WHAT ARE REFRIGERATION SYSTEMS?

REFRIGERATION

SYSTEMS

Refrigeration systems cool a space or substance by removing unwanted heat, which is transferred to another object or space. The removal of heat may be accomplished through the use of ice, chilled water or mechanical refrigeration, the latter made possible through refrigeration systems. Examples include air conditioning, refrigerators and freezers.

WHAT ARE THE BENEFITS OF THE ENERGY SAVINGS ACHIEVED?

Different measures can be taken to reduce the energy consumption of refrigeration systems, and as a result, reduce emissions. By using different devices, implementing energy efficiency practices and adapting systems to meetin production needs, it is possible to achieve better performance and higher efficiency.

WHAT ARE THE ENERGY SAVINGS OPPORTUNITIES?

The scope of application of refrigeration systems is broad, ranging from the air conditioning of buildings and food preservation in various sectors, to production processes such as plastic injection. The streamSAVE project will specifically address refrigeration systems in the commercial sector and the agro-food industry.

WHAT MAKES CALCULATING ENERGY SAVINGS CHALLENGING?

Calculating the efficiency of refrigeration systems is complex, and on-site data collection can be complicated given that performance varies under different conditions. In addition, poor management practices result in missed opportunities to improve performance and reduce energy consumption.

WHAT IS NEEDED TO IMPROVE ENERGY SAVINGS CALCULATIONS?

There is a need to define a baseline in order to ensure that energy savings achieved are accounted for. There is also a need for more realistic and standardised benchmarking tools to calculate efficiency and facilitate on-site data collection, for streamling engineering methods to calculate energy savings, and lastly, for best practices for implementation.

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

stream

Welcome and Agenda

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

Agenda

- 15:00 15:05 Welcome to participants
- 15:05 15:25 Overview of the energy savings calculation methodology developed for "centralized commercial and industrial refrigeration units", *by Cristina Gonzalo (CIRCE)*
- 15:25 15:55 Questions and Answers (Q&A) with open debate with participants:
 - Feedback about the presented methodology;
 - Key issues for the calculation methodology: discussion about sources of information for baseline definition and indicative values.

moderated by Cristina Gonzalo (CIRCE) and Michal Stasa (SEVEN)

15:55 – 16:00 Conclusions and next steps

Refrigeration systems

Status of methodology for "Centralized commercial and industrial refrigeration units"

Cristina Gonzalo, Juraj Krivošík , Michal Stasa

cgonzalo@fcirce.es / juraj.krivosik@svn.cz / michal.stasa@svn.cz

2nd PA Dialogue Group, 29 June 2021



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.





Scope of the methodology

- Calculation of final energy savings (Article 7) and impact on energy consumption (Article 3): TFES and EFE
- Ø Data sources for the indicative values
- Calculation of greenhouse gas savings
- Øpen debate / Q&A

Scope of the methodology

The savings calculation methodology targets:

- New installations or the replacement of air-chilled or water-chilled central compression refrigeration units;
- High temperature process chillers: "capable of cooling down and continuously maintaining the temperature of a liquid, in order to provide cooling to a refrigerated appliance or system, the purpose of which is not to provide cooling of a space for the thermal comfort of human beings; delivering its rated refrigeration capacity, at an indoor side heat exchanger outlet temperature of 7°C, at standard rating conditions"¹

✓ Limitations:

- Central compression refrigeration units with compressors power by electrical energy.
- Cooling systems using free cooling or heat recovery are not covered.

Sources:

- Austrian catalogue on bottom-up calculation methodologies²
- multEE project³

¹ Commission Regulation (EU) 2016/2281 implementing Directive 2009/125/EC of the European Parliament and of the Council establishing a framework for the setting of ecodesign requirements for energy-related products, with regard to ecodesign requirements for air heating products, cooling products, high temperature process chillers and fan coil units.

² Anlage 1 BGB1. II, Nr. 172 (2016). Verallgemeinerte Methoden zur Bewertung von Energieeffizienzmaßnahmen, 100–103. https://www.ris.bka.gv.at/Dokumente/BgblAuth/BGBLA_2016_II_172/C00_2026_100_2_1241958.pdfsig

³ Document with general formulae of bottom-up methods to assess the impact of energy efficiency measures. <u>https://multee.eu</u>

Calculation of final energy savings (Article 7) and impact on energy consumption (Article 3) in the Austrian catalogue and multEE project



Total Final Energy Savings (Art. 7):

$$TFES = n \times Pc \times h_{FL} \times \left(\frac{1}{\text{ESEER}_{Ref}} - \frac{1}{\text{ESEER}_{Eff}}\right)$$

Impact on Energy Consumption (Art. 3):

$$EFE = n \times Pc \times h_{FL} \times \left(\frac{1}{\text{ESEER}_{Ref}} - \frac{1}{\text{ESEER}_{Eff}}\right)$$

Austrian catalogue and multEE project formulas



$$TFES \text{ or } EFE = n \times Pc \times h_{FL} \times \left(\frac{1}{\text{ESEER}_{Ref}} - \frac{1}{\text{ESEER}_{Eff}}\right)$$

Baseline system data

- Ø Base: European Seasonal Energy Efficiency Ratio (ESEER)
 - Voluntary classification standard by Eurovent¹.
 - Comparison of units including technical and climatic point of view.
- Project-based parameters:
 - Pc: Installed cooling power of the cooling system (kW)
 - n: Number of cooling systems installed at a specific cooling power, Pc.
 - h_{FL} : Full-load operating hours related to the maximum installed power (h)
- Potential introduction of behavioral aspects (x f_{BEH})

Austrian catalogue and multEE project formulas

$TFES \text{ or } EFE = n \times Pc \times h_{FL} \times \left(\frac{1}{\text{ESEER}_{Ref}} - \frac{1}{\text{ESEER}_{Eff}}\right)$

Baseline system data

For air-chilled coolers	H
ESEER _{Ref.}	4
ESEERE	5.5
For water-chilled coolers	H
ESEERRet	5.6
ESEERE	7.5

Database of Eurovent certified air-chilled and water-chilled refrigeration units under the LCP-HP (Liquid Chilling Packages and Heat Pumps)¹: data from 2015

- ESEER_{Ref}: average of all units in the market.
- ESEER_{Eff}: average of units exceeding reference value.



Proposed methodology for calculation of final energy savings (Article 7) and impact on energy consumption (Article 3)

Calculation of TFES (Art. 7) and EFE (Art. 3)

**** TFES and EFE



⁵ Commission Regulation (EU) 2016/2281 implementing Directive 2009/125/EC of the European Parliament and of the Council establishing a framework for the setting of ecodesign requirements for energy-related products, with regard to ecodesign requirements for air heating products, cooling products, high temperature process chillers and fan coil units.

Data sources for indicative values

$$TFES \text{ or } EFE = n \times Pc \times h_{FL} \times \left(\frac{1}{\text{SEPR}_{Ref}} - \frac{1}{\text{SEPR}_{Eff}}\right)$$

For air-chilled coolers	H
SEPRRef	5.62
SEPRE	6
For water-chilled coolers	H
SEPRRef	8.76
SEPRE	11.41
Lifetime of savings	[a]
Lifetime of savings	8

Baseline system data

Database of Eurovent certified air-chilled and water-chilled refrigeration units under the LCP-HP (Liquid Chilling Packages and Heat Pumps)¹:

- SEPR_{Ref}: average of all units in the market.
- SEPR_{Eff}: average of units exceeding reference value.
- \rightarrow Data obtained from Eurovent website

Commission Recommendation about transposing the energy savings obligations (Indicative lifetime for commercial refrigeration)²

¹<u>https://www.eurovent-certification.com/en/third-party-certification/certification-programmes/lcp-hp</u>

² Commission Rrecommendation (EU) 2019/1658 on transposing the energy savings obligations under the Energy Efficiency Directive

Data sources for indicative values

$TFES \text{ or } EFE = n \times Pc \times h_{FL} \times \left(\frac{1}{\text{SEPR}_{Ref}} - \frac{1}{\text{SEPR}_{Eff}}\right)$

Baseline system data

For air-chilled coolers	[P _c]	
Cooling power	≤ 600 kW	
For water-chilled coolers	[P _c]	
Cooling power	≤ 1.500 kW	
Full-load hours	(ha.)	
Full-load hours	Project specific	\rightarrow
Number of cooling systems	[n]	
Number of cooling systems	Project specific	\rightarrow

LCP-HP (Liquid Chilling Packages and Heat Pumps) Programme by Eurovent:

 \rightarrow Capacity limits of certified units: air- and water-chilled, cooling mode

Full-load hours are project specific.

Number of units for specified cooling power (Pc). Project specific.

Calculation of greenhouse gas savings



- FEC: Final Energy Consumption (Article 3)
 - Same approach as TFES and EFE.
 - Based on SEPR values of baseline and new units.
- share_{ec}: Share of Energy Consumption
 - Share of different energy carriers
- ✓ f_{GHG,ec}: Emission factor
 - Emission factor for specific energy carrier

Indicative values for the "emission factor for electricity" are prepared for EU level, but national values can be used

Q&A / Open debate

Methodology for "Centralized commercial and industrial refrigeration units"

2nd Dialogue Group meeting

29 June 2021



Q&A and Open debate

First pool of Q&A => Feedback on methodology

• Results and open debate

Second pool of Q&A

- => Data sources for baseline and indicative values
 - Results and open debate

If there is further information or formulas, or ..., you are always welcome to share via chat, e-mail or Forum on streamSAVE platform.

Conclusions

Methodology for "Centralized commercial and industrial refrigeration systems"

2nd Dialogue Group meeting

29 June 2021



Next steps

Methodology for "Centralized commercial and industrial refrigeration systems"

2nd Dialogue Group meeting

1 June 2021





- 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?

Overview of the Dialogues Group

It description for the next Dialogue Groups web meetings



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

Subscribe via: <u>REGISTRATION LINK</u> or send an email to: <u>dialogues@streamsave.eu</u>



Iease, 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 \rightarrow register on the streamSAVE platform: <u>https://streamsave.flexx.camp/signup-0818ml</u>

Thank you!





* * * * * * * 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.

Carlos Patrão, Paula Fonseca, Pedro Moura

carlospatrao@isr.uc.pt / pfonseca@isr.uc.pt / pmoura@isr.uc.pt

2nd PA Dialogue Group, 1 June 2021