Streamlining savings from BACS within the EED framework

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This project has received funding from the Horizon 2020 programme under grant agreement n°890147. The content of this presentation reflects only the author's view. The European Commission is not responsible for any use that may be made of the information it contains.

Structure

- Introduction to the streamSAVE project
- Calculation methodology BACS
- Baseline, indicative values and data sources
- Platform and Training Module

1. Introduction to the streamSAVE project

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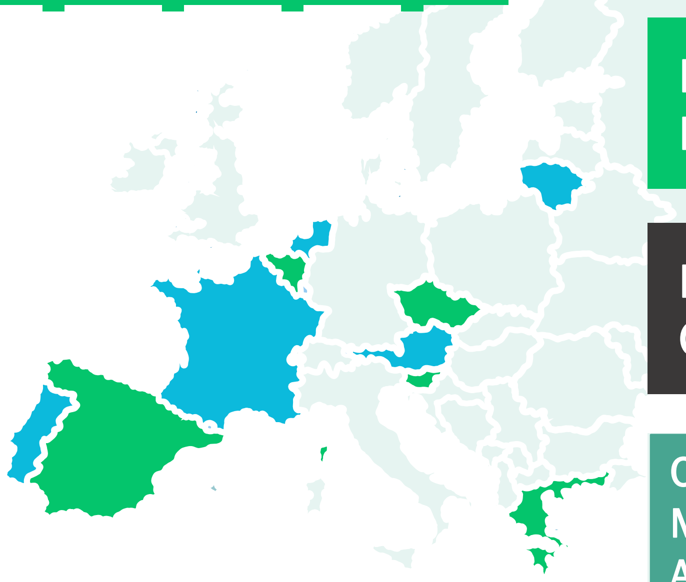
Who are we?

2020
START
SEPTEMBER 1, 2020

2023
END
AUGUST 31, 2023



12 PARTNERS
10 COUNTRIES

COORDINATOR	vito, Energy Ville
RESEARCH & POLICY INSTITUTIONS	vito, IEECP (Institute for European Energy and Climate Policy), ISR, circe, Jožef Stefan Institute
ENERGY AGENCIES OR RELATED	Austrian Energy Agency, ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie), ΚΑΠΕ CRES, Lietuvos Energetikos Agentūra, SEVEn7
CONNECTORS TO MARKET & TECHNOLOGY ACTORS	European Copper Institute (Copper Alliance), LGi (sustainable innovation)

What do we aim for?

- Building capacity among public authorities on Article 3 & Article 7 of the Energy Efficiency Directive:

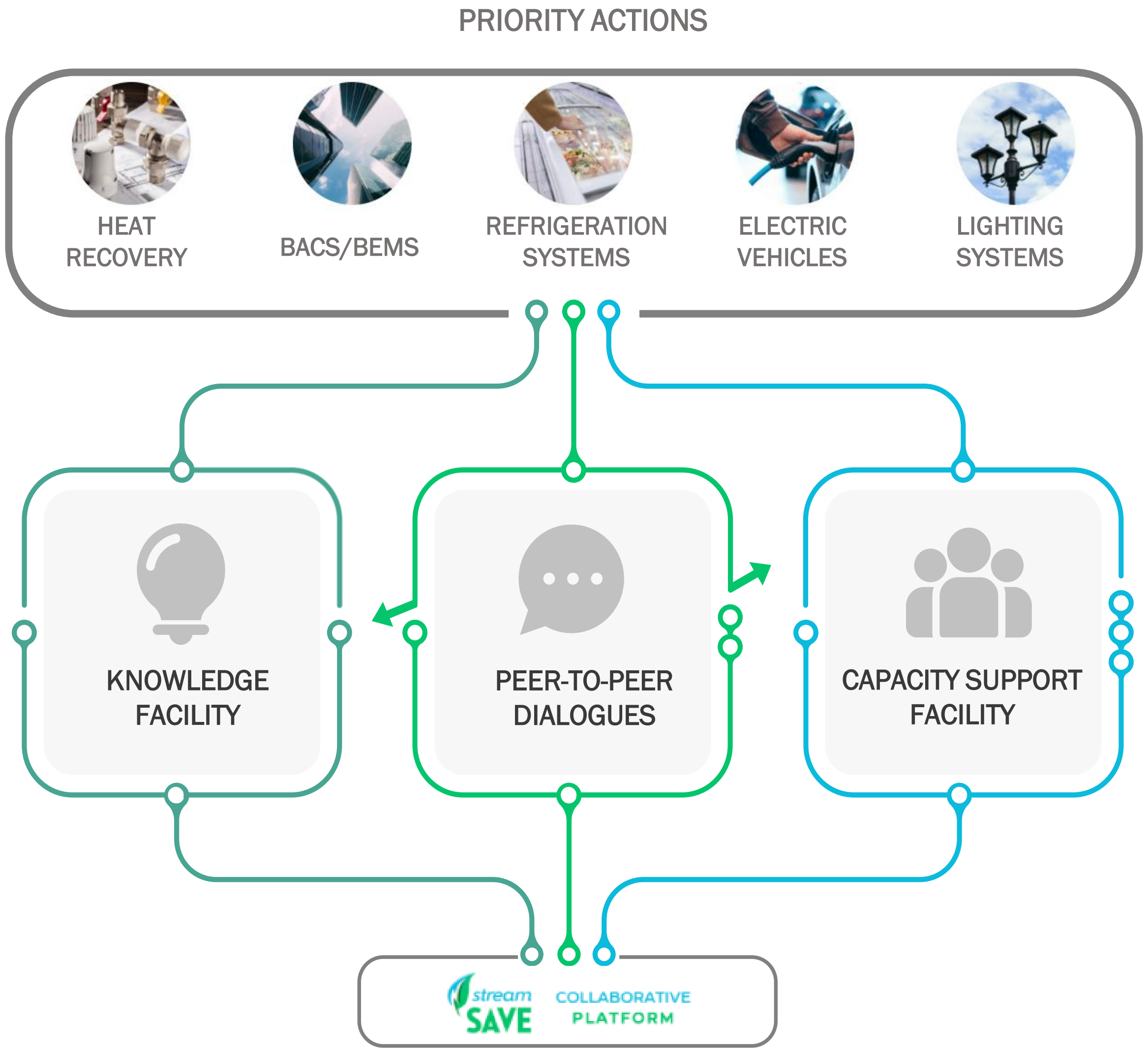
  streamSAVE builds capacity through the creation of an open dialogue that focuses on streamlining calculation methodologies to estimate bottom-up savings and cost effectiveness of technical energy savings actions. The project targets priority actions i.e., new actions with high energy saving potential and considered as a priority issue by national public authorities.

- Address additional efforts in EU Member States in realizing energy savings by 2030 under Article 3 & Article 7 of EED.

What do we aim for specifically?

- Streamline methodologies to estimate energy savings of 10 priority actions to answer the need for comparable progress reporting, while acknowledging diverse Member States' realities. 👉 GUIDANCE ON STANDARDIZED SAVING METHODOLOGIES
- Peer-to-peer capacity building through dialogue and capacity support to address Member States needs:
  - Cooperative community of technology group experts, public authorities and other market actors centered around each priority action.
  - One-to-one technical assistance: providing evidence-based support on streamlined savings calculation to the 10 partner Member States.
- Sustainability and replicability of streamSAVE outcomes: lively community and active streamSAVE platform beyond the life of the project

How do we realize these objectives?



In short, what do we stand for?

- Streamlining energy savings methodologies, incl. indicative values and cost effectiveness
- Technical priority actions: high energy savings potential and considered as priority by national public authorities
- Demand-driven: being close to and supporting stakeholders’ needs within EU Member States
- Creating lively community of experts on priority actions
- Building bridges towards existing initiatives to valorize streamSAVE outcomes.

2. Calculation methodology BACS

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Building Automation and Control Systems (BACS)

Definition (Ecodesign preparatory study, 2020):

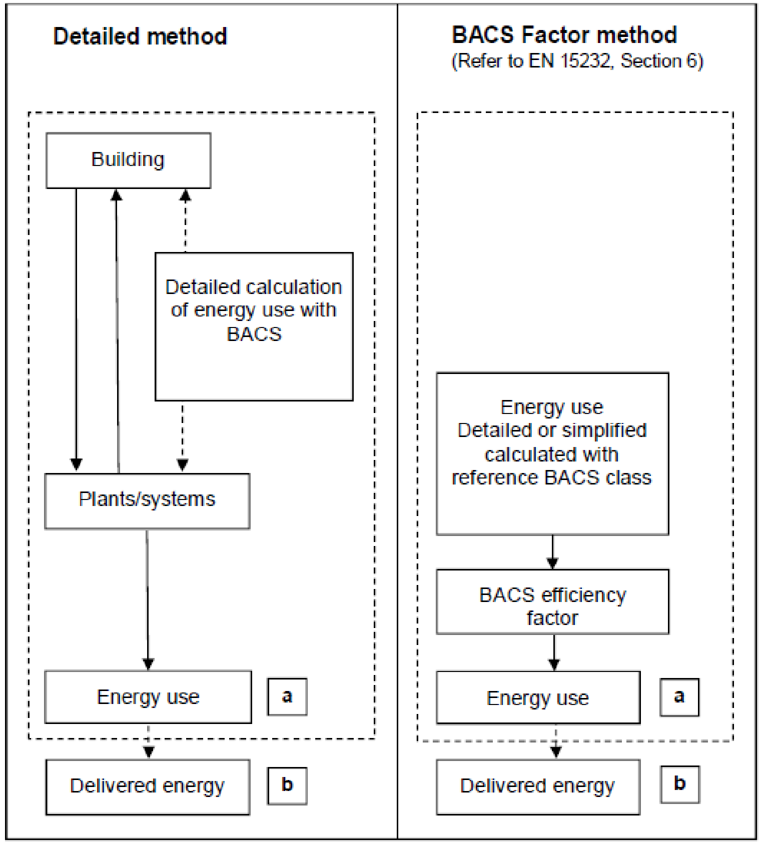
"All products and engineering services for automatic controls (including interlocks), monitoring, optimization, for operation, human intervention and management to achieve energy–efficient, economical and safe operation of building services. The term 'controls' also refers to 'processing of data and information'."

- Heating ventilation and Air Conditioning (HVAC)
- Domestic hot water (DHW)
- Lighting
- Metering
- Technical building management
- Access control
- Security
- Fire safety

BACS Factor Method

Two ways of calculating the impact of BACS on the energy demand of a building

- Detailed method vs. BACS factor method
- For BACS factor method, no information is needed about any specific control and automation function

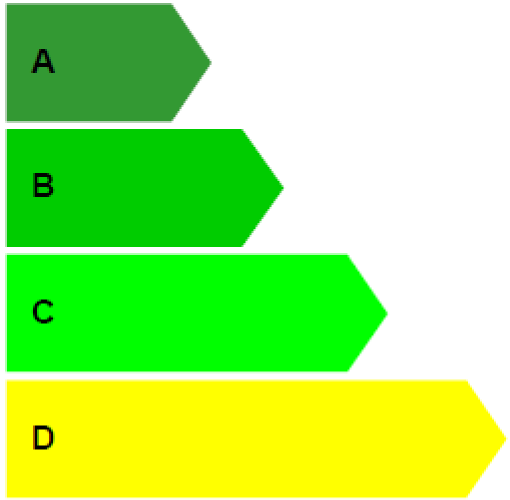


Source: Siemens, 2018

BAC Efficiency Classes

EN 15232 defines 4 different BAC efficiency classes (A, B, C, D) for building automation and control systems

- Assigned according to level of energy efficiency
  - A = high energy performance BACS and TBM
  - B = advanced BACS and some specific TBM functions
  - C = standard BACS
  - D = non-energy efficient BACS



Source: Siemens, 2018

BACS Factors

- Rough estimation of impact of BACS on thermal and electrical energy demand of the building according to the BACS efficiency classes A, B, C and D

- BACS efficiency factor
  - different levels of control accuracy and control quality
  - for different building types characterized by user profile of occupancy and internal heat gains (due to people and equipment)

BACS Factors

- On an aggregated level of thermal and electrical energy use

Non-residential building types	BACS efficiency factors thermal $f_{BAC,th}$			
	D	C	B	A
	Non energy efficient	Standard (reference)	Advanced energy efficiency	High energy performance
Offices	1.51	1	0.80	0.70
Lecture halls	1.24	1	0.75	0.5 [a]
Educational buildings (schools)	1.20	1	0.88	0.80
Hospitals	1.31	1	0.91	0.86
Hotels	1.31	1	0.85	0.68
Restaurants	1.23	1	0.77	0.68
Wholesale and retail buildings	1.56	1	0.73	0.6 [a]
Other types: • Sport facilities • Storage • Industrial facilities • etc.		1		

[a] The values are highly dependent on heating/cooling demand for ventilation

Residential building types	BACS efficiency factors thermal $f_{BAC,th}$			
	D	C	B	A
	Non energy efficient	Standard (reference)	Advanced energy efficiency	High energy performance
• Single family dwellings • Multi family houses • Apartment houses • Other residential or residential-like buildings	1.10	1	0.88	0.81

Source: EN15232

Non-residential building types	BACS efficiency factors electrical $f_{BAC,el}$			
	D	C	B	A
	Non energy efficient	Standard (reference)	Advanced energy efficiency	High energy performance
Offices	1.10	1	0.93	0.87
Lecture halls	1.06	1	0.94	0.89
Educational buildings (schools)	1.07	1	0.93	0.86
Hospitals	1.05	1	0.98	0.96
Hotels	1.07	1	0.95	0.90
Restaurants	1.04	1	0.96	0.92
Wholesale and retail buildings	1.08	1	0.95	0.91
Other types: • Sport facilities • Storage • Industrial facilities • etc.		1		

Residential building types	BACS efficiency factors electrical $f_{BAC,el}$			
	D	C	B	A
	Non energy efficient	Standard (reference)	Advanced energy efficiency	High energy performance
• Single family dwellings • Multi family houses • Apartment houses • Other residential or residential-like buildings	1.08	1	0.93	0.92

Source: EN15232

BACS Factors

- On a detailed level for
  - heating
  - cooling
  - DHW
  - lighting
  - ventilation

Non-residential building types	Detailed BACS efficiency factors $f_{BAC,H}$ and $f_{BAC,C}$							
	D		C		B		A	
	Non energy efficient		Standard (reference)		Advanced energy efficiency		High energy performance	
	$f_{BAC,H}$	$f_{BAC,C}$	$f_{BAC,H}$	$f_{BAC,C}$	$f_{BAC,H}$	$f_{BAC,C}$	$f_{BAC,H}$	$f_{BAC,C}$
Offices	1.44	1.57	1	1	0.79	0.80	0.70	0.57
Lecture halls	1.22	1.32	1	1	0.73	0.94	0.3 [a]	0.64
Educational buildings (schools)	1.20	–	1	1	0.88	–	0.80	–
Hospitals	1.31	–	1	1	0.91	–	0.86	–
Hotels	1.17	1.76	1	1	0.85	0.79	0.61	0.76
Restaurants	1.21	1.39	1	1	0.76	0.94	0.69	0.6
Wholesale and retail buildings	1.56	1.59	1	1	0.71	0.85	0.46[a]	0.55
Other types: • Sport facilities • Storage • Industrial facilities • etc.	–	–	1	1	–	–	–	–

[a] The values are highly dependent on heating/cooling demand for ventilation

Residential building types	Detailed BACS efficiency factors $f_{BAC,H}$ and $f_{BAC,C}$							
	D		C		B		A	
	Non energy efficient		Standard (reference)		Advanced energy efficiency		High energy performance	
	$f_{BAC,H}$	$f_{BAC,C}$	$f_{BAC,H}$	$f_{BAC,C}$	$f_{BAC,H}$	$f_{BAC,C}$	$f_{BAC,H}$	$f_{BAC,C}$
• Single family dwellings • Multi family houses • Apartment houses • Other residential or residential-like buildings	1.09	–	1	–	0.88	–	0.81	–

Source: EN 15232

Calculation of total final energy savings (Article 7 EED)

- Art. 7 EED: deemed savings approaches
  - streamSAVE aims to streamline bottom-up calculation methodologies and complement with scaled savings based on engineering estimates
- Savings formula & indicative values
- Baseline & additionality

Formula

- Using the BACS factor method, the formula we propose, is:

$$TFES_x = (FEC_{before,x} - FEC_{after,x}) \cdot f_{BEH} \cdot cf_x$$

$$FEC_{before,x} = FEC_{floor,before,x} \cdot A$$

$$FEC_{after,x} = \frac{BAC_{after,x}}{BAC_{before,x}} \cdot FEC_{floor,before,x} \cdot A$$

TFES	Total final energy savings for end-use type x [kWh/a]
$FEC_{before,x}$	Final energy consumption for end-use x, before implementation of the action [kWh/a]
$FEC_{after,x}$	Final energy consumption for end-use x after implementation of the action [kWh/a]
f_{BEH}	Factor to calculate behavioural effects for end-use type x [dmnl]
cf_x	Regional or climate factor for end-use type x [dmnl]
$FEC_{floor,before,x}$	Final energy consumption for end-use, before implementation of the action, per unit floor area [kWh/m²/a]
A	Total floor area of building [m²]
$BAC_{after,x}$	BAC energy efficiency factor after BACS upgrade for end-use type x [%], based on EN15232
$BAC_{before,x}$	BAC energy efficiency factor before BACS upgrade for end-use type x [%], based on EN15232

Formula

- Using the BACS factor method, the formula we propose, is:

$$TFES_x = (FEC_{before,x} - FEC_{after,x}) \cdot f_{BEH} \cdot cf_x$$

$$FEC_{before,x} = FEC_{floor,before,x} \cdot A$$

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$BAC_{after,x}$	BAC energy efficiency factor after BACS upgrade for end-use type x [%], based on EN15232
$BAC_{before,x}$	BAC energy efficiency factor before BACS upgrade for end-use type x [%], based on EN15232

End-uses: heating, cooling, DHW, lighting, ventilation

BAC factor *before* versus *after*

Formula: existing methodologies in EU countries

Bulgaria: heating residential

$$TFES = n * [FEC_{before} - FEC_{after}]$$

Where:

TFES	Total final energy savings [kWh/a]
FEC_{before}	Heat consumption of residential buildings before the installation of automation and heating control systems [kWh/m²]
FEC_{after}	Heat consumption of residential buildings after the installation of automation and heating control systems [kWh/m²]
n	Total heated area of the residential buildings where the automation and heating control systems will be installed

France: Heating & DHW non-residential

$$TFES = S * ES * G$$

TFES	Total final energy savings [kWh/a]
S	Surface [m²]
ES	Energy savings by sector by end use and energy [kWh/m²]
G	Geographical area

3. Baseline, indicative values and data sources

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BACS factors: baseline & indicative values

- Distribution of BACS factors in base year per end use per climate region
  - End uses: heating, cooling, DHW, ventilation and lighting
  - Building types: SFH, MFH, offices, retail outlets, education establishments, hospitality sector buildings, healthcare sector buildings, other
  - Climate regions: North, West and South

Table A-1 Estimated average stock BACS factors for 2020 by TBS and building type: North Region

TBS/system	SFH	MFH	Offices	Wholesale/ Retail	Education	Hospitals/ Healthcare	Hotels	Restaurants	Other
space heating	1.010	1.004	1.195	1.139	1.128	1.000	1.000	1.000	1.109
hot water	1.109	1.109	1.019	1.092	1.030	0.992	0.992	0.992	1.030
cooling	1.173	1.163	1.082	1.003	0.805	0.617	0.617	0.617	1.200
ventilation	1.091	1.084	1.138	1.071	0.966	1.000	1.000	1.000	1.154
lighting	1.079	1.079	0.989	0.991	0.991	1.000	1.000	1.000	1.000
space heating pumps	1.008	1.006	1.121	1.103	1.072	1.038	1.038	1.038	1.073
hot water pumps	1.109	1.109	1.018	1.092	1.029	0.991	0.991	0.991	1.029

Source: Ecodesign preparatory study for BACS, ongoing

- Expected impacts from EPBD on baseline
  - Non-residential buildings with installed HVAC capacity > 290 kW : the BACS capabilities required under art. 14-15 EPBD could correspond to B-class BACS.

FEC_{before}: baseline

- Energy consumption per building type and end use per climate region
  - Possibilities
    - *Building specific* FEC per end-use, based on EPC score
    - *Average* FEC of building stock per end-use and building type, based on *average EPC scores* per climate region
    - *Average* FEC of building stock per end-use and building type, based on *energy statistics (e.g., national energy balances)*

FEC_{before}: baseline & indicative values

- streamSAVE proposes indicative values on EU level

$FEC_{before,x}$		[kWh/m² useful floor area /a]
Residential	Space heating	131.9
	Space cooling	6.2
	Water heating	27.5
	Lighting	3.1
	Ventilation	Minor, about 0.5% of total FEC (*)
Non-Residential (services)	Space heating	130.2
	Space cooling	15.1
	Water heating	22.1
	Lighting	20.3
	Ventilation	15.7

Other indicative values

- Factor for climate/ region: cf_x
- Lifetime of savings
- Factor for behavioural effects: f_{BEH}

cf_x		North	West	South
Residential	Space heating	1.21	1	0.71
	Space cooling	0.64	1	1.95
	Water heating	1.19	1	0.97
	Lighting	0.95	1	0.92
	Ventilation			
Non-Residential (services)	Space heating	1.19	1	0.65
	Space cooling	0.74	1	1.45
	Water heating	0.96	1	0.98
	Lighting	1.05	1	1.08
	Ventilation	1.10	1	1.18
Lifetime of savings		**[a]**		
Lifetime of savings*		15		
f_{BEH}		**%**		
Residential	Space heating & cooling	80		

Data sources for streamSAVE indicative values

- IDEES database (JRC, 2018)
- Ecodesign preparatory study for BACS (ongoing, DG ENER)

Complemented with:

- EN15232
- Impact of the revision of EPBD on energy savings from BACS (eu.bac, 2019)

- Possibility to use national values ?

Indicative values in EU countries

- Bulgaria
  - Uses the energy class of the buildings (EPC) to calculate specific final energy savings for heating.

$$TFES = n * \left[FEC_{before} - FEC_{after}\right]$$

Where:

TFES	Total final energy savings [kWh/a]
FEC_{before}	Heat consumption of residential buildings before the installation of automation and heating control systems [kWh/m²]
FEC_{after}	Heat consumption of residential buildings after the installation of automation and heating control systems [kWh/m²]
n	Total heated area of the residential buildings where the automation and heating control systems will be installed

		sTFES Energy class of the building C [kWh/m2/a]									
		A	B		C		D		E		F
		HD ≤ 600	HD 601-900		HD 901-1400		HD 1401-2100		HD 2101-3000		HD >3000
Automation class A	S/V ≤ 0.2	0	1.615	0	2.432	0	4.047	0	6.46	0	8.892
	S/V ≥ 0.9	0	6.84	0	9.12	0	12.92	0	16.72	0	22.04
Automation class B	S/V ≤ 0.2	0	1.02	0	1.536	0	2.556	0	4.08	0	5.616
	S/V ≥ 0.9	0	4.32	0	5.76	0	8.16	0	10.56	0	13.92
		sTFES Energy class of the building D [kWh/m2/a]									
		A	B		C		D		E		F
		HD ≤ 600	HD 601-900		HD 901-1400		HD 1401-2100		HD 2101-3000		HD >3000
Automation class A	S/V ≤ 0.2	0	2.01875	0	3.04	0	5.05875	0	8.075	0	11.115
	S/V ≥ 0.9	0	8.55	0	11.4	0	16.15	0	20.9	0	27.55
Automation class B	S/V ≤ 0.2	0	1.275	0	1.92	0	3.195	0	5.1	0	7.02
	S/V ≥ 0.9	0	5.4	0	7.2	0	10.2	0	13.2	0	17.4

Indicative values in EU countries

- France
  - Uses average values per sector to calculate the energy savings for categories ‘heating’ and ‘hot water and heating’, per type of building.

Energy savings by sector by end used and energy type [kWh/m²]				
Sector	Heating only		Hot water and heating	
	Fossil energy	Electricity	Fossil energy	Electricity
Office	28	16	29	16
Education	10	6	12	8
Retail	29	16	31	18
Hotel and restaurants	27	9	31	13
Health	11	7	15	11
Other	10	6	12	8

$$TFES = S * ES * G$$

TFES	Total final energy savings [kWh/a]
S	Surface [m²]
ES	Energy savings by sector by end use and energy [kWh/m²]
G	Geographical area

Geographical area	G
H1	1,1
H2	0,9
H3	0,6

4. Platform and Training Module

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Training Module

https://streamsave.flexx.camp/training

Refrigeration systems

Calculate

This methodology is valid for new installations of air- or water chilled central compression refrigeration units in compliance with the new Ecodesign regulations. It is based on the Seasonal Energy Performance Ratio (SEPR) of high-temperature process chillers at the rated refrigeration capacity of the unit.

Building Automation & Control Systems

Calculate

This methodology is valid for calculating the impact of installing or upgrading BACS on the energy demand of building(s). It is based on the BAC factor method and can be used for calculating savings in residential and non-residential buildings, for five types of end-use (heating, cooling, domestic hot water, ventilation and lighting) and for the three climate regions. A factor for rebound effects is foreseen.

Electric vehicles

Calculate

This methodology targets the fuel switching between conventional and electric vehicles. The conventional options include vehicles using diesel, petrol and LNG, as well as hybrid options. The more efficient options include electric vehicles. Therefore, the savings are not only ensured with higher conversion efficiency but also with the ensured fuel switching between the use of fossil fuels and electricity, which is increasingly generated based on renewable resources. Therefore, such fuel switching is able to ensure a reduction of fossil fuel consumption, with the associated primary energy savings and reduction of GHG emissions.

Lighting systems

Simplified Approach | Engineering Approach

This methodology deals with the replacement of existing road lighting systems to more energy efficient technologies. It provides two different formulas for the calculation of energy savings of the implementation of measures that account not only for the replacement of existing light points but also for the installation of lighting control technologies. The methodology can be applied in all Member States, following the provided indicative values and indications.

My results

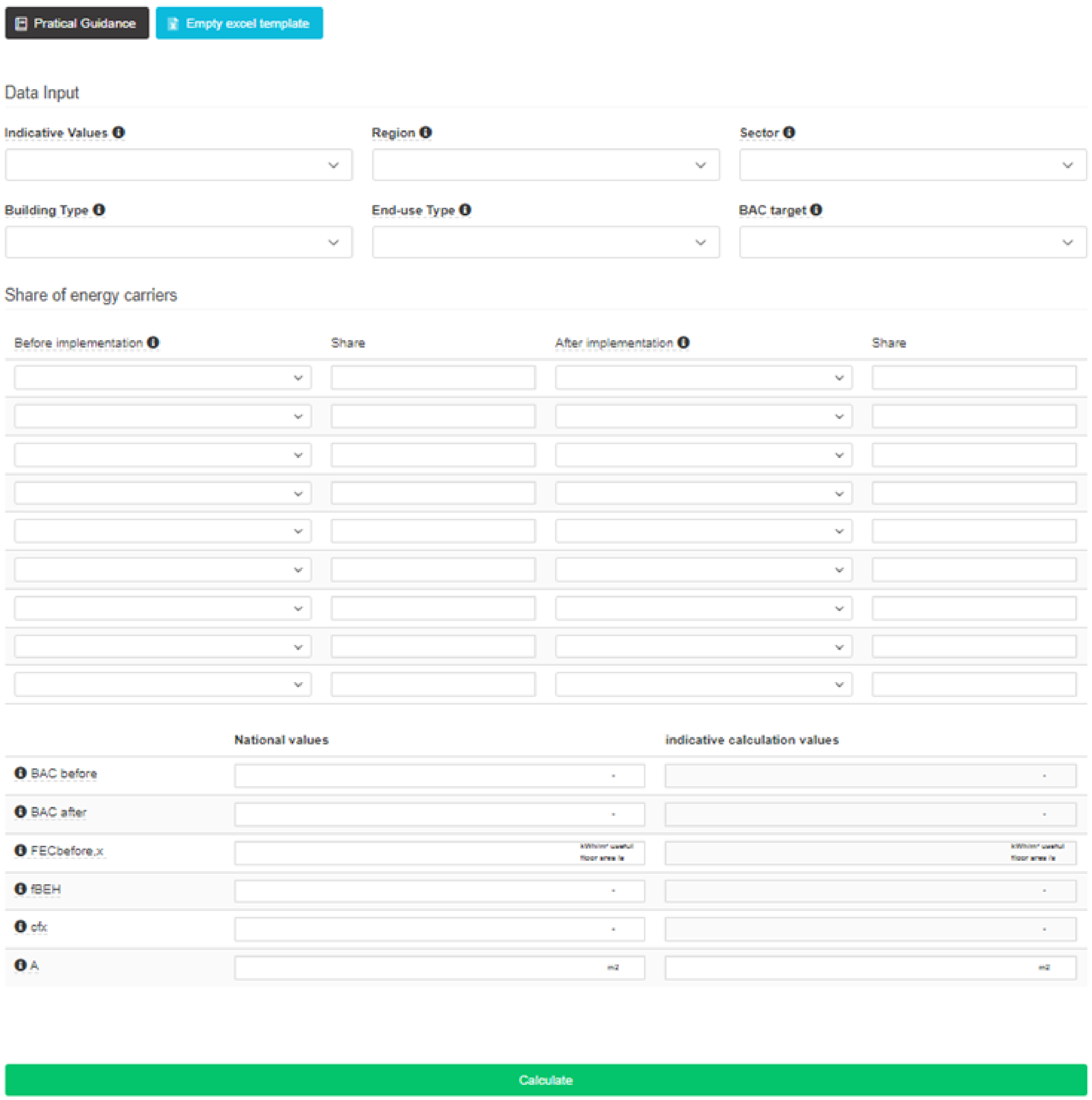
Heat recovery

On-site applications | On-site process | District heating

Savings calculation methodologies covered by this Priority Action focus on heat recovery from industrial processes used on-site and in district heating grids. There is a wide spectrum of heat consuming applications in industry that are suitable for heat recovery actions; therefore, it is not feasible to define one representative application. Methodologies have been prepared for the following three cases:

- Heat recovery for on-site use in industry - use of excess heat for on-site applications
- Heat recovery for on-site use in industry - feedback of excess heat into a process
- Heat recovery for feed-in to a district heating grid

Training Module



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

Email the project at contact@streamsave.eu

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Project Partners

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