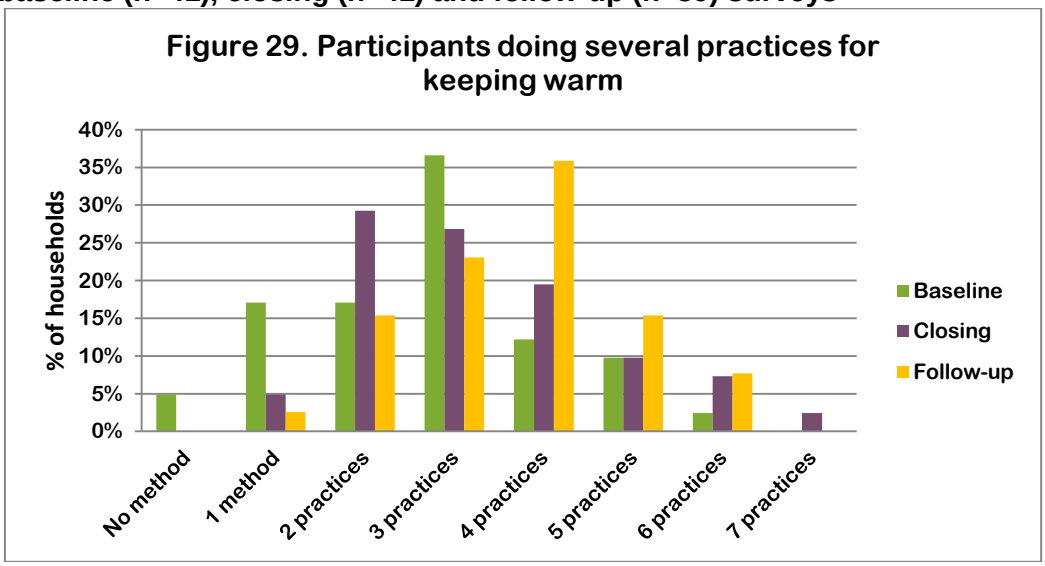
| | **Average before** | **Average directly after** | **Average 3 months after** | **Change, T3/T1** |
|---|---|---|---|---|
| **Living area, °C** | 22.0 | 20.7 | 20.6 | -1.4 |
| **Bedroom, °C** | 20.3 | 19.2 | 19.3 | -1.0 |
| **Child's bedroom, °C** | 22.2 | 20.8 | - | *(-1.4)* |

**Figure 28. Optimal or desirable temperature in the living area**
**Source: baseline (n=41), closing (n=41) and follow-up (n=39) surveys**




As for the persistence of changes, it is important to point out that as shown in Figure 29 the number of participants doing several practices parallel for keeping warm increased even after the Living Lab was completed. The most notable increase occurred in the number of people doing four or five practices, and a corresponding decrease in participants doing 1-3 practices.

**Figure 29: Change in the ratio of participants doing several practices for keeping warm**
**Source: baseline (n=41), closing (n=41) and follow-up (n=39) surveys**




## 4.2 PERSISTENCE OF CHANGES IN LAUNDRY PRACTICES

As concerns laundry, Table 19 examines the persistence of the reduced number of laundering cycles. Basically the number of cycles considerably decreased, and based on follow-up survey data washing became a more conscious activity. Compared to closing survey data, the number of cycles increased but only a very small extent (from 3.6 cycles to 3.7 cycles per week) during the three months after the Living Labs concluded.

**Table 19. Average number of laundry cycles before and after the challenge.**
**Source: baseline (n=41), closing (n=41) and follow-up (n=39) surveys.**

| | Average before | Average directly after | Average 3 months after |
|---|---|---|---|
| **Number of laundry cycles** | 4.5 | 3.6 | 3.7 |

Table 20 examines the persistence of alternative practices of keeping clothes clean. It is important to note that there was no household who did not use any alternative method for the follow-up survey. This shows that just like in the case of indoor comfort, participants continued to change their daily practices even after the Living Lab ended.
Based on data collected three months after the end of the ELLs, the most popular practice was the prevention of stains, which is a very encouraging finding. Following this, airing out clothes and washing out stains by hand were also significant. Brushing out stains was less popular during and after the challenge as compared to data from the baseline survey.

**Table 20. Persistence of alternative practices of keeping clean.**
**Source: baseline (n=41), closing (n=41) and follow-up (n=39) surveys.**

| | % of participants taking these measures, before | % of participants taking these measures immediately after | % of participants taking these measures, three months after |
|---|---|---|---|
| Air out clothes | 19.5 | 70.7 | 64.1 |
| Prevent stains (e.g. by wearing an apron) | 34.1 | 58.5 | 79.5 |
| Wash out stains by hand | 26.8 | 51.2 | 66.7 |
| Brush out stains | 34.1 | 41.5 | 33.3 |
| Other | 2.4 | 0.0 | 5.1 |
| No other ways | 34.1 | 2.4 | 0.0 |

Again, it is interesting to see how the number of participants applying several of these methods parallel changed during and after the Living Labs. As shown in Figure 30, the number of households using several methods continued to increase after the Living Lab, indicating that the period of change did not end with the intervention, participants continued to take up new practices.

**Figure 30. Change in the number of practices households apply to avoid washing**
**Source: baseline (n=41), closing (n=41) and follow-up (n=39) surveys.**

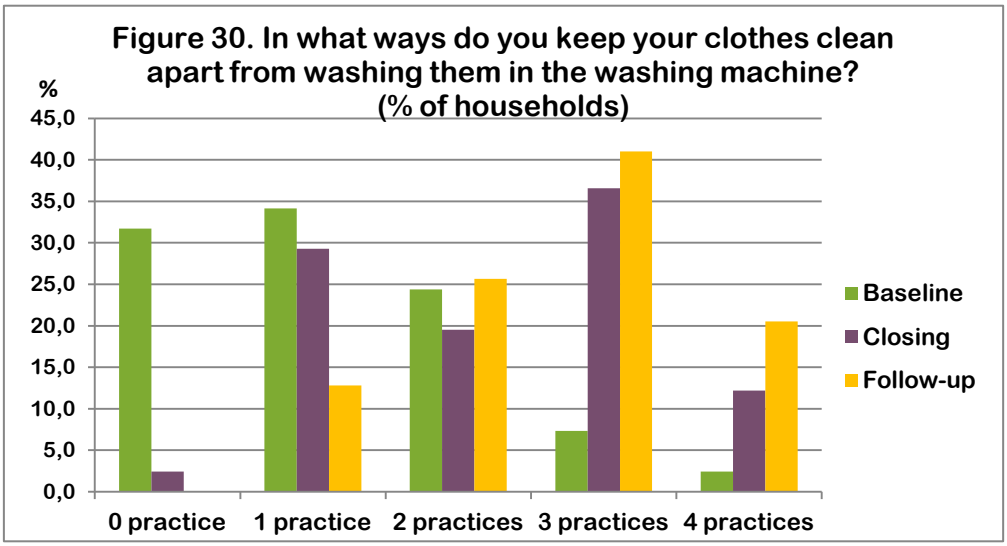


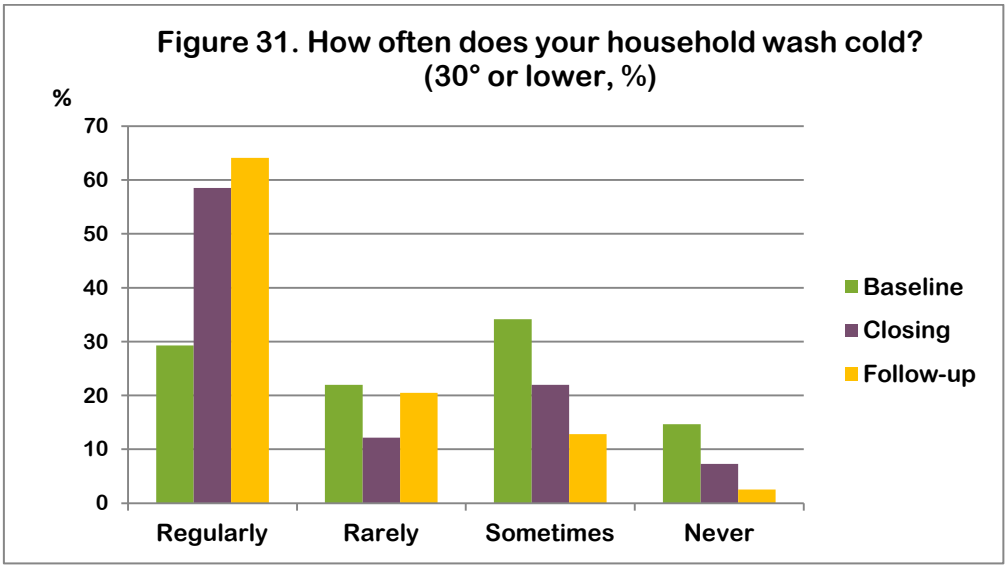
Table 21 examines potential changes in norms related to laundering by exploring changes in how households decide when an item requires washing.
Based on the baseline survey length of wear was the most frequent reason to wash, but during the challenge the distribution of the main reasons became more equal. By the end of the laundry challenge smell and stains were a bit more important than before, and the ratio of length of wear decreased. This means that households started washing clothes that really needed washing more instead of simply putting clothes in the wash because they have worn them for some time (but did not necessarily needed washing). Three-months-after data showed even more change. Based on follow-up survey data 'smells' became the most significant reason for washing, and on the other hand ratio of 'length of wear' continued to decrease.

**Table 21. Persistence of changes in criteria for deciding when items require washing. Source: baseline (n=41), closing (n=41) and follow-up (n=39) surveys.**

| | Share of households using this criterion, % | | |
|---|---|---|---|
| | **Before** | **Directly after** | **3 months after** |
| **Smells** | 22.0 | 26.8 | **38.5** |
| **Stains** | 26.8 | 34.1 | 28.2 |
| **Length of wear** | **51.2** | **39.0** | 33.3 |
| **Don't know or other** | 0.0 | 0.0 | 0.0 |

As for the frequency of doing cold washes (washing at 30 °C or lower), most of the participants started washing at cooler temperatures: 40 °C for certain, and a lot of them experimented with washing at 30 °C as well. Positive tendencies continued even after the conclusion of the Living Labs as shown in Figure 31 according to which the number of households responding that they only 'sometimes' or 'never' wash at low temperature continued to decrease. This trend was accompanied by an increase in the number of households who regularly wash at low temperatures.

**Figure 31. Persistence of the frequency of cold (30° or lower) wash Source: Baseline (n=41), closing (n=41) and follow-up (n=39) surveys.**



## 4.3 POTENTIAL EFFECTS: SPILLOVER EFFECTS, REBOUND EFFECTS, CALCULATED $CO_2$ AND ENERGY SAVINGS, POTENTIAL FOR SCALING UP

This section explores the potential effects of the ELL challenges, based mostly, but not entirely on data collected in the follow-up survey sent out three months after the end of the ENERGISE Living Labs. We first consider potential spillover effects, which can magnify the effectiveness of the ELLs and can contribute to how the changes that occurred spread further. Thus, in addition to changes achieved in laundry and heating, it was expected that experimentation with new practices in the ELLs might also encourage households to experiment with new energy saving practices in other areas as well as discuss and become active in other energy and climate change related issues
Then we explore rebound effects, partly related to how participants view potential monetary and time savings and how they intend to use them, and partly through analyzing what they said during interviews and focus group meetings.
We also explore the potential for scaling up on the basis of how participating households have communicated and are willing to communicate on the ELLs.
Finally, we calculate energy and $CO_2$ savings using laundry diary data as well as consumption data collected with the help of participants in the form of monthly meter readings during and after the Living Lab period (up until the follow-up survey was administered) and comparing it to reference consumption data from previous years, also supplied by participants based on official utility invoices.
Finally, our last section in this chapter explores issues related to scaling up the impact of the Living Labs through looking at how the ELL participants themselves spread the news about their experience.

### 4.3.1 SPILLOVER EFFECTS

In terms of spillover effects major surveys data show improvement in engagement with energy and climate issues. The proportion of participants who raise energy and climate issues at home or with friends was the most significant during the examined period, but the proportion of those who consider energy and climate issues when voting was characterized by the highest increase (11.4 percentage points). In some cases, for example considering energy issues when buying new appliances, the spillover effects continued to grow even after the end of the Living Lab (i.e. the closing survey). In other cases, for example, raising energy and climate issues at work, the effects decreased after the Living Lab - but were still higher than at the baseline.

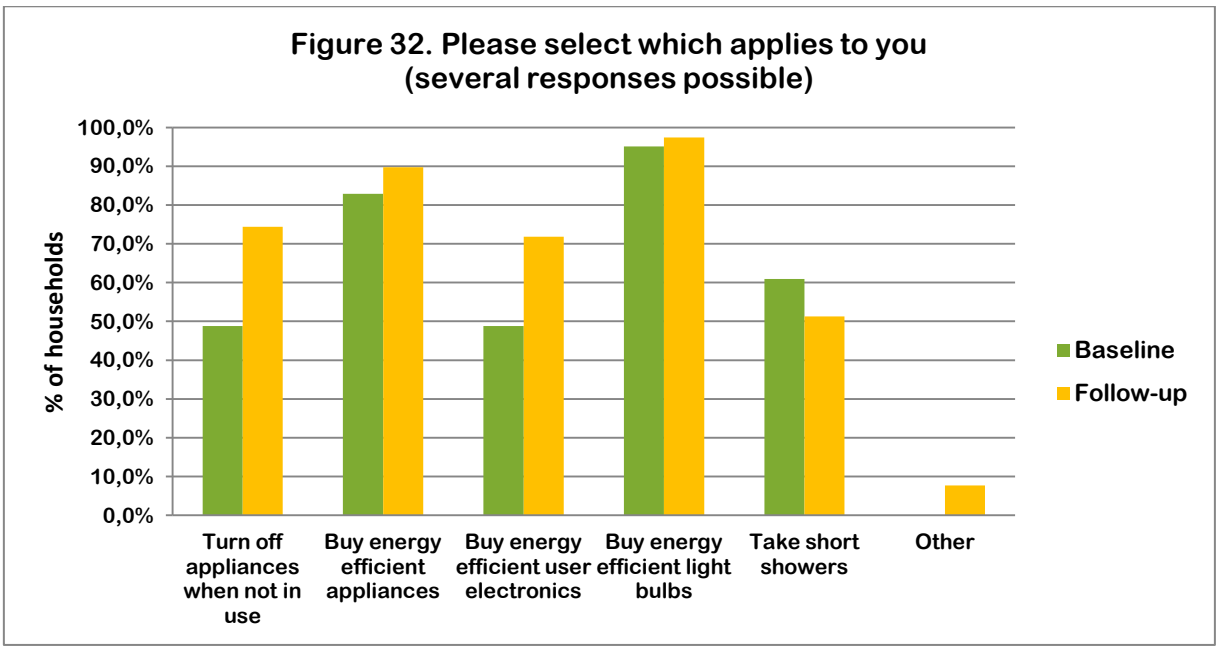
**Table 22. Spillover effects from the ELLs: changes in general engagement with energy and climate issues**
**Source: baseline (n=41), closing (n=41) and follow-up surveys (n=39)**

| | T1 : Before challenge, % | T2 : Directly after challenge, % | T/3, three months after challenge, % | Change, %, T3/T1 |
|---|---|---|---|---|
| Raise energy and climate issues at home or with friends | 78.0 | 78.0 | 87.2 | 9.1 |
| Raise energy and climate issues at work | 39.0 | 51.2 | 43.6 | 4.6 |
| Raise energy and climate issues in NGOs or other groups of which I am a member | 4.9 | 7.3 | 10.3 | 5.4 |
| Actively search for news or information on energy and climate issues | 58.5 | 61.0 | 59.0 | 0.4 |
| Consider energy and climate issues when voting | 22.0 | 31.7 | 33.3 | **11.4** |
| Consider energy efficiency | 82.9 | 80.5 | 89.7 | 6.8 |

| | | | | |
|---|---|---|---|---|
| when buying electrical appliances/devices | | | | |
| Other | 2.4 | 7.3 | 2.6 | 0.1 |
| Not specifically | 4.9 | 2.4 | 0.0 | -4.9 |
| **Energy saving activities performed at home[12]** | | | | |
| Turn off appliances when not in use | 48.8 | - | 74.4 | 25.6 |
| Take short showers | 61.0 | - | 51.3 | -9.7 |

As for energy saving and energy efficient practices performed at home, most of the practices we asked participants about in the baseline and follow-up surveys were performed more often in the case of the latter (see bottom of Table 22 and Figure 32). The practices of turning off appliances when not in use increased the most considerably. It was only the practice of taking short showers that showed a decrease.

**Figure 32: The % of households having various additional energy efficiency practices Source: baseline (n=41) and follow-up surveys (n=39)**




Finally, it is interesting to take stock of the **changes in other areas that participants reported.** Quite clearly, doing the laundry and heating challenges affected participants' other practices as well, for example:

**Energy use:**

- they started ironing (even) less;
- some of them turned off the stand-by mode on appliances, and some of them even did some measurements (i.e. measuring stand-by consumption) with the energy meter;
- some participants mentioned purchasing extension cords with a switch so that they can easily get rid of stand-by consumption;

[12] Please note that in Hungary, in the follow-up survey, we included two separate questions in relation to Table 22: one to examine the practice of raising issues and considering energy and climate issues when buying new appliances, and another to examine performing energy saving and efficiency activities. We did this in order to be able to make a better comparison between the baseline and follow-up surveys.

- resolving to carry on with recording meter readings[13];

**Water use:**

- several participants started using less water for taking a bath, and switched to showering instead; related to this,
- some participants changed their showering habits (e.g. turning off the tap while soaping);
- others developed plans for the coming spring and summer to use less water in the garden and build a rainwater collection system;

**Shopping and presents:**

- several people also reported changing their shopping habits: they have become more careful about what they buy, they take a bag with them in order to avoid receiving a plastic or complementary bag, etc.;
- and what kind of presents they bought for their family members for Christmas: e.g. warm pyjamas, warm slippers;
- interest in finding out where it is possible to get environmentally friendly things in the local town;

**Other:**

- some participants decided to build a passive shading system to reduce cooling costs in the summer;
- still others reduced their car use;
- and several other type of changes exemplified by the quotes below from various participants:

*"Reducing food waste, if we would raise awareness on it, do it more consciously, many things could be changed in this field as well. We just live from one day to the next, but if we paid attention to it the same way we did with laundry and heating in the living lab, concentrating on it, we could achieve a lot more results." (female participant)*

*People tend to think climate change depends on agriculture, industry and transport, but it depends on individuals, to experience this is a very good feeling. [...]*
*"I can influence certain things, regulate in a way that it is better globally." (female participant)*

*"You don't need big planet saving ideas, and big investments to have more savings. If you keep the challenge in front of yourself many things come up by themselves (e.g. windows opening) If you have it as a priority ideas are popping up." (female participant)*

*"Other things were not changed consciously and knowingly but participating in the project and doing the challenges probably has some so far not detected impact on other aspects of our daily routines." (female participant)*

On the other hand, there was also a male participant who mentioned that there is no change in other areas of their life, and he is just happy that his wife now at least uses the eco button on the washing machine.

### 4.3.2 REBOUND EFFECTS

The potential socioeconomic impacts of the ELLs were evaluated on the basis of money and time saved. Most of the ELL participants reported that they thought they had saved both energy and

[13] GDI asked participants to record meter readings - electricity and gas - every month during the ELLs, up until the monitoring survey.

money (see Table 23). In terms of both energy and money, no participants claimed that they were sure they did not save; however, the ratio of those who were not sure was considerable (about a third of the participants) in the case of money.

As for saving time, participants were less certain, in fact, a third of them reported that they did not think they saved time. These findings correspond to what participants reported during individual interviews and focus group discussions. Some of the participants reported that they had no time saving as a result of the challenges; moreover, some of them even indicated that they spent more time with laundry activities as a result of starting to examine clothes more carefully, as one participant expressed in her interview:

> *"10-15% time more spent on washing, because of collecting and sorting them."*

**Table 23. Participants opinion on whether they saved money, energy and time as a result of the ENERGISE Living Labs**
**Source: follow-up survey (n=39)**

| Do you think your household has saved | | | |
|---|---|---|---|
| **%** | **money?** | **energy?** | **time?** |
| Yes | 69.2 | 84.6 | 41.0 |
| No | 0.0 | 0.0 | 33.3 |
| Don't know | 30.8 | 15.4 | 25.6 |

As for what people would spend the money and time saved (see Tables 19), a considerable proportion of households (about a third in each case) were not yet sure what they would do with it. The largest number of households in both cases spends the extra money and time on household running expenses / other housework. Nevertheless, there are some items in both lists that may result in more energy used, and thus have a rebound effect. For example, in the case of time, spending the time saved on watching TV, travel or cooking will likely result in energy use just like spending the amount of money saved would if spent on entertainment or travel.

Based on information collected at closing interviews and focus group discussion, the potential sources of rebound effects need to be further examined. For example, participants mentioned the following alternative practices that they used to avoid having to turn up the thermostat but that also increase their energy use, albeit not their gas heating bills:

- using an electric blanket to keep warm,
- using the wood-burning tile stove or an electric radiator,
- having a bath to keep warm.

**Tables 24. What would savings be used for: most common responses**
**Source: follow-up survey (n=39)**

| Time saved would be used for | |
|---|---|
| **items** | **% of participants selecting this response** |
| TV / computer | *2.6* |
| Cooking | *5.1* |
| Cultural activities | *5.1* |
| Travel | *5.1* |
| Other | 5.1 |

| | |
|---|---|
| Sleeping | 7.7 |
| Reading | 7.7 |
| Working | 7.7 |
| Home maintenance | 10.3 |
| Social activities | 10.3 |
| Sports or outdoors | 12.8 |
| **Other housework** | **20.5** |
| I don't know | 28.2 |
| Not applicable, no time saved | 30.8 |

| **Money saved would be used for** | |
|---|---|
| **items** | **% of participants selecting this response** |
| Eating out | 0.0 |
| Other | 2.6 |
| Purchase of new equipment | *5.1* |
| Entertainment | *5.1* |
| Travel | *5.1* |
| Savings | 12.8 |
| **Everyday running costs** | **38.5** |
| I don't know yet | 33.3 |
| Not applicable, no money saved | 10.3 |

### 4.3.3 CALCULATED $CO_2$ AND ENERGY SAVINGS

First, we examine what participating households thought about saving energy. As Table 25 shows, most of the households reported that they thought they had some degree of energy saving. A significant part of them (48.7%) supposed that energy saving was less than 5% of their annual energy use, and also a considerable proportion (33.3%) reported that their saving was between 5-10%.

**Table 25. The amount of energy saved according to participating households**
**Sources: follow-up survey (n=39)**

| **How much energy saving do you think you have?** | |
|---|---|
| **categories** | **%** |
| No | 0.0 |
| < 5% of our annual energy use | 48.7 |
| 5-10% of our annual energy use | 33.3 |
| 10-20% of our annual energy use | 2.6 |
| > 20% of our annual energy use | 0.0 |
| Don't know | 15.4 |

Following participating households' own view as to how much energy they saved, we also calculated their energy and $CO_2$ savings using different methodologies[14]:

1. we calculate their laundry (i.e. washing machine) related energy saving based on electricity consumption recorded in laundry diaries;
2. we calculate their overall energy saving based on gas and electricity meter recordings during and after (up until the administering of the follow-up survey) the ENERGISE Living Labs, and compared to previous consumption established through official utility bills. For this calculation, a calculator developed in a European project called 'EnergyNeighbourhoods' in which GDI participated was used[15].

First, we examine **laundry (washing machine use) related energy saving**[16]. Based on data from the laundry diaries written by households, if we look at average weekly energy consumption, we arrive at a figure of 22% saving, or average weekly washing machine related electricity consumption reduced by 22% (see Table 26). Furthermore, even though data is slightly less robust for the weeks after the laundry challenge (a few participating households became a bit less rigorous about writing their laundry diaries), we can conclude that the reduced weekly electricity consumption was kept up by participating households.

**Table 26. Average weekly energy use based on laundry diary data**
**Source: laundry diaries (n= between 35-38 households)**

| | Average kWh / week |
|---|---|
| Before laundry challenge | 2.74 |
| During laundry challenge | 2.13 |
| After challenge | 2.14 |

Examining the data from the laundry diaries from a different point of view and calculating the sum of all electricity consumption in the 35-38 households we have reliable metering data from, we find that electricity consumption was reduced by about a hundred kWh (see Table 27).

**Table 27. Overall energy saving by all participating households**
**Source: laundry diaries (n= between 35-38 households)**

| | Total kWh consumed by washing machines |
|---|---|
| Before laundry challenge (4 weeks) | 417.12 |
| During laundry challenge (4 weeks) | 315.56 |
| **Electricity saved** | 101.56 |

This means a **24.3% saving** from one month to the next in electricity use in the participating households. And while this may not look like a huge amount of saving, using statistical data (HCSO, 2011d) we calculated that if all households in Hungary managed to reduce their washing machine related electricity consumption by the same percentage, and managed to keep up this

[14] Please note that energy saving and avoided $CO_2$ emissions for Hungary were calculated based on a specific methodology, and not based on the methodology proposed by UH.
[15] For further information on the calculation methodology please see Annex 2.
[16] For the details of this calculation please see Annex 2.

reduced consumption, **in one year the emission of 32,908 tons of $CO_2$ could be avoided**. This amount of $CO_2$ **equals to the annual $CO_2$ emission of about 6,800 average Hungarian citizens**.

In addition to energy saving by washing machines, we examined and calculated **the overall energy saving** by participating households **based on monthly gas and electricity meter readings during and after participation in the ENERGISE Living Labs** and compared to previous energy consumption calculated with the help of official invoices from the utility companies.[17] Unfortunately, although we made a serious attempt at collecting this information from all households, we only managed to use data from 13 households (32% of participants) for this calculation as for various reasons not all data - especially relating to previous consumption - could be verified.

Based on the data from these households, up until the end of the ENERGISE Living Labs an **average 10.6 % energy saving occurred** compared to the energy consumption of Living Lab participants in the previous year (Table 28). Although this is already very promising, it is important to note that some of the households had double this saving.

**Table 28. Overall energy saving in ELL participant households**
**Source: monthly electricity and gas meter readings and previous utility bills at the end of the ENERGISE Living Labs (n=13)**

| | % saved |
|---|---|
| **Average saving** of all households whose consumption data could be verified: | -10.6 |
| *Gas:* | -11.8 |
| *Electricity:* | -4.5 |
| **Households saving the most:** | -19.6<br>-22.2 |

We were interested in seeing how this saving changed three months after the conclusion of the Living Labs, so we asked participants to carry on with reading their meters and share their data with GDI. Using the same calculation methodology we found that energy saving for the group continued to grow as shown in Table 29. **The average saving increased to 15.2%, largely due to saving in energy used for heating**. Again, the largest saving household saved close to double than the average of the group. However, the most encouraging result is that just like the other data shows, overall consumption data also appear to support the fact that positive changes in participating households continued even after the ENERGISE Living Labs concluded.

**Table 29. Overall energy saving in ELL participant households 3 months after the ELLs**
**Source: monthly electricity and gas meter readings and previous utility bills 3 months after the ENERGISE Living Labs (n=13)**

| | % saved |
|---|---|
| **Average saving** of all households whose consumption data could be verified: | -15.2 |
| *Gas:* | -16.7 |
| *Electricity:* | -4.7 |
| **Households saving the most:** | -23.2<br>-26.8<br>-29.0 |

[17] See Annex 3 for details of this calculation.

### 4.3.4 THE POTENTIAL FOR SCALING UP

The broader impacts of the ELLs on everyday practices depend on the dissemination of the new norms beyond the participating households. Table 30 and 31 present the extent to which participants have shared or would consider sharing their experiences from the ENERGISE Living Labs.

**Table 30. Share of households having shared or willing to share experiences**
**Source: follow-up survey (n=39)**

| Various groups of people | % |
|---|---|
| Friends | 74.4 |
| Other members of my household | 61.5 |
| Co-workers | 46.2 |
| Extended family / relatives | 41.0 |
| Neighbours | 30.8 |
| Groups/associations in which I participate | 7.7 |
| With people at my child(ren)'s kindergarten, school, sports club or similar | 5.1 |
| Other | 2.6 |
| Not specifically | 5.1 |

Experiences are very mixed in this regard: people actively told about the ELL and the challenges to others, but others noticed it in a more passive way as well (e.g. visitors). The following are some of the concrete experiences:

- *"I told my neighbours about it. They thought it sounded interesting but said that they would not have time for something like this."*
- *"I told a friend who stayed over. And we also had to wash her clothes as she spilled tea on them, and I asked her to fill in the diary. She thought it was a great idea."*
- *"I told my colleagues, they are quite environmentally friendly, and they thought it was a good idea to do something like this."*
- *"I raised issues related to the ELL and my participation at the office, and we had a great discussion."*

Some participants told their visitors to bring warm clothes, and it worked fine, nobody complained.

Although there were positive experiences, participants were also confronted with a lot of scepticism from others, for example the following reported by a female participant:

> *"Friends asked me: 'Is it really saving money? Do you really need this saving?' or 'Do you really have time for things like this?' But we did it for the environmental benefits not for the money!"*

As for **spreading news of the ENERGISE Living Labs through different media**, participants in Hungary were not very active. Most of them did not really share posts or news items about their experience, and if they did, they did it through various social media sites such as Facebook. (see Table 31).

**Table 31. Share of households sharing news of the ELLs in various media**
**Source: follow-up survey (n=39)**

| items - media | % |
|---|---|
| Facebook, Twitter or Instagram | 20.5 |
| Other (please specify) | 7.7 |
| Newspaper article | 2.6 |
| Blog post | 0.0 |
| Not specifically | 71.8 |

In terms of scaling up, it is also worth considering whether participants would take part in similar challenges in the future. In Hungary we asked participants about taking part in similar challenges in the future in an indirect way: we enquired whether they would like to participate individually, in a group, or not at all in something similar. With the exception of two participants (one each from ELL1 and ELL2) said that they would participate again. As for how they would like to participate, based on responses (see Figure 34) we can see an overall preference for participation in a group rather than individually. As Figure 35 shows, this preference is even more pronounced for ELL2 participants none of whom said that they would prefer to be involved individually.

**Figure 34. How ELL participants would like to take part in a similar future programme**
**Source: follow-up survey (n=39)**

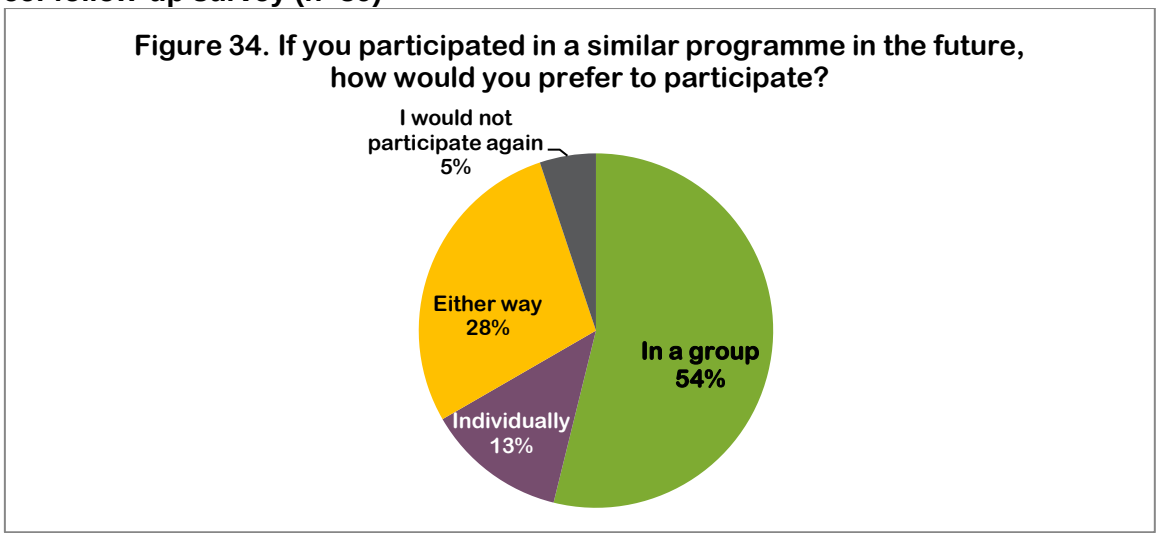
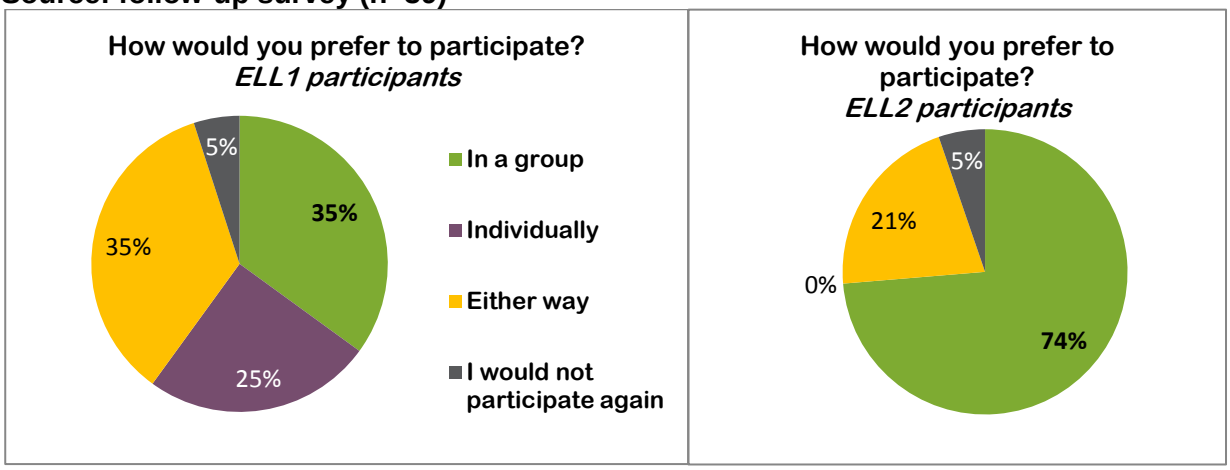



**Figure 35. How ELL1 and ELL2 participants would like to take part in a similar future programme**
**Source: follow-up survey (n=39)**



In addition, as further proof of their interest and willingness to experiment further with low-carbon living, 8 living lab participant households joined another initiative of GDI, namely the E.ON EnergyNeighbourhoods programme and formed an EnergyNeighbourhood in the framework of the programme. In this group they meet regularly and work together to reduce their energy consumption further. Moreover, several ENERGISE Living Lab participants also started joining the club events of the local Climate Club. They have also been invited to share their experience in the Living Lab through a roundtable discussion.

# 5. FEEDBACK FROM PARTICIPANTS AND IMPLEMENTATION TEAM ON ELL IMPLEMENTATION

For feedback from participants we look at information from three sources: (1) comments from participants from the closing individual interviews; (2) reflections from participants from the closing focus group discussion; and (3) comments from participants given three months after the completion of the ENERGISE Living Labs in the follow-up survey.

At the end of the individual interviews **ELL1 participants** were asked what they thought about their participation in the Living Labs. They were generally happy to have participated in the challenges and stated that they did learn new practices and skills, as well as received new information about energy use in the home.

> *"It was very interesting to participate; I was interested in finding out more about energy use and saving. It is worth paying attention to these things, I learnt about and became interested in saving energy through changing my everyday practices. It's amazing that I can still find ways to save." (female participant)*

> *"It gave me a good feeling to participate, I'd do it again. The challenge was good as it wasn't too much; it wasn't like we could hardly wait for it to stop although I'm not saying we'll miss writing the diary. And, in the end, even writing the diary wasn't such a big task." (female participant)*

At the same time, although the majority of comments are positive, some participants commented that at times it was very demanding to participate mainly due to the great amount of 'administration' (i.e. writing laundry and heating diaries, filling in weekly surveys, etc.) required. These sentiments are reflected in the quotes below:

> *"[Participation] gave us more things to do; we ended up with more tasks. But it was also challenging. And in return we received new ideas, tips and new experiences. It was interesting." (female participant)*

> *"It was tiring. I was happy to get home, but I still needed to read the meters. Sometimes I wished I did not sign up." (female participant)*

**ELL2 participants** offered similar comments about participation at the end of the closing focus group discussion. Participants generally loved being part of the ELL2 and nobody had any regrets about joining. For all it was great to belong to this group and participate at the meetings.

People loved the challenge kits and the meters. However, they also liked the fact that the ELL was all carefully thought out and everything was carefully planned. And even though there was a challenge, they could also choose their own challenge, which was good. The ENERGISE Living Labs felt like a game with rules.

The most important comment, about which a lot of participants were quite vocal, is that through participating in the ELL2 they gained confirmation, support and inspiration for leading environmentally friendly lifestyles as well as reducing their consumption. Furthermore, a lot of them would like to continue with their efforts for which there is also proof in sign-ups for various local and national sustainable lifestyle an programmes run by GDI (e.g. the local Climate Club, the national E.ON EnergyNeighbourhoods programme).

In addition, participants welcomed the opportunity and gained positive energy and inspiration from belonging to the ELL2 group.

Finally, 14 participants offered comments about participation and the ENERGISE Living Labs at the end of the **follow-up survey.** These comments are overwhelmingly positive, and several participants even expressed their thankfulness for being able to participate. Below, we provide the translation of several of these comments:

> *"It was a great experience for me to participate in this project, it was really inspiring, it has had an impact on other environmental aspects of my life as well. GreenDependent implemented the project in a very professional way, congratulations!!!" (female participant)*
>
> *"This is a great initiative! There definitely was a challenge. The presents were great and very good quality :)" (female participant)*
>
> *"I had a great time at the group events. The questions and tasks were good as they helped me become even more conscious about my energy use and focus more on my use. I think paying attention to these kinds of things has become part of my everyday life, thank you." (female participant)*
>
> *"It was interesting, I'd be happy to do the same with other focus areas." (female participant)*
>
> *"Thank you for the opportunity to participate, we have truly learnt and experienced a lot!' (female participant)*

# 6. CONCLUSIONS AND REFLECTION

As it was shown and detailed in the previous chapters, change towards more sustainable energy use and consumption occurred in many different ways during and even after the ENERGISE Living Labs. There were also quantitative and qualitative aspects of the change.

As for the **quantitative aspects**, in terms of doing laundry and washing clothes, there was change

- in the number of washes done every week (i.e. reduction on average in the ELL group);
- in the temperature of the washes (i.e. reduction on average); and also
- in the electricity consumption of doing laundry.

As for heating, the quantitative changes consisted of the following:

- reduction of indoor temperatures; and
- reduction of heating-related consumption.

The **qualitative change** that occurred also has several aspects. In the case of **laundry** changes in

- how participants use their washing machine;
- why participants decide to wash a piece of clothing;
- what kind of and how many practices they apply to avoid having to wash clothes; and also in
- a general level of awareness about the energy consumption of washing, social norms related to washing and how washing relates to the size and quality of our wardrobe.

In the case of **heating** the change was also manifold, relating to

- an awareness of temperature and the many factors that influence our indoor comfort;
- the use of the thermostat, thermostatic valves, doors and windows in the home and how their use has an impact on thermal comfort and heating energy consumption;
- the perception of what constitutes the ideal indoor temperature in various rooms; and to
- practices participants use to keep warm without having to turn the heating on.

It also needs to be noted that based on an analysis of responses given to the follow-up survey administered three months after the conclusion of the ENERGISE Living Labs, changes continued to occur even after the Living Labs ended, both in quantitative and qualitative terms. This is very encouraging; however, it would be useful to investigate what happens in the longer run, for example a year after the Living Labs ended.

As for **differences between ELL1 and ELL2**, or in other words between participating individually or in a group format, our analysis is still ongoing. Nevertheless, based on the results that we already have, it appears that confirming our previous findings from the literature in the Changing Behaviour project (Heiskanen *et al.*, 2010), **the group format seems to be more motivating for participants**. This is supported by

- how their mood changed during the process and the lower level of anxiety and higher level of excitement experienced by ELL2 participants (see Figure 24);
- the higher level of commitment by ELL2 participants measured, for example, in the number of weekly surveys not filled in, which is higher for ELL1 participants;
- and the many reported positive aspects of participating in group meetings that provided confirmation of sustainable lifestyles practices, learning opportunities as well as a sense of belonging to a group of like-minded individuals for participants.

It is also important to mention that organizing group-based living labs is less resource intensive than individual ones, so scaling up becomes more viable.

**Dissemination and scaling up of the ENERGISE Living Lab experience, outcomes and lessons learnt in Hungary** has been ongoing and is happening in various ways and at different levels. First of all, it is important to mention dissemination in the local community in which the

organization of the final ELL community event played a big role. At this event, with participation from local decision makers, stakeholders, local and national experts as well as ELL participants, the outcomes of the Hungarian ELLs were discussed, and potential ways forward were presented and debated. Local media reported on the event and outcomes both online and in a printed format. Then, we also need to note that several living lab participants have now become regulars at the local climate club, which is open to all local residents, and the local club also invited selected ELL participants to a roundtable discussion of their experience.

Finally, as noted above (see Table 30), several Living Lab participants have been active in spreading their experience and learning to family members, neighbours and co-workers.

Here, we also need to note that quite a few participants expressed interest in continuing the reduction of their energy consumption through the energy efficient renovation of their homes as well as installing renewable energy generation capacity.

The expert community in Hungary already heard about the ENERGISE Living Labs at various professional events, but they will also have the opportunity to read the present final report along with a summary in Hungarian. Furthermore, selected stakeholders - researchers, policy makers and intermediaries - will be invited to an expert workshop organized by GDI in the fall (2019) to further discuss outcomes and consider potential ways of using the methodology and taking the results further.

In addition, GreenDependent is in the process of considering how to apply the lessons learnt for its own national and European projects, both ongoing and planned.

Finally, in terms of **policy implications**, the Hungarian ELLs point to the importance of drawing attention to the role and responsibility of households in the energy transition, including the fact that even seemingly small changes in daily practices like reducing the temperature or the number of weekly washes can have big effects if each and every household makes them. Related to this and regarding methodology, combining qualitative and quantitative programme elements is a very effective way of helping participants change their practices.

To conclude, we should also underlie the significance of embedding initiatives like the ENERGISE Living Labs locally in order to contribute to their longer-term impact. The fact that GDI was known in the local community made the recruitment of participants easier and also helped to keep them involved in the programme. And since GDI - and other local initiatives - offer opportunities for ELL participants to stay engaged in sustainable lifestyles programmes, their longer term commitment, activity and further change is managed more easily and become part of a natural process.

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We are thankful to the Gödöllő Civil House and the Gödöllő NGO Roundtable for providing space for the first focus group discussion and the mid-term ELL2 meeting.

And last, but no least, we would like to thank all the ELL1 and ELL2 participants for their enthusiasm, perseverance and readiness to experiment with and change practices. Without them the ENERGISE Living Labs would not have been possible.

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# ANNEXES

## ANNEX 1.
## A SELECTION OF PHOTOGRAPHS TAKEN DURING ELL IMPLEMENTATION


Training for GreenDependent colleagues before the start of ELLs


Discussing important questions with energy experts in preparation for the ELL1 interviews

Background office work: configuring thermologgers

Sustainable delivery of challenge kits and starting the interviews

Challenge kits for ELL2 households – 1st focus group meeting


At the time of the first focus group meeting none the ELL participants knew what had been hidden in the challenge boxes ☺

A half-term ELL2 meeting inspired household to take the challenges serious

Discussing the experiences of heating and laundry challenge at the final focus group meeting

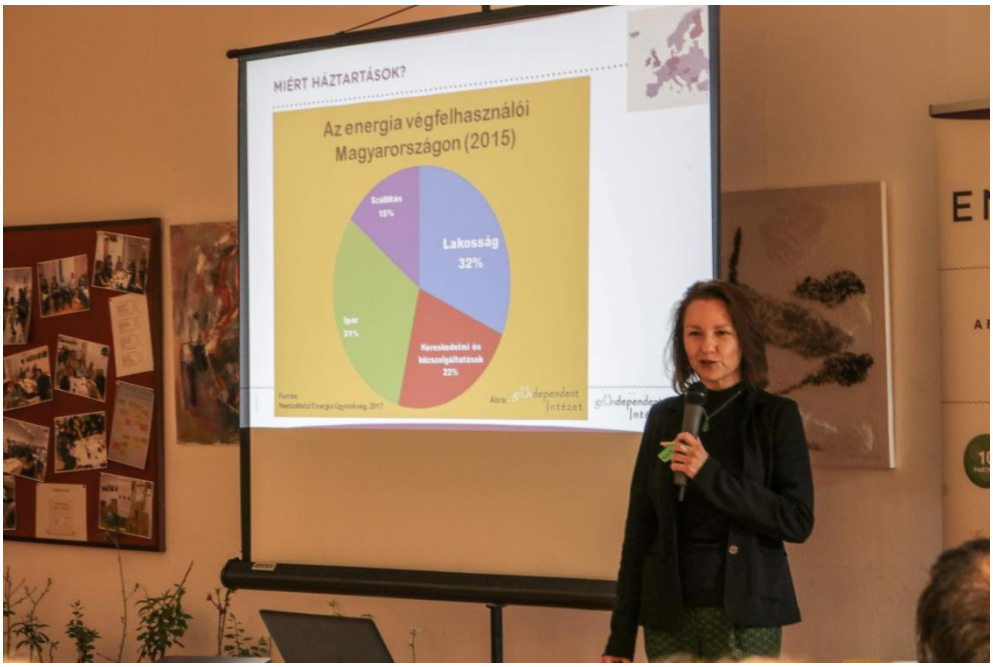
ELL2 and some ELL1 households celebrating the successful closure of the Living Lab challenges


Living Lab participants were given gifts (books, green vouchers) to appreciate their efforts

ENERGISE meeting at Budapest (Jan-Feb. 2019) hosted by GreenDependent Institute (with a picture exhibition of Hungarian ELLs in the background)


Results, experiences and analysis methodology of ELLs were broadly discussed at the Budapest meeting (here: presenting some of the Hungarian results)

Closing event of the ENERGISE Living Labs with more than 100 participants



Exciting results of ELL were shared in detail at the closing event

One of the experts invited talked about community energy (a way forward after the ELLs...)

An energy expert shared information about solar panels, heat pumps and the importance of proper insulation of homes (another way forward after the ELLs...)


The third expert was an eco engineer, presenting the concept of autonomous houses (still another way forward after the ELLs...)

At the closing event ELL1 and ELL2 participants had a chance to discuss their experiences


ELL participants and local stakeholders listen to the presentations

ELL1 and ELL2 households with their family members at the closing event


Delicious food was served at the closing event, including seasonal food and cakes with Living Lab logo from the local confectionery ☺

Households were given native fruit trees at the end of the closing event to offset carbon footprint of the ELL events


A happy native fruit tree owner

## ANNEX 2:
## THE ENERGYNEIGHBOURHOODS METHODOLOGY USED TO CALCULATE ENERGY SAVINGS

**Some of the basic principles for calculating energy saving using the EnergyNeighbourhoods methodology and online calculator:**

- The calculator automatically downloads the daily average temperature values for the given town/region/country from an official meteorological site.
- The historical or reference (i.e. prior to the project saving period) energy use of the household is calculated based on the preferably one year historical data (start value and end value) provided by the household. Households collect and share data for all relevant energy carriers (e.g. gas, electricity, water, coal, wood).
- The calculator transforms every value (J, MJ, m3, kg, etc.) into kWh and after a climate correction step for the heating values it provides users with an overall historical consumption for the household (e.g. X family - 18,300 kWh/year).
- The households start sharing meter readings at the beginning of the programme, in this case the ENERGISE Living Labs, and continue to do so regularly (e.g. every month) until the end of the programme, in this case 3 months after the ELLs concluded.
- After the second entry (e.g. a month into the programme period) the calculator calculates the used energy in kWh and after an extrapolation step it indicates whether the given household is going to save energy or not by the end of the saving period compared to the historical reference data. All the energy carriers can be seen, thus it may happen that a household saves in gas usage, but overuses electricity, etc.
  The saving is modified after each new data (i.e. meter reading) entry.

Below, the **technical part of the detailed calculation** process is explained[18]:

**1) Theory**

In which way is the energy saving calculated? There have been three important matters taken into account:

- the partitioning of the energy usage into the different household applications (such as cooking, central heating, warm water, etc.);
- the influence of temperature and seasons on the heating, but also on sanitary en electrical use;
- making sure the measured periods are comparable.

**The partitioning of the usage concerning the applications**

Each participant has to provide certain information. How he cooks (electrical, gas, etc,) how he heats (on oil, gas, electrical, wood,…), how he heats up his sanitary water, and how well his home is insulated (the insulation categories are defined based on national averages obtained from experts).

The programme (i.e. online calculator) calculates how much percent of gas and electricity usage goes to the different types of applications. This calculation is based on historical data and statistics.

Gas is divided between:

- central heating
- cooking
- production of hot water

[18] Source: EnergyNeighbourhoods 2 project and was developed in 2011 by the project consortium (project no. IEE/10/2013/SI2.589413). GDI has been using this methodology in its EnergyNeighbourhoods project for 7 years, continually updating the variables.

Electricity is divided between

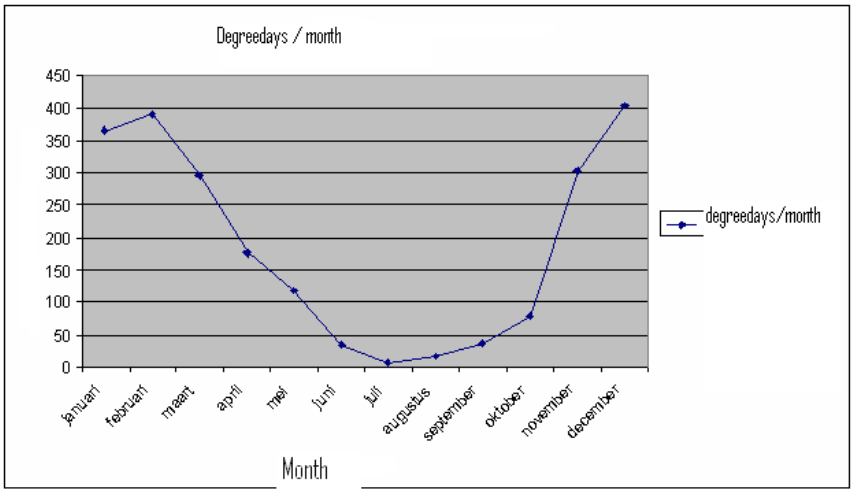
- heating
- cooking
- production of hot water
- other

**Why is this important?**
If it is colder outside, you will use more energy. But the temperature only affects on that part of the energy consumption, used for heating and in a lesser extent on the production of sanitary hot water. On cooking it has no influence. So for each type of usage, there has to be other corrections.

**The influence of temperature and seasons**

**Central Heating**
The energy used for central heating depends on outside temperature.
The outside temperature is notated in number of degree-days.
A degree day is the number of degrees below 16.5°C. If the average temperature is higher than 16.5°C, that day has zero degree-days. This method assumes that when its warmer than 16.5°C, you don't have to heat up your house.

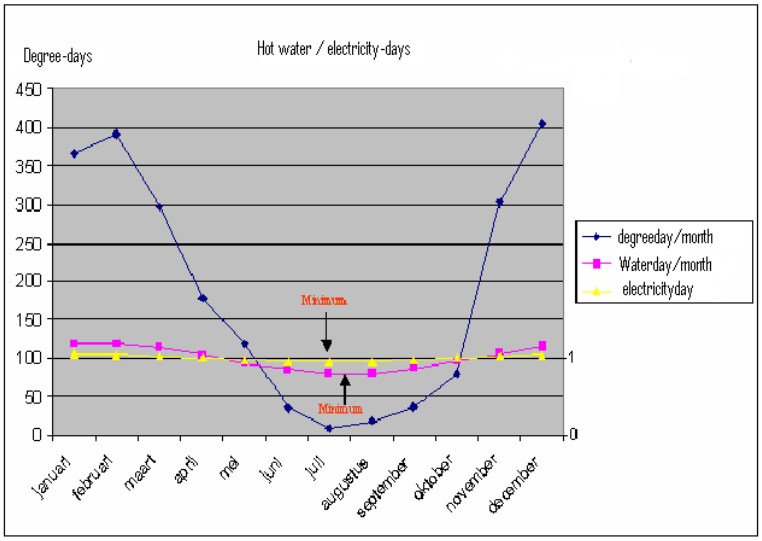
Example: if the average temperature for one day is 3°C, that day has 13.5 degree-days (16.5-3=13.5)




**Production of sanitary hot water**
The energy consumption for hot water also depends on the outside temperature but to a lesser degree and the influence has a delay.

In the wintertime, people us a little bit more hot water than in the summertime. The difference is smaller than the curve of central heating.
There's a delay: when it freezes, the temperature of your water will cool down after a few days, so you don't need more energy right away to heat up your water.

This unit is expressed in the fictional term "hot-water-day".




**Other uses of electricity**
The use of electricity depends on the outside temperature to a very small degree. In the wintertime lights stay on longer and people spend more time indoors.

**Cooking**
Cooking does not depend on the outside temperature.

**Making the measured periods comparable**
The reference period (the period to which we compare the current measured energy usage) is minimum 9 months, including a winter. To compare these two periods, both the reference data and the measured data have to be converted to a year.

**2) Formulas**
**Converting the reference use to a corrected reference use**
Step 1:
The reference use "gas used for central heating" is converted to a standard reference use (Corrected Referenc-use$_{aCV}$), by carrying out a correction on temperature (degree-days) and a time-correction (period)

$$\text{Corrected Referenc-use}_{aCV} = \frac{\text{number of kWh in reference period}}{\text{number of degree-days in reference period}} * \text{average number of degree-days in 1 year (2140)}$$

Step 2:
The reference use "gas used for hot water" is converted to a standard reference use (Corrected Referenc-use$_{aWW}$), by carrying out a correction on temperature (warm-water-days) and a time-correction (period)

$$\text{Corrected Referenc-use}_{aWW} = \frac{\text{number of kWh in reference period}}{\text{number of warm-water-days in reference period}} * \text{average number hot water-days/year (365)}$$

Step 3:
The reference use "gas used for cooking" is converted to a standard reference use (Corrected Referenc-use$_{aKO}$), by carrying out a time-correction (period)

$$\text{Corrected Referenc-use}_{aKO} = \frac{\text{number of kWh in reference period}}{\text{number of days in reference period}} * 365$$

Step 4:
The calculations for electricity are analogous with the calculation for gas.
For the correction of the other uses of electricity, an extra correction with the "electricity days" is necessary.
The end results for electricity must be multiplied once more with 2.5 (conversion to primary usage). This takes into account the fuel which is consumed for the production of electricity.

As a next step, the figures of gas and electricity are added up.

**Converting the measured use to a corrected measured use**
The measured use is converted in the same way as the reference use.

$$\text{Corrected measured-use}_{aCV} = \frac{\text{number of kWh in measured period}}{\text{number of degree-days in measured period}} * \text{average number degree-days/year}$$

**Comparing the corrected usages:**
Now it can be calculated how much percent the corrected measured usage differs from the corrected reference usage, and this for each application (aCV, aKO, aWW, aDI, eCV, etc.).

Thus, we arrive at the saving percentage of a participant.

For the percentage of a group, we do not take the average of all percentages. No, we add up all primary usages of the participants and we compare measure - and reference period of all participants together. Therefore someone with large energy consumption, counts heavily, someone with small energy consumption weighs less in the calculations.

**Comments**

- -The partitioning of the usage is based on averages. It is possible that this doesn't match a specific situation, example, when your house is very well isolated, the percentage of energy for central heating will be less.
  The averages are different for each country in Europe.

- The use of central heating not only depends on the outside temperature but also on wind, behaviour, what type of boiler participants have, etc,…

- The degree days need to be measured/collected separately for each European region.

The longer the period you measure (i.e. have meter readings for), the better the results!

## ANNEX 3:
## THE METHODOLOGY USED FOR CALCULATING LAUNDRY-RELATED AVOIDED $CO_2$ EMISSIONS

First, we calculated how many tons of CO2 emissions can be avoided in a month through the electricity consumption reduction achieved during 4 weeks (~ 1 month) by ELL participants, as shown in Table 27, repeated here:

| | Total kWh consumed by washing machines |
|---|---|
| Before laundry challenge (4 weeks) | 417.12 |
| During laundry challenge (4 weeks) | 315.56 |
| **Electricity saved** | **101.56** |

In Hungary, 1 kWh entails the emission of 0.25 kg $CO_2$[19]. So, 101.56 kWh means that 25.39 kg (or 0.025 tons) of $CO_2$ were avoided, which was achieved by 38 households.

From this, we can calculate the emission of how much $CO_2$ could be avoided if all households in the town of Gödöllő, and in Hungary saved the same amount[20]. These values will be for 1 month (see the first three rows of the table below.

From this we can arrive at the value for 1 year, which, of course, assumes that all households in Hungary will adopt practices like those adopted in the ELL households, and will keep doing them.

| | $CO_2$ (tons) | How many average Hungarian citizens emit this amount of $CO_2$ in a year? |
|---|---|---|
| ENERGISE Living Lab participants *in 1 month* (38 households) | 0.025 | - |
| All households in the town of Gödöllő *in 1 month* (12,015 households) | 8 | 2 |
| All households in Hungary *in 1 month* (4,105,708 households) | 2,742 | 566 |
| **All households in Hungary *in 1 year*** | **32,908** | **6,788** |

[19] Covenant of Mayors Default Emission Factors for the Member States of the European Union Dataset Version 2017
[20] Household number values are from the Central Statistical Office (HCSO, 2011d)