REMODECE WP3 -Sub task 3.2

Establishment of the samples for the monitoring and survey campaigns

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Introduction

The purpose of this document is to define a common method for the establishment of the samples of households participating to the monitoring campaign and the questionnaire based survey of the REMODECE project.

The analysis of the monitoring and survey campaigns results should help evaluate the equipment energy efficiency and to identify trends at national and European levels for the residential electricity consumption, including user behaviour in the selection and operation of the equipment. An important outcome of the project is the innovative combination of selective monitoring with a wider scale questionnaire based survey.

The common method for selection of the samples of households will enable cross comparison in the different countries involved. The characteristics of samples and sampling methods have direct consequences on how the result may be analysed.

1 Key issues

The analysis of the monitoring and survey campaigns should lead to evaluate the equipment energy efficiency and to identify trends at national and European levels for the residential electricity consumption, including user behaviour in the selection and operation of the equipment. It implies results must be of comparable structure in all participating countries, and a minimum of common rules in establishing the samples must be followed.

The constraints of both campaigns must be taken into account in terms of budget, time, available means and type of information to be retrieved from the samples. The requested level of representativeness of the samples varies according to the actual goal: a compromise must be reached between on one hand the need to apply statistical inference and on the other hand a budget and available means that limit the number of households to be monitored or surveyed as well as the time and means dedicated to the selection of the sample.

The analysis should help link together the results of the monitoring campaign, which is oriented towards efficiency of equipment and patterns of electricity use by end-uses, with those of the questionnaire based survey, which is more oriented towards study of behaviours and targets a larger number of households. A minimum degree of consistency between the selection processes of both samples must therefore also be respected. The information collected during both campaigns and the analysis of results must also be oriented to complete each other.

2 Considerations about representativeness

One must proceed with caution when applying statistical methods, as the representativeness of samples and the validity of results must first be evaluated. Ideally, applying statistical inference to the sample should enable to determine accurately figures at national level. The bias can be very important if the sample does not represent the participant population.

However the aim of REMODECE is not to describe precisely well defined strata of the population in terms of electricity consumption but to identify trends in patterns of use, equipment efficiency and behaviours.
The issue of representativeness must be tackled in different manners for the monitoring and survey campaigns. Since these have different constraints as for how many and which households will take part in the campaign, the selection of samples is guided by practical consideration as much as the necessity to achieve representativeness. Consistency of the sample is best satisfied by making certain a sufficient number of samples are collected and the variables of interest are properly chosen whenever possible, so that the sample matches the participant population.

3 Monitoring campaign

3.1 Scope

The monitoring campaign aims at establishing the pattern of use of domestic appliances in households and at evaluating their efficiency in real conditions of use. Thanks to the adopted method, which combines monitoring measurements to a behavioural questionnaire, comparison of these two sources of data from the same households might show a correlation between the consumption pattern on one hand and the habits and selection criteria of electric appliances on the other hand.

3.2 Collected data

Accurate data is collected by direct measurement of energy consumption by appliance or end-use. Equipment characteristics are also collected at the time of the installation of meters.

In order to keep the cost of the monitoring campaign within the allocated budget, the number of households taking part in the campaign is limited to 100 households per country. It is planned to dedicate on average 10 meters to major appliances or end-uses per household (cold, washing, consumer electronics…). In the case of lighting, at least the 10 main light sources should be monitored per household. The duration of 1 month per household is a target. Some partners have specified they would make ½ month monitoring.

The countries participating to the REMODECE campaign focus on different applications according to their past experience and expectations. Central and Eastern European (CEE) countries have little or no data available from previous monitoring campaigns about domestic appliances in general. Therefore they should focus on end-uses causing the biggest electricity consumption in the households. Older EU member states and Norway, who already have carried out monitoring campaigns about domestic appliances, are interested in evaluating the raise of new loads, such as electronics with special attention towards their standby consumption. Southern countries with an increasing use of air conditioning must also assess the trends of this load.

Due to the wide variety of equipment rate that can be encountered and the limited number of households willing to be monitored, we must focus on the appliances most likely to be found in typical households. The list of end-uses as defined in the contract must be used as a guideline to follow as closely as possible. The end-uses and appliances to be monitored are detailed in table 1 and table 2.

Countries	As agreed in the contract	If possible
Bulgaria Czech Republic Hungary Romania	- Total consumption (mains) - Washing machine - Tumble dryer - Entertainment as a group of appliances in living room: TV, DVD, CD - Computer and peripherals as a group for home office	Sum of computer and TV set per teenager room Cooker including oven Dishwasher Oil or gas burner including circulation pump

	- Refrigerator - Freezer - 10 most used lamps individually or the sum of lighting by groups - All kinds of standby consumptions recorded at the time of installation	

Table 1 List of appliances to be monitored in CEE countries

Countries	As agreed in the contract	If possible
Belgium Denmark France Germany Greece Italy Portugal Norway	- Total consumption - TV + VHS + DVD - Large TV screen or other unusual appliance might be monitored separately - CD + stereo - Computer and peripherals as a group in office room - Sum of computer and TV set for every teenager room - All kinds of standby consumptions recorded at the time of installation - 10 most used lamps individually or the sum of lighting by groups - Air condition (Southern countries)	Washing machine Tumble dryer Cooker including oven Dishwasher Refrigerator Freezer

Table 2 List of appliances to be monitored in older member states

3.3 Monitoring sample

Representativeness is best satisfied by making certain a sufficient number of samples are collected and the sampling categories are selected properly. However reaching 100 households willing to be monitored and having a suitable profile is very uncertain, especially if air conditioning is to be monitored. Practically, it is very likely that little selection can be done at this level and households responding to call for participation should be monitored.

Before discussing representativeness, the main difficulty to overcome is therefore to find participants. Approaches have been suggested by partners who have already experience in this field. Satisfying response rates have been obtained in other campaigns by broadcasting ads on the local radio. Incentives may encourage participation to the monitoring campaign, such as a personalised energy consumption diagnostic and advice for reducing the consumption. A small charge may even be applied so that it is perceived as a commercial service of quality.

3.4 Documenting the monitoring sample

The approach to find and select monitored households must be clearly documented in each country:
- how were the households contacted
- how many were directly contacted

- how many responded favourably
- were some parameters pre-determined (geographical location, type of dwelling, etc.)
- if a contacted household was considered as non eligible, the reasons should be clearly explained

3.5   Eligibility to monitoring: defining typical profile

It can be fairly assumed that the sample of 100 monitored households won't match nor represent the target population for any variable of interest. However typical profiles for each country may be simply defined that could still lead to discard a number of sites not suitable for the purpose of the project. The sample used for the monitoring campaign should not be regarded as representative and statistical inference cannot be directly applied to households. However it should be sufficient to draw valid conclusions per type of appliance or end-uses. It is still expected that patterns of use and appliance efficiency will reveal typical profiles in each country and common features to characterise residential electricity consumption at a European level.

The first criterion that makes a household eligible to monitoring is the equipment rate. If the equipment rate of the household is not sufficient or cannot bring any valuable information within the scope of the REMODECE project, obviously it should not be kept for monitoring.
A list of typical electrical equipment present in households should therefore be defined for each country and most of them must be found in the monitored household to describe it as typical. It is possible that in some countries this list does not match the list of appliances or end-uses defined in tables 1 and 2.

For instance in the case of France, one expects the typical equipment consists of:
- at least one light bulb in every room
- heating in most rooms
- kitchen equipped with a refrigerator, a cooker, a fan and an oven, maybe a dishwasher
- a washing machine, maybe a tumble dryer
- at least one TV set and DVD player
- at least one stereo
- a computer and a printer

If a large number of these appliances, say 50%, are not found in the household, then it cannot be regarded as a typical French household and should be discarded.

Atypical profiles should also be discarded, for instance:
- households with rare appliances w.r.t. national standards that could cause a high consumption
- holiday house / secondary residence
- home serving as an office
- exceptionally large family

4 Questionnaire based survey

4.1 Scope

The questionnaire based survey has a different purpose and different constraints from the monitoring campaign. The survey completes the monitoring campaign by focusing on the behaviour of users more than on the pattern of use and the actual consumption. It survey should help identify points where information campaigns, market oriented policies or new appliance features could influence behaviours towards awareness of energy saving in the selection and the operation of the equipment. Monitored households are included in the survey sample, which should help investigate the correlation between the pattern of use and these issues.
The whole process of sample selection, from defining the sampling frame and method to contacting the targeted household may be subcontracted to a marketing institute.

4.2 Sampling frame

The survey sample consists of a mimimum of 500 households per country, including the 100 households participating to the monitoring campaign. As mentioned above, these 100 households are unlikely to be selected for their representativeness of the national population for any variable of interest.
Selection of a representative sample can only be done through existing databases of consumers from national statistics or marketing institutes. However those are aimed at electricity consumption campaigns.
Furthermore, it must be reminded that a sample size of 500 for a total household population of several millions at national level is very low if several variables of interests are to be investigated. Little can be expected for an accurate application of statistics and this should be kept in mind when analysing the results. However we are interested in evaluating trends that clearly give a direction for policy recommendations and we don't need figures of high accuracy.

4.3 Sampling method

Quota sampling method may be applied to obtain a sample having the same profile as the national household population for one variable of interest. In any case convenience sample (i.e. chosen arbitrarily) must be avoided.
Households must be chosen in a structured manner. Selection of the sample should depend on relevant criteria. It can be very time consuming to gather some detailed information for the selection of the sample and then try to respect a preset ratio for every single variable. The number of selection criteria must therefore be limited.
The relevance of each criterion may vary according to the country, but at least one common variable of interest could facilitate cross comparison.
Thus each partner should set up to two custom priorities in addition to one compulsory common criterion.

Wherever national statistics are available, the proportions should correspond. If national statistics are not available, the custom criterion should be that best commonly known, even roughly.

4.4 Common variable of interest

The variable that seems the most linked to behavioural characteristics such as duration and frequency of use of appliances (washing, lighting, cooking, volume and number of rooms, etc.) and least discriminating is the number of members of the household.
- number of members: 1 or 2 , 3 or 4 , 5 or more

4.5 Custom criteria at national level

The decision is up to each partner as for which criteria (up to two) are more adapted to the country.
- type of dwelling: apartment / house
- location: rural / urban
- highest level of education in the household
- climate or cultural area (e.g. in Italy climate and cultural influence can roughly be split between North vs. South)

4.6 Distribution of the questionnaire

Various approaches are possible to reach the 500 households who will take part in the survey. However the cost of a method will vary according to the country (access to a consumer database, contacting households, etc.). The approach will therefore not be common to all partners, but instead it will adapt to the available means in each country.
Some partners have already gained experience with questionnaires and have suggested various approaches:
- In Germany, Fraunhofer-ISI has experienced a previous campaign for which questionnaire were sent as a 2 page attachment to other surveys conducted by GfK, and could reach a panel of some 20000 representative German households at a lesser cost (40000€ for the lot).
- Wherever affordable, some "representative" panel could be reached by subcontracting through national statistics institute or marketing services companies such as GfK, which ensures a high response rate.
- Email survey is believed to reach only households with a higher income in most countries, since they have an internet connection and are equipped with the necessary appliances.
- Internet survey: on the REMODECE website an online questionnaire could be filled up by the user. It would be convenient to use a user interface similar to online Energybox from SAFE.
- Some specialised websites offer the possibility of using predefined layouts, automated online distribution and systematic analysis of the questionnaire.

The questionnaire will be distributed to partners as an excel file, so that a common structure is adopted for treatment of answers. The format of the version distributed to households is up to each partner.

4.7 Documenting the survey sample

The approach to select and contact surveyed households must be clearly documented in each country. The following points should be recorded:
- What is/are the method(s) to contact households (online, marketing institute, mailing, etc.)

For each method:
- How many questionnaires have been sent?
- How many questionnaires have been returned and answered? it is important to know how many households were willing or unwilling in order to evaluate the bias due to non-respondents.
- In the case of non-respondent, is there a systematic characteristic standing out?
- If several rounds of contact occurred, how many?
- Was a subcontractor used to establish the sample or for diffusion of the questionnaire?
- Were national statistics available and used to establish the sample?
- What is the sampling frame? (where the contact details were taken from, e.g. directory, database from a marketing institute, etc.)
- What is the sampling method? (quota, random, geographical cluster)
- Is the survey nationwide? if not what were the restrictions?
- Which criteria or variables of interest have been used and for each one:
- Specify the national distribution per variable of interest
- Specify the resulting sample distribution per variable of interest

4.8 Content and structure of the questionnaire

Questions are clear and show little difficulty for understanding. Some terms that could cause misunderstanding are defined. Questions are sorted by end-uses to give a clear structure to the questionnaire and have been selected as the most relevant to identify the barriers preventing the penetration of energy-efficient equipment. Respondents should answer as many questions as possible but only when they know the answer. If a question shows a low response rate after analysis it should not be validated.

The time required to fill out the questionnaire was tested and is of the order of 15 to 25 minutes.

The questionnaire focuses on the user behaviour. It addresses four main issues:
- the equipment penetration rate in various end-uses
- the general characteristics of the equipment (type, age, quality, etc.)
- what are the criteria for acquiring new equipment?

- are the users aware of energy saving good practice? (awareness of energy saving functions, awareness of standby consumption, etc.)

Information to be collected are divided into the following sections:

Identification of the household: every surveyed household should be allocated an identification code but anonymity should be guaranteed to the respondent. This is both for practical and legal reasons: some respondents might be deterred from answering the whole questionnaire if they judge questions are too personal, and gathering this information without anonymity might not be legal in some countries.

Household details: gathers the main information about the household or family structure:
- household structure by age
- level of education
- global electricity consumption
- type of dwelling (single or multi-family)
- optionally another determinant, if relevant in the country for selection of the sample

Cold appliances:
- type of equipment used in the household
- main characteristics of equipment (age, capacity, energy class, etc.)
- awareness of electricity saving and good practice

Washing appliances:
- type of equipment used in the household
- main characteristics (age, capacity, energy class, etc.)
- awareness of electricity saving and good practice

Office electronics:
- type of equipment used in the household
- awareness of electricity saving and good practice, especially with standby consumption
- selection criteria

Home entertainment:
- type of equipment used in the household
- awareness of electricity saving and good practice, especially with standby consumption
- selection criteria

Air conditioning:
- type of equipment used in the household
- awareness of electricity saving and good practice
- condition of use and comfort requirements
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Lighting:
- type and distribution of bulbs used in the household
- awareness of electricity saving and good practice

- selection criteria

General questions about behaviour towards electricity saving