# STREAMSAVE DIALOGUE GROUPS

## PRIORITY ACTION:

## ENERGY EFFICIENCY MEASURES TO ALLEVIATE ENERGY POVERTY

# MINUTES OF MEETING 1

## TUESDAY 14 JUNE 2022

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# Short summary

This meeting discussed the calculation methodology and related issues about energy savings from energy efficiency measures to alleviate energy poverty. Key points highlighted in the discussions:

- There is a growing interest in energy efficiency measures to alleviate energy poverty and the related energy savings calculations. The proposed EED recast that reinforces the requirements related to energy poverty and the current energy crisis put these issues even higher on the agenda.
- The current practices of energy savings calculations for Article 7 EED rarely differentiate the calculations according to the type of households or dwellings, whereas there is a growing body of literature indicating significant differences in energy consumption, and thereby in energy savings, of energy poor households compared to other households.
- Likewise, studies have shown significant differences between theoretical energy consumption (as estimated by building energy models) and actual energy consumption (based on measurements or metering). These differences are larger for the least energy efficient dwellings (overestimations by the models).
- Differences between theoretical and actual energy savings can also be due to performance gaps (lower performance of the measure installed compared to the expectation, for example due to defaults in the installation, different conditions of use compared to the standard conditions used to define the manufacturer data, …).
- A common approach to address these issues is to include correction factors in the calculation formula (e.g., prebound effect, rebound effect / comfort taking factor, performance gap / measure correction factor).
- The literature provides indicative values of such factors for space heating (but with variability from one study to the other). There is less evidence available for other end-uses (e.g. electrical appliances).
- While rarely implemented yet, another complementary approach would be to consider indicative values for key parameters (e.g., space heating demand, heating system efficiency) that would be differentiated by energy band of dwellings and/or by type of households.

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| 15:50 | Open discussion |

*(All times are in CEST)*

# PART 1: streamSAVE methodology for energy efficiency measures to alleviate energy poverty

## Scope and main issues addressed in the methodology, by Kelsey van Maris and Guillermo Borragán Pedraz (VITO)

*(See presentation file available on the streamSAVE Knowledge and support facility)*

Kelsey van Maris explained briefly the context of developing a methodology for energy efficiency measures to alleviate energy poverty, especially the related requirements in Article 7 EED that should become Article 8 EED with the currently proposed EED recast, that **reinforces these requirements**.

If this proposal is adopted, Member States would need to achieve a **share of the energy savings** they report to Article 7 (then 8) EED among people affected by energy poverty, vulnerable customers and, where applicable, people living in social housing.

The Governance Regulation of the Energy Union ((EU) 2018/1999) already requires Member States to report information on the amount of savings achieved by policy measures aimed at alleviation of energy poverty in line with current Article 7(11) EED.

A review of current practices shows that most often there is no differentiation in the savings calculations according to the type of households. The objective of the streamSAVE methodology is to **investigate the possible differences in energy consumption, and thereby in energy savings**, of energy poor households compared to other households.

However, **the streamSAVE project does not specify a definition of energy poverty**, as the practical definitions of energy poverty vary substantially from one country to the other (when any).

The streamSAVE methodology is focused on measures dealing with building renovation (insulation), heating installation (small-scale RES) and behavioural measures. Heating systems and behavioural measures are also dealt with in other streamSAVE methodologies (but not considering the special issues related to energy poverty).

Guillermo Borragán Pedraz then presented the current findings and developments for each type of measure.

About **insulation measures**, the main differences in the calculation formula are the introduction of two special factors:

- the prebound effect (to adjust the energy consumption before the action);
- the rebound effect (to adjust the energy savings after the action).

The objective of these factors is to reflect the possible differences between conventional energy consumption (based on standard assumptions on indoor temperature, heating periods, etc.) and actual energy consumption (taking into account actual behaviours).

A review of 9 studies has found an average of about -35% for prebound effect in energy poor households, due to self-rationing (cf. households who cannot afford a standard use of space heating).

A review of 13 studies has found an average of about 24% for rebound effect (lower savings after the interventions).

In both cases, prebound and rebound effects, there is a large variability in the results from the different studies. Therefore, the indicative values should be taken with caution (kind of benchmark).

About **heating systems**, the research looked at differences in average characteristics of heating systems (efficiency) between energy poor households and other households. Energy poor households indeed tend to have less efficient heating systems. However, there might be large variations among countries, as the main type of heating system might differ, and also the rate of equipment for heating system might differ (e.g., lower rate in Southern countries).

About **behaviour changes** (focus on feedback and tailored advise in residential sector, as defined in the related Priority Action), the original idea was to look for a specific factor for energy saving effect when considering behaviour changes among energy poor households. However, there is not enough data or evidence in the literature to support this. Therefore instead, the approach is to include a factor for prebound effect to adjust the energy consumption before the behavioural intervention (as done for insulation and heating systems). Rebound effect is normally not relevant in case of behaviour measures, as the objective of these measures is indeed to optimise the energy-using behaviours.

The remaining issue is to find sources about possible prebound effects for electricity consumption.

### Q&A

- *Are the factors about prebound and rebound effects also applicable when calculating savings from heating systems?*

Yes, the calculation approach is the same for both cases, insulation and heating systems. The difference between both is in what is improved (reduction of the heating demand in case of insulation, improvement of the efficiency in case of heating systems).

- *How did you define the prebound effect?*

The prebound effect is not as well defined as rebound effect. The starting point on prebound effect is the following paper:

Sunikka-Blank, M., & Galvin, R. (2012). Introducing the prebound effect: the gap between performance and actual energy consumption. *Building Research & Information*, 40(3), 260-273.

Then we reviewed all the papers that mentioned the prebound effect to specify the indicative values used in the streamSAVE methodology. The report will include the references found on this issue.

# PART 2: Experiences from two countries

### Energy poverty quantitative measurement: methodology and case studies in Italy, by Anna Realini (RSE - Ricerca sul Sistema Energetico)

*(See presentation file available on the streamSAVE Knowledge and support facility)*

Anna Realini presented the results from projects done by RSE (public research institute owned by the ministry of economy and finance, dealing with energy systems from the consumers' viewpoint).

Research by RSE on energy poverty have investigated in particular three different approaches, that provided opportunities to monitor and assess the impacts of energy efficiency measures aiming at alleviating energy poverty. These impacts include energy savings, but also other impacts according to the projects (e.g., comfort improvement, health).

The first project is the national project Energia Su Misura (2015-2018), that aimed at identifying the most relevant **variables explaining variations in energy consumption** of Italian households, and at evaluating the effects of different energy efficiency measures (including building retrofits and behavioural effects), including the validation of models with measurements.

The energy poverty focus of this project was to analyse the **causes of differences in energy consumption** between energy poor/vulnerable households and other households. The 'energy poor' group was defined based on income criteria, and the energy poor households in the sample investigated were living in social housing.

A **monitoring campaign** was done with 67 households (distributed in the North, Centre and South of Italy), focused on **electricity consumption**, and with a duration over 225 days on average. The monitoring campaign also looked at differences in **equipment rates** (about electrical appliances).

The energy **vulnerable households were found to consume much less** than the average Italian households, **whereas they pay more.** So the main issue is energy cost (and tariff), rather than energy consumption. However, it was also noted that energy vulnerable households have in general old and inefficient appliances.

Another lesson learnt from this campaign was that it was more difficult to recruit households for the measurements among the ones living in social housing (the 'energy poverty' group) compared to the other households.

The second project is the European project ASSIST (2017-2020), that aimed at training **Home Energy Advisors (HEAs) to support energy poor consumers** in saving energy, and testing different approaches to implement pilot actions among energy vulnerable consumers (mostly through behavioural changes).

The presentation focused on the monitoring part of the project. It included two levels: one about the number of involved participants (both, HEAs and vulnerable households); and one about the impacts in terms of energy savings, comfort increase, cost reduction and consumer empowerment.

The **monitoring of impact** was covering a sample of 10% of the participants with calculation of energy consumption before and after the intervention. This was complemented with a survey of the 90% other participants.

A key component of the ASSIST methodology was the definition of **three Key Performance Indicators**:

- Energy savings: it monitored the amount of energy saved (in kWh and %) thanks to the pilot actions.

- Energy Savings Indicator (ESI): it was defined to **go beyond the savings in energy terms**, considering also the monetary savings, and the improvements in comfort and quality of life (based on the answers to the survey).
- Vulnerability Empowerment Factor (VEF): it was designed to assess consumers' confidence in dealing with energy issues at home (also based on the survey).

Overall, more than 300 HEAs get trained by the project and supported more than 420 000 participants in six countries (Belgium, Finland, Italy, Poland, Spain and United Kingdom), with significant variations among countries (e.g., 300 000 households in Finland).

The **energy savings** were in the range **from 4 to 7%**. The Energy Savings Indicator was assessed to be between 2 to 5.5% on average according to the country.

The differences between the countries are also due to **differences in the definition** of the 'energy poverty' group **and in the methodology** used to assess the impacts (including about metering). A harmonised definition and methodology (and availability of data) to evaluate the real impact of energy poverty and measures to tackle energy poverty is needed.

This experience showed that the **monitoring period** should be **at least one year**, not only to represent seasonal variations (for heating and cooling) but also to avoid bias due to random variations and to enable normalizing the data (as done when correcting for weather conditions with Heating Degree Days).

**Direct monitoring** proved **essential** to get reliable energy data. Energy data collected with questionnaires might not be reliable enough.

The third project is an on-going research started in 2019, on the **interactions between energy poverty and health**, and the related financial implications. The starting point of this research is that energy poverty is not limited to not affording space heating and living in cold homes. The Italian definition considers energy poverty more broadly as the "*inability to purchase a minimum set of energy goods and services, with consequences on consumers'physical and mental health*".

The research started by investigating the energy needs and costs of households, and by applying an energy poverty indicator and characterizing which households are vulnerable. Then these results were **related to the health status** of the members of vulnerable households considering relevant pathologies.

The next step will be to assess the costs due to the treatment of the pathologies linked to energy poverty, and ultimately to assess the **payback time thanks to reduced health costs** from energy efficiency improvements of low-quality buildings.

The part of the research on **energy poverty indicator** resulted in a proposal to improve the indicator previously defined in the Italian National Energy Strategy of 2017. The new proposal broadens the parameter of energy needs to **encompass all domestic energy end-uses** (including cooling, lighting and electrical appliances), whereas the previous indicator was focused on heating needs.

Considering cooling needs would increase the estimate of energy poor households in Italy by about 500 000 households. A specificity of the cooling costs is that the largest share of the cooling cost is the installation cost, and then maintenance cost. The direct energy cost of cooling is limited (much lower number of operating hours compared to heating).

## Q&A

- *The data collected are really valuable, and this type of research is very important. Was the research significantly affected by the Covid period?*

Not, because the monitoring campaigns ended by January 2020. So fortunately, it was completed before COVID.

- *How did you recruit the HEAs (Home Energy Advisors) (in the ASSIST project)?*

The recruitment was different in each country. The project involved a variety of stakeholders, including NGOs and other organisations having an active network in the territories and with experience in contacting vulnerable households (but not necessarily experienced with energy issues; e.g., nurses). These organisations act as intermediaries to reach vulnerable households, and their members were trained to provide energy advice.

- *In the first project (Energi Su Misera), demographics show an 'energy poverty' population relatively old: can the underuse of appliances found in this group be explained by age and not necesarily by energy prices?*

Yes and no. Households were not under-using their equipment (e.g., rather intensive use of TV). However, they have less equipment compared to other households (for example, much lower equipment rate for dishwasher or microwave oven). And for most types of appliances, age does not explain the difference in the equipment rate.

## Modelling real world energy savings in UK policy appraisal – challenges and potential approaches, by Avishek Banerjee (BEIS – UK Department for Business, Energy and Industrial Strategy)

*(See presentation file available on the streamSAVE Knowledge and support facility)*

Avishek Banerjee presented current research done at BEIS about the **difference between the theoretical and 'real world' energy demand**, and thereby improving the assessment of 'real world' energy savings.

The theoretical demand means the one as assessed by energy models assuming standard occupancy and heating patterns. While real word demand means data based on measured data or model that accounts for the **actual behaviour** of the occupant.

Assessing theoretical demand and energy savings can be more relevant when comparing the energy performance of different technologies or houses (independently of the user behaviour). While assessing 'real world' savings can be more relevant when the objective is to assess the likely impact of a policy.

Research has shown that the **differences** between theroretical and 'real world' energy consumption **may vary according to the level of energy performance** of the dwelling: higher gaps are found in the least performant dwellings (e.g., modelled consumption more than twice as much as 'real world' consumption for F-rated dwellings). A **smaller, but still significant difference** can also be observed **according to income levels.**

Different factors can be included in energy models to reduce the difference of the estimated energy consumption compared to the actual one. Correcting for **external and indoor temperatures and heating period** can for example have a **major influence**.

Currently, the approach used at BEIS is to apply 2 correction factors to the initial energy savings estimates: a 'measure correction factor' and a 'comfort taking factor'.

The **measure correction factor** takes into account the possible performance gap between the expected impact of the measure, and its actual impact.

The **comfort taking factor** takes into account the possible rebound effect.

Using these correction factors improved the energy savings estimates. However, the **limitation** in this approach is that a **single value** is applied for **each factor**, whatever the initial energy performance of the dwelling and the income level of the household.

Another limitation is that the factors are applied to the energy savings. Which means that there is no correction of the energy demand before the intervention.

The work on these factors and reducing the difference between theoretical and 'real world' energy consumption and savings combines **several tools and data sources**, including:

- The **Standard Assessment Procedure** (SAP), i.e. the energy model used to establish the Energy Performance Certificates (EPCs).
- **Two major national surveys** (EHS – English Housing Survey, and EFUS – Energy Follow up Survey) that provide data about the households and their dwellings (EHS, thousands of households, annual) and about indoor temperature (EFUS, sub-sample of EHS, hundreds of households, every 10 years).
- The **National Buildings Model** (NBM), a housing stock energy model using SAP on the EHS sample, that can be used to simulate the installation of different measures on each house of the sample.
- The **National Energy Efficiency Data Framework** (NEED) that gathers and relates different databases, matching annual electricity and gas meter data for millions of households with EPC data and other data sources (including the installation of energy efficiency measures supported by a government scheme).

The **combination of detailed survey data and measured consumption data** is important: survey data are key inputs for the energy models, and the measured data enable to calibrate the models to 'real world' demand.

Further improvements are currently under consideration, that could investigate four new approaches.

The **first option** would be to update the current approach for the correction factors, to **use more granular factors** according to different types of dwellings or households. While this should be relatibely easy to implement, this would not solve the issue of differences in the energy demand before intervention. Moreover, the new correction factors would not be as granular as the data available from the research.

The **second option** would be to **update the input temperatures and heating patterns** in the SAP model, as these prove to be critical parameters explaining a large share of the differences observed. This would imply to create a model to predict internal temperature according to certain characteristics of households*dwellings. Then, the parameters used to represent the measure installed could be fine tuned to better reflect the 'real world' performance of measures. While this would **integrate all the corrections directly in the model**, enabling a dwelling*household-specific estimate, it remains very difficult to predict internal temperature.

The **third option** would be to apply proportional energy savings from energy model to a **more accurate estimate of starting demand.** This would imply to create a statistical model of starting demand and to combine this with proportional theoretical modelled savings. Like in the second option, the parameters about the measure could be fine-tuned. While this seems achievable with the data already available (and, like the second option, this would provide dwelling*household-specific estimates), this would require combining three different models. Which could be challenging and computation-intensive.

## Q&A

- *is the difference among income levels partly explained because low income households usually live in less energy efficient buildings?*

It is indeed part of the explanation. However, a large share of the low income households live in social housing that has a rather good energy performance level. Moreover, differences between theoretical and 'real world' consumption are also observed in higher income levels.

- *Using correction factors usually lead to smaller results. What are the reactions of policy officers or programme managers to this?*

Analysis is valued in the policy making, as it is essential to improve the policies and have a better idea of their actual impacts. But it can indeed be challenging. There can be some difficulties sometimes, but overall the policy team understands that evidence-based results is better.

- *How to define the types of households to differentiate the factors?*

We use a statistical model of heat demand matching metered data and data from surveys. We perform regressions to assess what are the most important explanatory variables. Then we can look at how these variables are related to households' characteristics.

# List of participants

33 participants

| Name | First name | Organisation | Country |
|---|---|---|---|
| Agius | Matthias | The Energy and Water Agency | Malta |
| Alberti | Livia | Aisfor | Italy |
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