streamSAVE 2nd Dialogue on Energy Poverty

STREAMLINING ENERGY SAVINGS CALCULATIONS

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PRIORITY ACTION EIGHT

ACTIONS TO ALLEVIATE ENERGY POVERTY

WHAT ARE ACTIONS TO ALLEVIATE ENERGY POVERTY?

Energy poverty is the incapacity of a household to maintain reasonable conditions of indoor comfort. Actions to alleviate energy poverty include the initiatives, measures and policies put in place to mitigate increases in energy prices or to facilitate access to energy efficiency improvements, such as building renovation programs or funds to install solar panels or heat pumps.

WHAT ARE THE BENEFITS OF THE ENERGY SAVINGS ACHIEVED?

Although research has shown that measures targeting energy efficiency improvements for energy poor households do not always lead to energy savings, they have other important impacts. These benefits include higher comfort levels, healthier indoor air quality, reduction of stress and illness, and increase in self-esteem (JRC, 2020).

WHAT ARE THE ENERGY SAVINGS OPPORTUNITIES?

The energy savings opportunities encompass renewable energy generation for heating and building insulation as well as tailored feedback to optimise consumption. These actions are expected to allow energy poor households to benefit from energy services while making their consumption adequate to their needs.

WHAT MAKES CALCULATING ENERGY SAVINGS CHALLENGING?

The prebound effect, the result of under-consumption in inefficient buildings (Sunikka-blank et al., 2012) and the rebound effect, caused by over-consumption post- renovation (Galvin, 2015a), impact the success of renovation (Friege & Chappin, 2014). Both effects can lead to the miscalculation of energy savings and emissions (Teli et al., 2016).

WHAT IS NEEDED TO IMPROVE ENERGY SAVINGS CALCULATIONS?

Correction factors are needed to adjust the real outputs of renovation programs that target households in energy poverty. Most of these programs concern the renovation of buildings, the replacement of heating systems, energy advice and the replacement of household equipment. Therefore, there is a need to develop calculation formulas covering these specific actions.

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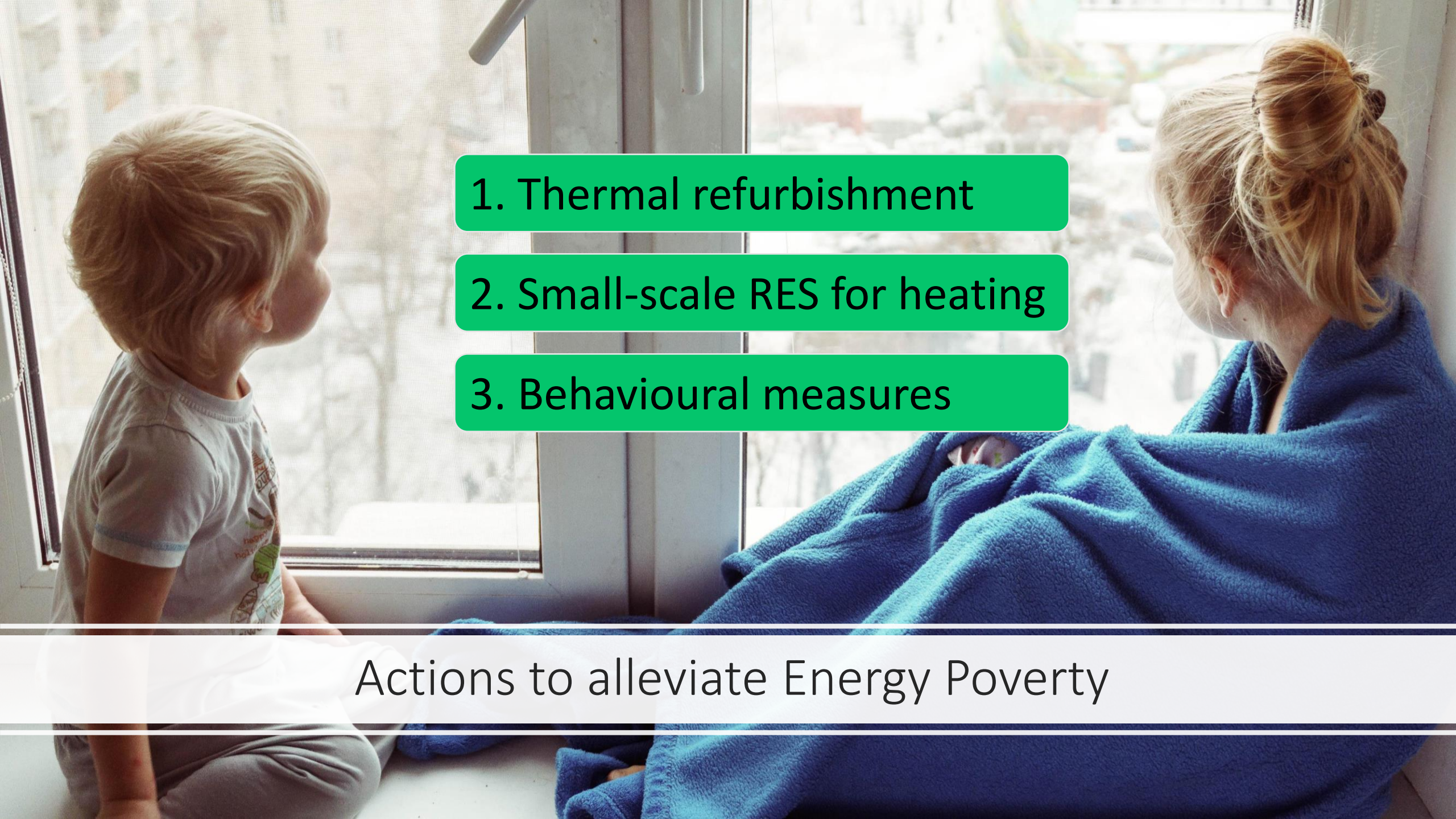
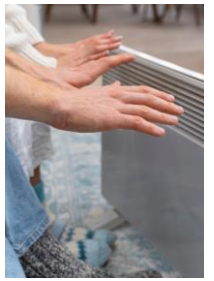
https://streamsave.eu/priority-actions-impacts/#page



Actions to alleviate Energy Poverty

Calculation methodology – Art. 7 Thermal refurbishment

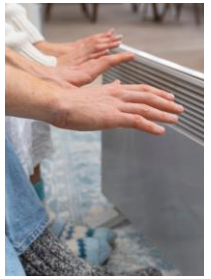


$$TFES = (FEC_{baseline} - FEC_{action}) \cdot (1 - f_{BEH})$$

$$TFES = A \cdot \left(\frac{SHD_{baseline} \cdot (1 - f_{prebound\ EPOV}) + DHW}{eff} - \frac{SHD_{action} + DHW}{eff} \right) \cdot (1 - f_{BEH})$$

TFES	Total Final Energy Savings [kWh/a]
$FEC_{baseline}$	Final energy consumption for end-use, before building refurbishment [kWh/a]
FEC_{action}	Final energy consumption for end-use, after building refurbishment [kWh/a]
A	Useful floor area of the refurbished building [m^2]
$SHD_{baseline}$	Specific space heating demand of the reference building [$kWh/m^2/a$]
SHD_{action}	Specific space heating demand of the efficient building [$kWh/m^2/a$]
HWD	Specific domestic hot water demand [$kWh/m^2/a$]
eff	Conversion efficiency of the heating system [dmnl]
$f_{prebound\ EPOV}$	Factor for adjusting baseline consumption of average household to energy poor household [dmnl]
f_{BEH}	Factor to adjust for rebound effects of the action [dmnl]

Calculation methodology – Art. 7 Thermal refurbishment

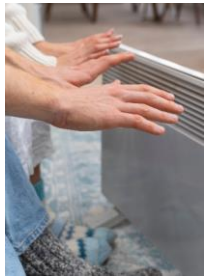


- Rebound effects (0,25) & prebound effects (0,35): based on literature review; median of all scores reported (n=5 for prebound; n=14 for rebound)
- Conversion efficiency of heating systems EPOV: less efficient systems
- EU indicative values to be adjusted to national circumstances!

f_{BEH}	[dmnl]
Residential – average* and EPOV	0.25
$f_{prebound\ EPOV}$	[dmnl]
Residential – average*	0.00
Residential - EPOV	0.35
eff	[dmnl]
Residential – average	0.712
Residential - EPOV	0.630
$SHD_{baseline}$	[kWh/m² useful floor area a]
Residential	92.1
SHD_{action}	[kWh/m² useful floor area a]
Residential	Depending on type and degree of refurbishment
HWD	[kWh/m² useful floor area a]
Residential	19.2
Lifetime of savings	[years]
Lifetime of savings	>25

*Note: Average represents the indicative values for an average, EU27 household, while EPOV is representing values specifically for energy poor households.

Calculation methodology – Art. 7
Small-scale RES for heating

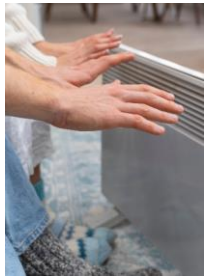


$$TFES = (FEC_{baseline} - FEC_{action}) \cdot (1 - f_{BEH})$$

$$TFES = A \cdot \left(SHD \cdot (1 - f_{prebound\ EPOV}) + HWD\right) \cdot \left(\frac{1}{eff_{baseline}} - \frac{1}{eff_{action}}\right) \cdot (1 - f_{BEH})$$

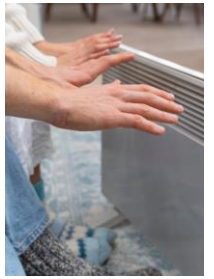
TFES	Total Final Energy Savings [kWh/a]
$FEC_{baseline}$	Final energy consumption for end-use, before the action [kWh/a]
FEC_{action}	Final energy consumption for end-use, after the action [kWh/a]
A	Useful floor area of the dwelling [m^2]
SHD	Specific space heating demand of the dwelling [$kWh/m^2/a$]
HWD	Specific domestic hot water demand of the dwelling [$kWh/m^2/a$]
$eff_{baseline}$	Conversion efficiency of the reference heating system [dmnl]
eff_{action}	Conversion efficiency of heating system after the action [dmnl]
$f_{prebound\ EPOV}$	Factor for adjusting baseline consumption of average household to energy poor household [dmnl]
f_{BEH}	Factor to adjust for rebound effects of the action [dmnl]

Calculation methodology – Art. 7
Small-scale RES for heating



f_{BEH}	[dmnl]
Residential – average* and EPOV	0.25
$f_{prebound\ EPOV}$	[dmnl]
Residential – average*	0.00
Residential - EPOV	0.35
$eff_{baseline}$ – heating system	[dmnl]
Residential – average	0.712
Residential - EPOV	0.630
eff_{action} – heating system	[dmnl]
Residential – average* and EPOV: Biomass boiler	0.92
Residential – average* and EPOV: Air source HP	2.6
Residential – average* and EPOV: Ground source HP	3.2
Residential – average* and EPOV: Groundwater HP	3.5
SHD	[kWh/m^2 useful floor area a]
Residential – average* and EPOV	92.1
HWD	[kWh/m^2 useful floor area a]
Residential – average* and EPOV	19.2
Lifetime of savings	10 (air to air) 15 (air to water) 25 (geothermal) 20 (biomass boiler)

Calculation methodology – Art. 7 Behavioural measures



- Feedback and feedback including tailored advice

$$TFES = \mathrm{N} \times \mathrm{UFEC} \times \mathrm{f}_{\mathrm{prebound}} \times \mathrm{S} \times \mathrm{dc}$$

TFES	Total final energy savings [kWh/a]
N	Number of participants [dmnl]
UFEC	Unitary Final Energy Consumption of an average household (electricity or gas) [kWh/a]
$\mathbf{f}_{\text{prebound EPOV}}$	Factor for adjusting consumption of average household to energy poor household [dmnl]
S	Energy saving factor [%]
dc	Double-counting factor [%]

- Indicative values – cf. PA behavioural changes:
  - UFEC: from Odysee-MURE, 2019 values per EU country
  - Saving factors:

Final use	Type of measure	Energy savings factor (S) [%]
Electricity	Feedback	2.30%
	Feedback with tailored advice	3.50%
Electricity for heating	Feedback	2%
	Feedback with tailored advice	3%
Gas for heating	Feedback	3.40%
	Feedback with tailored advice	3.60%

Impact on energy consumption (Article 3)

$$EPEC = FEC_{Baseline} \cdot \sum_{ec}\left(share_{ec,Baseline} \cdot f_{PE,ec}\right) - FEC_{Action} \cdot \sum_{ec}\left(share_{ec,Action} \cdot f_{PE,ec}\right)$$

EPEC	Effect on primary energy consumption [kWh/a]
FEC	Annual final energy consumption [kWh/a]
$share_{ec}$	Share of final energy carrier on final energy consumption [dmnl]
$f_{PE,ec}$	Final to primary energy conversion factor of the used energy carrier [dmnl]
Baseline	Index for the baseline situation of the action
Action	Index for the situation after the implementation of the action
ec	Index of energy carrier

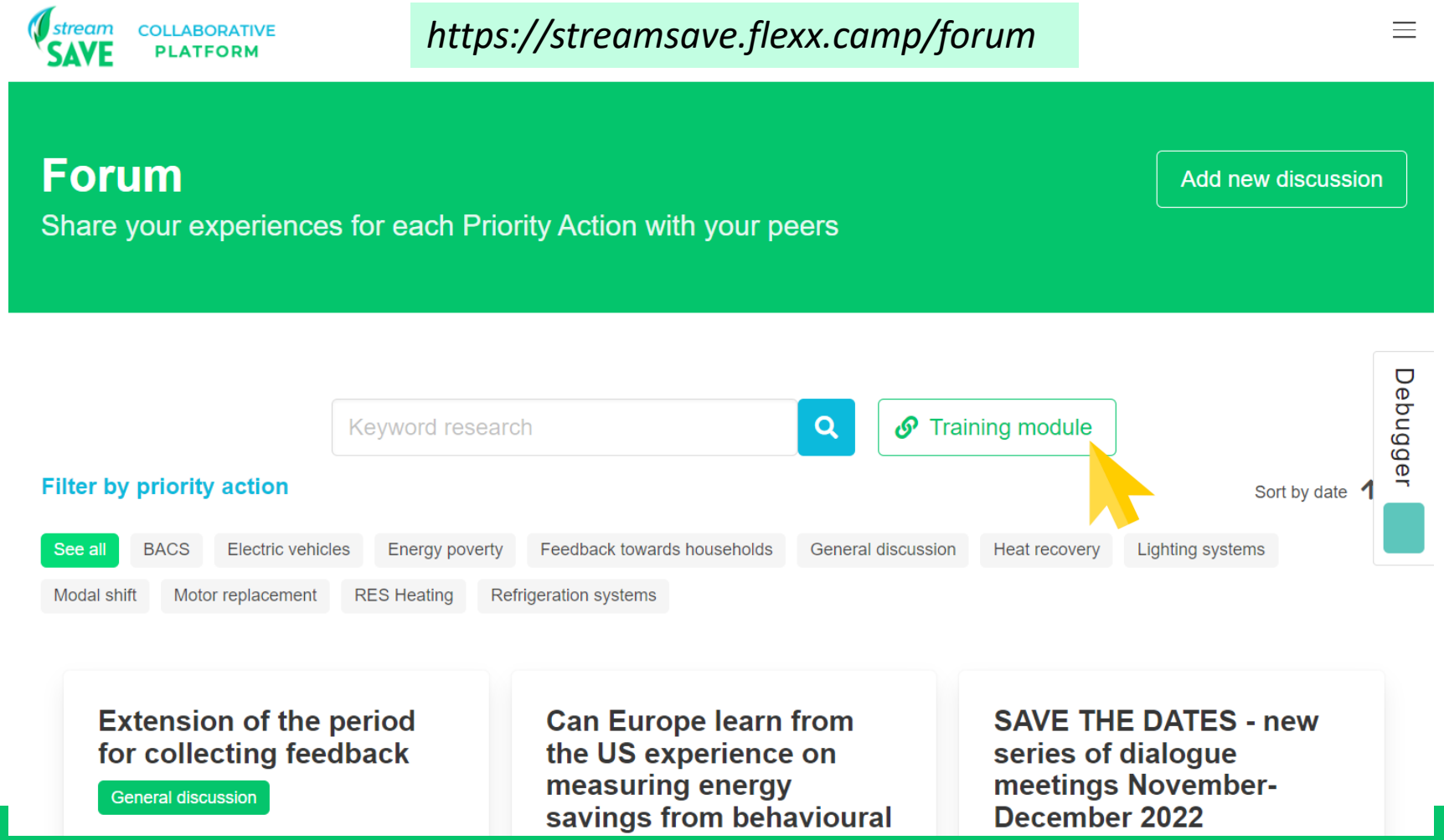
Calculation of CO2 savings

$$GHGSAV = \left[FEC_{Baseline} \cdot \sum_{ec} \left(share_{ec,Baseline} \cdot f_{GHG,ec}\right) - FEC_{Action} \cdot \sum_{ec} \left(share_{ec,Action} \cdot f_{GHG,ec}\right)\right] \cdot 10^{-6}$$

GHGSAV	Greenhouse gas savings [t CO_2/a]
FEC	Annual final energy consumption [kWh/a]
share	Share of final energy carrier on final energy consumption [dmnl]
f_{GHG}	Emission factor of final energy carrier [g CO_2/kWh]
Baseline	Index for the baseline situation of the action
Action	Index for the situation after implementation of the action
ec	Index of energy carrier

WHERE TO FIND IT?

Collaborative Platform



Training module for Energy poverty

- Overall potential calculates the energy savings resulting from the overall modal shift potential. Another Excel sheet is available to assess the savings resulting from modal shift potential per distance class and group of goods.
- Potential per distance class and group of goods calculates the modal shift potential per distance class and group of goods. Another Excel sheet is available to assess the savings resulting from the overall shift potential.

Small-scale renewable heating technologies

Heat pumps | Biomass boilers

The scope of this Priority Action is to estimate the annual energy and emission savings that can be achieved with the installation of small-scale renewable energy systems for central heating in buildings. The developed methodologies cover residential as well as non-residential buildings. Methodologies have been prepared for the following technologies:

- Heat pumps for heating and domestic hot water
- Biomass boilers for heating and domestic hot water

Energy Poverty

Feedback and tailored advice | Small scale renewable heating systems | Thermally refurbished buildings

Energy or fuel poverty can be defined as the incapacity of a household to maintain reasonable conditions of indoor comfort. A[illegible]art of one of the Priority Actions of streamSAVE, the developed methodologies introduce formulas and a series of corrections factors that can be applied to adjust the real outputs of different energy savings actions that target households in energy poverty. The following actions are covered:

- Thermally improved building envelope of refurbished buildings of energy poor households
- Small-scale renewable energy systems in buildings for energy poor households
- Feedback and tailored advice addressing energy poor households

Example: Thermal refurbishement

Practical Guidance | Empty excel template

Data Input

Calculation results

	national values			indicative calculation values	
TFES Article 7	insufficient data	kWh/a		-3,453.75	kWh/a
TFES Article 3	insufficient data	kWh/a		-3,453.75	kWh/a
EPEC Article 3	insufficient data	kWh/a		-15,528.13	kWh/a
GHGsav	insufficient data	tCO2		0.19	tCO2

Thank you

Get in touch for more information!

Project coordinator - Nele Renders, VITO

All project reports will be available for download on the streamSAVE website www.streamsave.eu

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