PRIORITY ACTION FIVE

HEAT RECOVERY

WHAT IS HEAT RECOVERY?

Heat recovery is the process of using waste heat from industrial processes that would otherwise have been lost. Recovered heat is used to increase the temperature of water—conventionally heated by a fuel-powered boiler or furnace—before it is fed into an industrial process or a district heating grid.

WHAT ARE THE BENEFITS OF THE ENERGY SAVINGS ACHIEVED?

Heat recovery reduces greenhouse gas emissions and fuel costs. When recovered heat is fed into district heating grids, heating efficiency improves and emissions in urban areas decrease due to centralised heat production. District heating is also considered a very comfortable heating solution for residents, as no yearly service is required.

WHAT ARE THE ENERGY SAVINGS OPPORTUNITIES?

The potential for energy savings in the case of on-site industrial heat recovery is very high. There is also the possibility to account for recovered heat that is fed into district heating grids by comparing the efficiency of district heating systems with those of less efficient heating technologies which would have otherwise been used.

WHAT MAKES CALCULATING ENERGY SAVINGS CHALLENGING?

Drawing a line between final energy savings and final energy consumption is quite challenging. When excess heat from industry is recovered and integrated into district heating, it is tricky to evaluate energy savings, and a one-size-fits-all solution is not applicable as heat recovery takes place in various industries.

WHAT IS NEEDED TO IMPROVE ENERGY SAVINGS CALCULATIONS?

A good understanding of both technical processes and the Energy Efficiency Directive framework is needed to correctly calculate savings. Clear explanations of how to define baselines and system boundaries, how to prepare a measurement concept and how to account for influential factors like varying production levels are also needed for improvement.

The streamSAVE project received funding from the Horizon 2020 Programme under grant agreement N° 890147.

Welcome and Agenda

Please rename yourself in zoom: Name (organisation, country code)

Agenda

15:00 – 15:05	Welcome to participants
15:05 – 15:10	EED framework & overview of developed methodologies *Elisabeth Böck (Austrian Energy Agency)*
15:10 – 15:35	Methodologies on on-site heat recovery Interactive Q & A *Angelika Melmuka (Austrian Energy Agency)*
15:35 – 15:55	Methodology heat recovery for district heating Interactive Q & A *Christoph Ploiner (Austrian Energy Agency)*
15:55 – 16:00	Conclusions and next steps

Heat recovery in industry and district heating

Presentation of the developed methodologies

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EED Framework

- In 2014 – 2020 period, Article 7 savings referred to “energy sales to final customers”
- Since the 2018 update, the Article 7 savings target is based on final energy consumption
- For heat recovery, this can lead to changes in eligibility due to some areas being considered part of the energy transformation sector and not final energy consumption

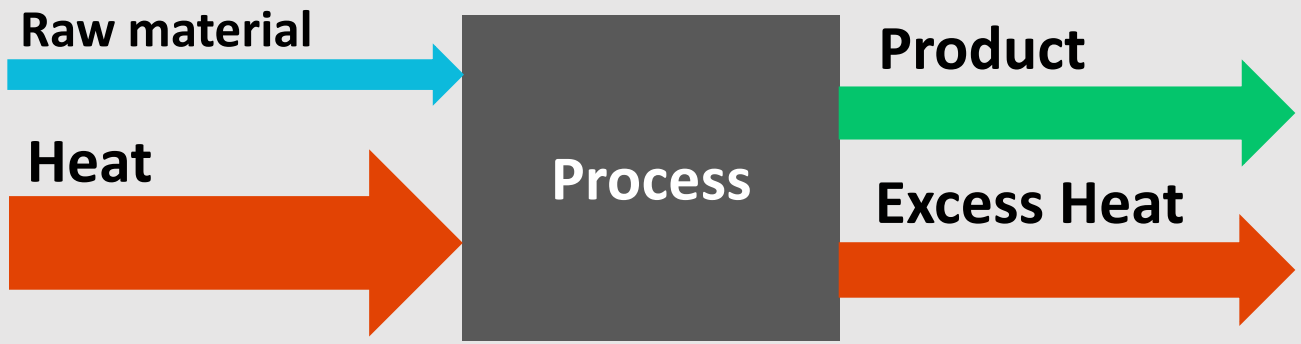
Methodologies developed

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

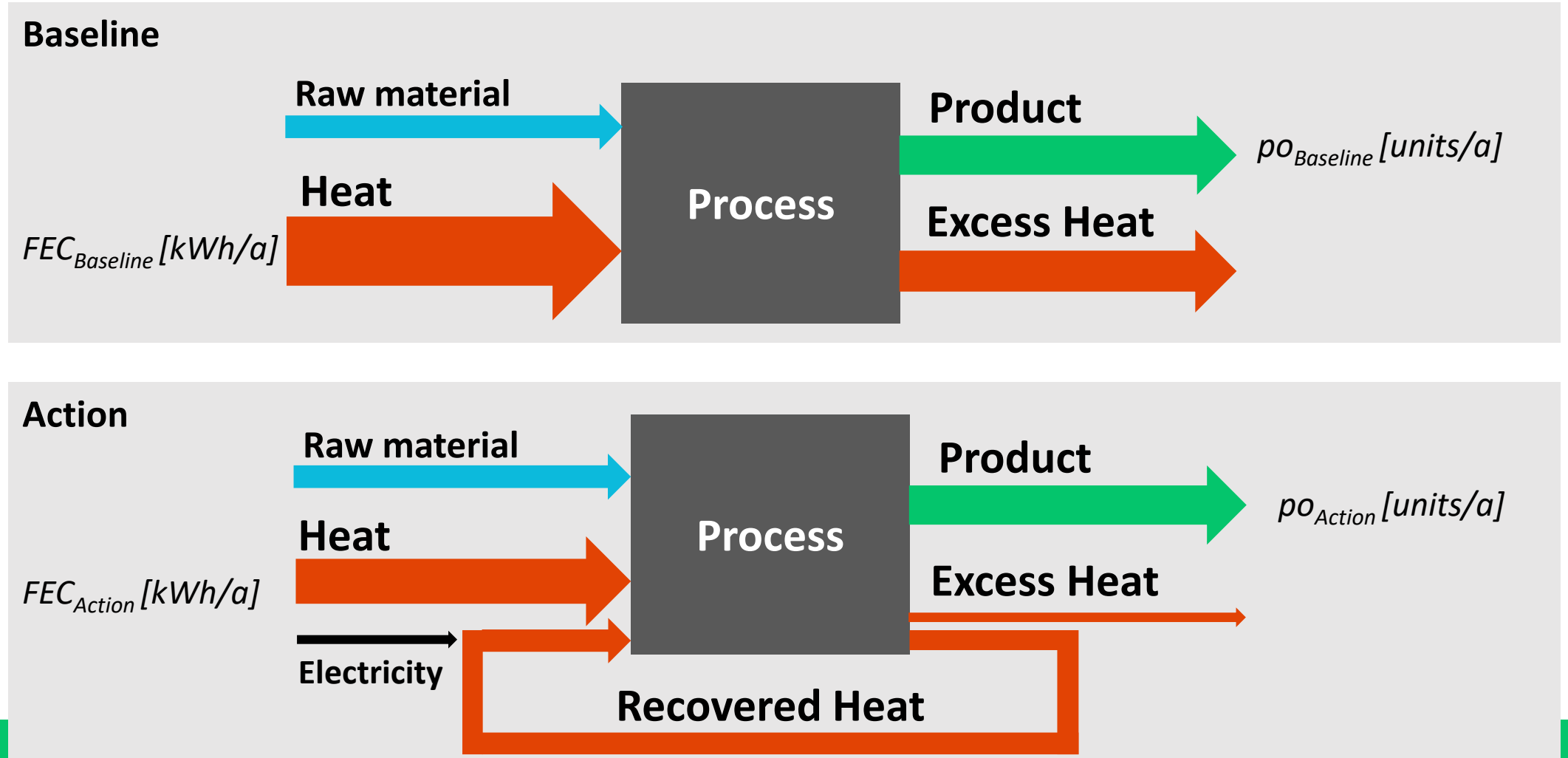
Heat recovery for on-site use in industry:
I) feedback of excess heat into process &
II) use of excess heat for on-site applications

I) Feedback of excess heat into process
General approach

Baseline



I) Feedback of excess heat into process
General approach



I) Feedback of excess heat into process
Calculation of savings for Art. 7

Specific energy consumption Action

$$TFES = \left(\frac{FEC_{Baseline}}{po_{Baseline}} - \frac{FEC_{Action}}{po_{Action}} \right) * po_{Action}$$

Specific energy consumption Baseline

TFES	Total final energy savings [kWh/a]
FEC	final energy consumption [kWh/a]
po	Production output [units/a]
Baseline	Index for the situation before the implementation of the action
Action	Index for the situation after the implementation of the action

I) Feedback of excess heat into process
Calculation of impact for Art. 3

Specific energy consumption Action

$$EFE = \left(\frac{FEC_{Baseline}}{po_{Baseline}} - \frac{FEC_{Action}}{po_{Action}} \right) * po_{Action}$$

Specific energy consumption Baseline

EFE	Effect on the final energy consumption [kWh/a]
FEC	final energy consumption [kWh/a]
po	Production output [units/a]
Baseline	Index for the situation before the implementation of the action
Action	Index for the situation after the implementation of the action

I) Feedback of excess heat into process
Indicative calculation values (Art. 7 and 3)

- $FEC_{Baseline}$, FEC_{Action}:
  - Include all energy sources of the process: fuels, electricity consumption of pumps, compressors, control units etc.
- $po_{Baseline}$, po_{Action}:
  - Amounts of goods which are produced or manipulated in the process (volume, tons, pieces etc.)
- ***FEC*** and ***po*** must be measured/documented over the same representative periods before and after the implementation of the action. Measured data has to be extrapolated to a calendar year.
- Lifetime of savings: 10 years

Source: Commission Recommendation (EU) 2019/1658

I) Feedback of excess heat into process
Calculation of CO_2 savings

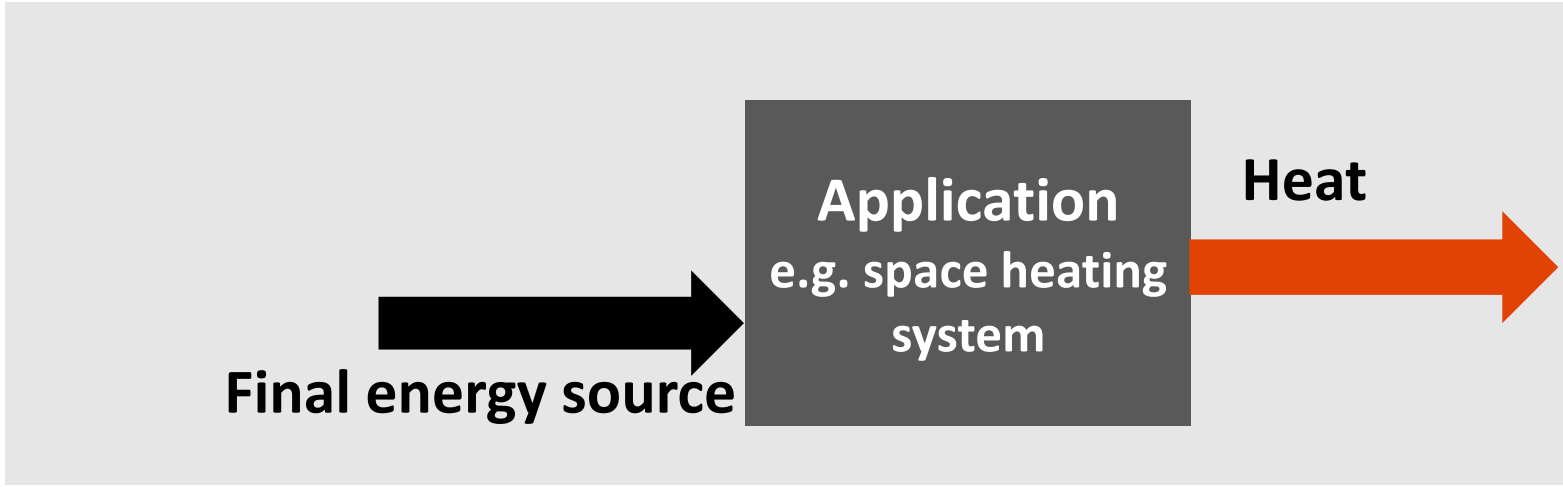
Specific energy consumption Action

$$GHGSAV = \left(\frac{FEC_{Baseline}}{po_{Baseline}} * \sum_{ec} (share_{ec,Baseline} * f_{GHG,ec}) - \frac{FEC_{Action}}{po_{Action}} * \sum_{ec} (share_{ec,Action} * f_{GHG,ec}) \right) * po_{Action}$$

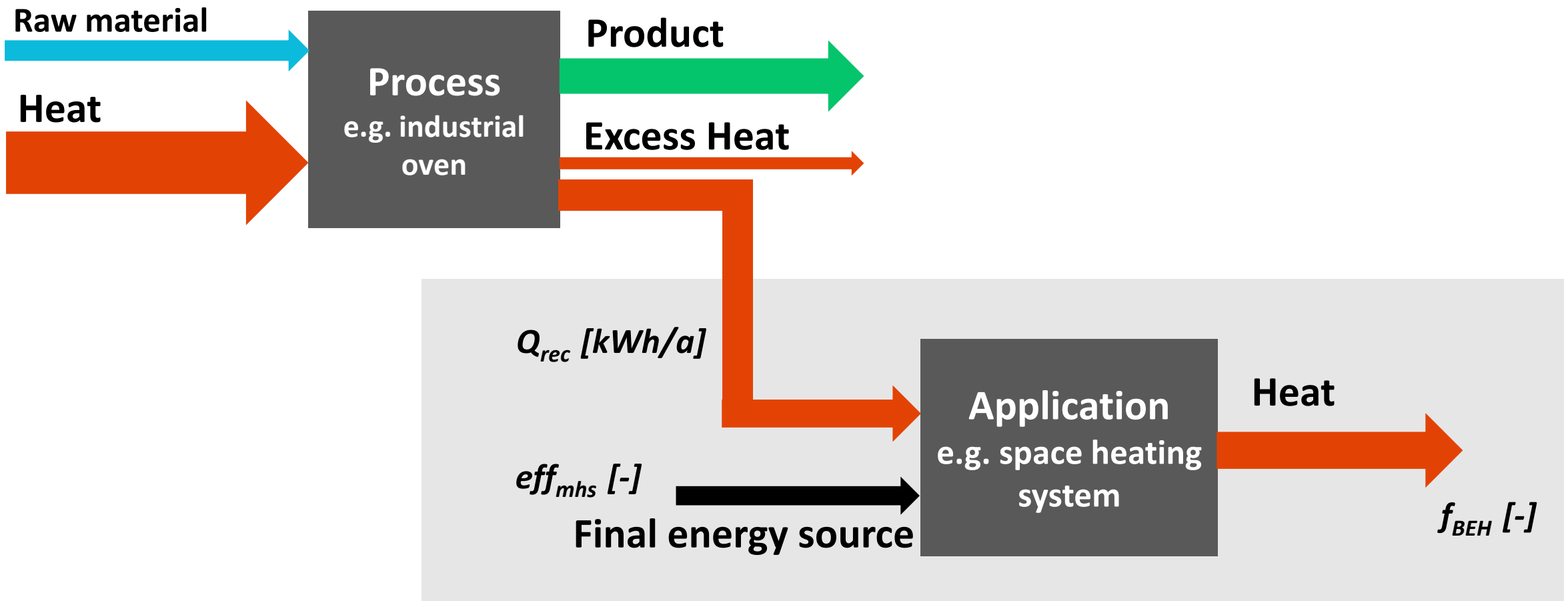
Specific energy consumption Baseline

GHGSAV	Greenhouse gas savings [g CO_2 p.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 situation before action were implemented
Action	Index for the situation after the implementation of the action
ec	Index of energy carrier

II) Use of excess heat for on-site applications
General approach



II) Use of excess heat for on-site applications
General approach



II) Use of excess heat for on-site applications
Calculation of savings for Art. 7

$$TFES = Q_{rec} * \frac{1}{eff_{mhs}} * f_{BEH}$$

TFES	Total final energy savings [kWh/a]
Q_{rec}	Recovered heat consumption of the application [kWh/a]
eff_{mhs}	Conversion efficiency of the main heating system of the application [dmnl]
f_{BEH}	Factor for correction of behavioural effects [dmnl]

II) Use of excess heat for on-site applications
Calculation of impact for Art. 3

$$EFE = Q_{rec} * \frac{1}{eff_{mhs}} * f_{BEH}$$

EFE	Effect on the final energy consumption [kWh/a]
Q_{rec}	Recovered heat consumption of the application [kWh/a]
eff_{mhs}	Conversion efficiency of the main heating system of the application [dmnl]
f_{BEH}	Factor for correction of behavioural effects [dmnl]

II) Use of excess heat for on-site applications
Indicative calculation values (Art. 7 and 3)

- Q_{rec} (recovered heat consumption):
  - Should be measured with a heat meter over a representative period
  - Measuring protocols incl. installation layout, measurement setup and period are recommended
- eff_{mhs} (efficiency of main heating system):
  - Possibly provided by manufacturer of the application (e.g. eco-label)
- f_{BEH} (behavioural effects):
  - May arise because heat source seems “cheap” (e.g. increased comfort like a higher room temperature) and need to be considered
- Lifetime of savings: 10 years

Source: Commission Recommendation (EU) 2019/1658

II) Use of excess heat for on-site applications
Calculation of CO_2 savings

$$GHGSAV = TFES * \sum_{ec} (share_{ec,Baseline} * f_{GHG,ec})$$

GHGSAV	Greenhouse gas savings [g CO_2 p.a.]
TFES	Total final energy savings [kWh/a]
$share_{ec,Baseline}$	Share of final energy carrier on final energy consumption before the implementation of the action [dmnl]
f_{GHG}	Emission factor of final energy carrier [g CO_2/kWh]

Q & A on On-site heat recovery

- Are savings from on-site heat recovery currently eligible in your country?
- Do you think a guidance for implementing parties on how to correctly calculate savings from heat recovery is useful?
- What aspects of savings calculation for heat recovery do you consider most valuable?
  - Concepts for measurement
  - Normalization for alternating production volumes
  - Normalization for weather data
  - Verification of reported actions (including documentation data)
  - Other (please specify via the chat)
- Who is allowed to calculate energy savings for Article 7 actions in your country?
  - External energy service providers qualified in accordance with Article 8
  - Internal energy service providers qualified in accordance with Article 8
  - External engineers with relevant experience
  - Internal engineers with relevant experience
  - No regulations / everyone
  - Other (please specify via the chat)

Heat recovery for infeed into a district heating grid

General approach

- Generation of district heating = Transformation sector
  (according to energy statistics regulation (EC) 1099/2008)
- Transformation sector ≠ Final energy
- Final energy savings at final customers
- ⟶ Triggering new district heating connections

Calculation of savings for article 7

$$TFES = Q_{EH} * (1 - HL_{DHG}) * \left(\frac{1}{eff_{Baseline}} - \frac{1}{eff_{Action}}\right) * (1 - f_{ei})$$

Baseline energy consumption **savings** **extrinsic effects**

TFES	Total final energy savings [kWh/a]
Q_{EH}	Excess heat fed into the district heating grid [kWh/a]
HL_{DHG}	Heat losses in the district heating grid [dmnl]
$eff_{Baseline}$	Conversion efficiency of reference heating systems [dmnl]
eff_{Action}	Conversion efficiency of district heat consuming heating systems [dmnl]
f_{ei}	Factor to calculate extrinsic incentives [dmnl]

Effects on Article 3

$$EFE = TFES$$

EFE	Effect on final energy consumption (Article 3) [kWh/a]
TFES	Total final energy savings [kWh/a]

$$PES = Q_{EH} * \sum_{ec} (share_{ec} * f_{PE,ec})$$

Baseline fuel input for district heating generation **Weighted primary energy factor**

PES	Primary energy savings [kWh/a]
Q_{EH}	Excess heat fed into the district heating grid [kWh/a]
$share_{ec}$	shares of energy carrier in district heating generation [dmnl]
$f_{PE,ec}$	Primary energy factor of energy carrier [dmnl]

Effects on green house gases

$$GHGSAV = Q_{EH} * \sum_{ec} (share_{ec} * f_{GHG,ec})$$

GHGSAV	Greenhouse gas savings [g CO_2 p.a.]
Q_{EH}	Excess heat fed into the district heating grid [kWh/a]
$share_{ec}$	shares of energy carrier in district heating generation [dmnl]
f_{GHG}	Emission factor of final energy carrier [g CO_2/kWh]

Indicative values (Article 7)

- District heating network - distribution losses 10.6 %
  Source: Complete Energy Balances Eurostat

- Efficiency reference heating system: 86 %
  Source: A technical analysis of FTT:Heat (2017) | values from 2012 !

- Efficiency district heating connection: 98 %
  Source: A technical analysis of FTT:Heat (2017) | values from 2012 !

- Lifetime of saving: 10 years
  Source: Commission Recommendation (EU) 2019/1658

Example

$$TFES = 10,000\ kWh/a * (1 - 0.106) * \left(\frac{1}{0.86} - \frac{1}{0.98}\right) * (1 - 0) = 1{,}272.9\ \text{kWh/a}$$

$$EFE = TFES = 1{,}272.9\ \text{kWh/a}$$

$$PES = 10,000 \frac{kWh}{a} * 1.006 = 10{,}060.0\ \text{kWh/a}$$

$$GHGSAV = 10,000 \frac{kWh}{a} * 217,8\ g\ CO_2/kWh = 2{,}178.0\ \text{kg } CO_2\text{/a}$$

Little effect on final energy but large effect on primary energy and CO_2

Q & A on district heating

- Did your country report savings from district heating in the 2014 – 2020 period?
- Who reported these actions?
  - Reported via Alternative measures
  - Operators of district heating grids
  - District heat supplier
  - Parties feeding into the district heating grid
  - Final customers of district heating
  - Other (please specify via the chat)
  - No savings reported
- How are savings from district heating calculated in your country at the moment? (open discussion)

Conclusions

Methodologies for “Heat recovery in industry and district heating”

2nd Dialogue Group meeting

June 22nd 2021

Next steps

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Feedback

- Please, fill out our quick feedback survey

- You may also leave us a longer message
  - Via forum on the streamSAVE platform
  - Via the anonymous form (link in the chat)
  - Via dialogues@streamsave.eu
    - Please accept as sender

- To receive more info → register on the streamSAVE platform: https://streamsave.flexx.camp/signup-0818ml

Next steps

- Meeting minutes
  - please feel free to send us your suggestions
- All information will be included on the platform
  - in case you are not registered yet, we will show you how
- Next round: late autumn 2021
- Suggestions for topics or want to share policy practices?

Next Dialogues Group

- Dates for the next Dialogue Groups web meetings

18.05.2021	Changed date 29.06.2021	01.06.2021	15.06.2021	22.06.2021
				
BUILDING AUTOMATION & CONTROL SYSTEMS	REFRIGERATION SYSTEMS	LIGHTING SYSTEMS	ELECTRIC VEHICLES	HEAT RECOVERY

All web-meetings will be from **3.00 to 4.00 pm CEST**.

- Subscribe via: **REGISTRATION LINK**
  or send an email to: dialogues@streamsave.eu

Thank you!

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