STREAMSAVE DIALOGUE GROUPS

PRIORITY ACTIONS:

HEAT RECOVERY &

REFRIGERATION SYSTEMS

MINUTES OF MEETING 3

TUESDAY 19 OCTOBER 2021

This project has received funding from the Horizon 2020 programme under grant agreement n°890147.

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Short summary

This meeting presented and discussed the calculation methodologies developed by streamSAVE for energy savings from heat recovery and refrigeration. Key points highlighted in the discussions:

- Heat recovery and refrigeration systems represent significant potentials of final energy savings.
- The scope considered is very important when assessing final energy savings from heat recovery systems, hence the distinction between three main cases.
- Projects in industry are sometimes complex and requiring to use specific data to calculate the savings. A standard method then helps to ensure that the calculations are done in line with the rules set in the scheme it is reported to.
- For projects in industry, part of the data needed can often be collected from meters or other measurement devices already in place for other purposes (e.g., safety, optimisation). However, projects in industry might also deal with various processes and complex interactions, making the assessment of energy savings also complex.
- Assessing the rebound effect mostly depends on the perspective you adopt (policy or project). Moreover, the notion of rebound effect in industry might not always be relevant, and be related in practice to productivity gains.
- For refrigeration systems, the efficiency indicators to be documented by the manufacturers have evolved. Which might require to update the calculation methods used by Member States accordingly.
- Indicative cost values about refrigeration systems can be found in the preparatory studies (impact assessments) in frame of the Ecodesign Directive. These values can be presented in absolute ranges to give an order of magnitude of the cost of a project, or in relative terms (cost per kW of capacity), as the capacity has a strong influence on cost.
- The indicative cost values provide a general benchmark, but should not be used for a particular case.
- A set of deemed savings can be used to provide a standardised way to monitor energy savings while reflecting variations according to key parameters that can easily be reported by stakeholders.

Agenda

03.00-03.05	Introduction to the meeting
	PART ON HEAT RECOVERY *moderated by Elisabeth Böck and Matevž Pušnik (Jožef Stefan Institute, Slovenia)*
03.05-03.20	Presentation by Christoph Ploiner (Austrian Energy Agency) about the final streamSAVE methodology with a focus on how to define the system boundaries for heat recovery measures + *Q & A*
03.20-03.35	Presentation by Johann Geyer (ENERTEC) about savings calculation for heat recovery in industry to supply another site – a best practice example from Austria
03.35-03.40	Open discussions about energy savings calculations for heat recovery
	JOINT PART
03.40-03.50	First preview of the streamSAVE Training Module
	PART ON REFRIGERATION SYSTEMS *moderated by Maria Lopez Arias (CIRCE, Spain) and Michal Stasa (SEVEn, Czech Republic)*
03.50-04.05	Presentation of the final streamSAVE methodology with a focus on costs related to commercial and industrial refrigeration systems + *Q&A*
04.05-04.20	Presentation by Jean-Sébastien Broc (IEECP): calculation methods for refrigeration systems in the French white certificates scheme
04.20-04.30	Open discussions about energy savings calculations for refrigeration systems and Wrap-Up

(All times are in CEST)

Part 1: Energy savings calculation for heat recovery systems

Presentation about the final streamSAVE methodology with a focus on how to define the system boundaries for heat recovery measures (Christoph Ploiner, Austrian Energy Agency)

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

Christoph Ploiner first reminded the importance of the definition of final energy savings in the context of Article 7 EED.

A few examples of heat recovery were then briefly presented to illustrate typical sources of excess heat, and thereby final energy savings.

The streamSAVE methodology is focused on heat recovery in industry, due to the large final energy savings potential in this sector. Industry indeed represents 26% of the EU27 final energy consumption, with about two thirds being related to heat demand. Moreover, part of this heat demand is about high temperature heat. Industry is therefore both a source of excess heat and a large user of heat, which creates favourable conditions for heat recovery.

Three types of methodologies have been developed in streamSAVE, considering different scopes:

1. using the heat recovered directly on-site and for the same process.
2. using the heat recovered directly on-site but for another end-use (e.g., other process, space heating)
3. using the heat recovered to feed into a district heating

Overall, final energy savings are calculated as the difference in final energy consumption of the industrial process without and with the heat recovery adds-on. However, what differs in the three cases is the scope of energy consumption to consider.

In the **first case (same process)**, the comparison to calculate the energy savings should take into account the whole energy consumption (energy consumption of the industrial process + other consumption related to the heat recovery system). The final energy savings equal to the **heat recovered minus the electricity used to run the heat recovery system** (e.g., additional pumping power), and normalizing the calculation according to the production output after the installation of the heat recovery system.

In the **second case (on-site, but different end-use(s))**, the final energy savings are calculated as the **substituted final energy consumption** in the other end-use, taking into account the **efficiency of the heating (or heat generation) system** that would have supplied the same amount of heat in the absence of heat recovery.

An additional parameter may be included in the calculation to take into account possible behavioural effects. For example, as the heat recovery makes the heat source cheaper, this may lead to rebound effects (e.g., higher indoor temperature when the heat recovered is used for space heating).

The **third case (feed into district heating)** is more complex as district heating is considered as part of the energy sector. Assessing final energy savings requires to consider energy savings at the side of the end-users. This can happen in case the heat recovery supplied to the district heating makes it possible to extend the district heating grid or reduce prices, and therefore foster the connection of additional buildings.

Then the final energy savings result from the efficiency gain from being supplied from district heating vs. the efficiency of the replaced or baseline heating system that would have been used in the absence of the connection to district heating. The final energy savings are proportional to the heat recovered and supplied to the district heating, taking into account the losses in the district heating network, and the so-called “extrinsic incentives” (related to the expected new connections).

Presentation about savings calculation for heat recovery in industry to supply another site – a best practice example from Austria (Johann Geyer, ENERTEC)

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

ENERTEC is a consulting and engineering company about thermal energy systems.

Dr. Johann Geyer presented a practical example of heat recovery implemented in a pulp production plant in Austria. Pulp production is an energy-intensive and complex process.

In this case, it is about cooking wood chips in a so-called cooking-liquor. This liquor needs to be cooled for the next processing (concentration in evaporation plant). This cooling is done by various heat recovery systems. It represents a case with several successive processing steps, creating opportunities for heat recovery.

However, in practice, it is frequent that these processes produce a share of excess heat that has to be cooled by the environment (and therefore wasted), because the different processing steps are not optimised:

- the heat demand from the hot water system in the process is smaller than the potential heat recovery capacity;
- then the cooling step makes that the further heat recovery capacity is smaller than the heat demand (steam demand) in the next step for the condensate system;
- but the overall heat recovery potential is bigger than the total heat demand (hot water and condensate systems).

Moreover, in the case of the production plant in this example, this plant can also supply heat to a nearby sawmill (heat used for wood drying). There was thus an opportunity to recover heat from the process steam system.

The following optimisations were therefore implemented:

- improved regulation of the cooler, according to the actual demand of the hot water system, enabling to increase the heat recovery capacity;
- rearrangement of the coolers (from series to parallel), enabling an increased “source temperature”, with the benefit of an increase in the heat recovery capacity, and a reduced steam demand in the condensate system;
- installation of an additional heat recovery cooler (also in parallel) that is used for preheating, enabling to reduce the steam demand for wood drying in the sawmill.

Data on key parameters (e.g., temperatures, volume flows, heat generation of the cooling systems, load curve of the wood drying systems) were recorded before and after the optimisations to calculate the energy savings.

Overall, the optimisations done have enabled to increase the actual heat recovery, thereby reducing the steam demand.

The total final energy savings amount to 72.3 GWh/year.

Christoph Ploiner provided complementary explanations about the legal background of this Austrian example, reported to the Austrian EEOS in the period 2014-2020. During this period, the scope of energy savings for Article 7 EED was slightly different, compared to the current period 2021-2030.

In 2014-2020, final energy savings could be considered in terms of reduced energy sales. Therefore the heat recovered and supplied to the sawmill nearby could be considered as final energy savings.

In 2021-2030, final energy savings shall be directly related to end-users’ final energy consumption. In that case, the third case of the streamSAVE methodology should be applied: the final energy savings then correspond to the difference in efficiency between the whole heat recovery systems and the baseline heat (or steam) generation system.

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Q&A on heat recovery

- *How to measure the excess heat input when feeding other application? And also into district heating? Any guidance on how to collect data needed for using the methodologies?*

Christoph Ploiner: The simplest way to measure the heat recovered and supplied is via heat meters at the heat transfer stations.

Johann Geyer: In the Austrian example, there were already flow and temperature meters with data logging systems. These are needed for safety reasons. Therefore, it made it easier to get measured data (with very low extra cost).

However, sometimes it is not so easy to assess the overall energy savings potentials for an industrial site, especially when it includes various processes with complex interactions.

Also, it is more difficult when the site is not already equipped with meters or other measurement systems as part of their usual practices (safety, optimisation, etc.).

It was also mentioned from the audience that, since the savings are linked to various different heat recovery technologies, the savings are mostly linked to the industrial measurements that are required for the process control, i.e. temperature, flow, pressure measurements or calorimeters for monitoring energy fed to a district heating.

- (follow up of the previous question on data collection) *Do you provide any data collection procedure or guidance in the streamSAVE methodology?*

  (note: when using the streamSAVE Training Module, it is indeed needed to enter data to test the methodology).

Christoph Ploiner: The streamSAVE methodology does not enter into the practical details about how to collect or measure the data. It specificies the calculation formula and what data is needed.

- *How should rebound factors be assessed?*

Christoph Ploiner: Assessing the rebound effect mostly depends on the perspective you adopt (policy or project).

When assessing policy impacts, it would be too difficult or expensive to collect data about the parameters relevant to assess rebound effects for each project. One approach can therefore be to do a survey on a sample of projects.

At the level of a project, it can be easier to monitor the before/after situations to identify changes that would be related to rebound effects (e.g., higher indoor temperature, larger heated areas).

It was then discussed that the notion of rebound effect in industry is difficult to define. The energy services needed are indeed used to deliver products. Energy efficiency improvements might help to improve the productivity and increase the production. However, the volume of production is above all related to the demand from the customers, which does not depend on the energy consumption or energy efficiency of the company.

Part 2: Preview of the streamSAVE Training Module

The Training Module enables users to directly use the streamSAVE methodology.

Users can select the type of action they are interested in. Then they get the description of the methodology, see the input data needed, provide input data and get results.

The Training Module is available on the streamSAVE platform from Friday 22 October 2021: https://streamsave.flexx.camp/training

A more complete demo of the Training Module will be done at the dialogue meeting of 23 November 2021 (registration here).

Part 3: Energy savings calculation for refrigeration systems

Presentation of the main points from the previous dialogue meeting on refrigeration systems (Michal Stasa, SEVEn)

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

Michal Stasa reminded the scope of the streamSAVE methodology that is focused on new installations or replacements of air-chilled or water-chilled central compression refrigeration units, and high temperature process chillers.

A key point of the methodology is the choice of the efficiency indicator to be used in the calculation formula.

The relevant Ecodesign regulation ((EU) 2016/2281) stipulates that the recommended efficiency indicator is now SEER (Seasonal Energy Efficiency Ratio) or SEPR (Seasonal Energy Performance Ratio).

Based on the review done to prepare the methodology and the discussions at the previous dialogue meeting, it was chosen to use the SEPR indicator in the streamSAVE methodology.

Eurovent data were used to define indicative values of SEPR and SEER for the market average (baseline situation) and high efficiency units.

The standard EN14825:2018 on air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling was also mentioned by stakeholders at the previous dialogue meeting as a possible data source.

Focus on costs related to commercial and industrial refrigeration systems (Maria Lopez Arias, CIRCE)

Three main categories of costs are considered: investment costs, variable operating costs, and repair and maintenance costs.

There can be major variations according to the capacity of the refrigeration system. In particular, capacity/size has a strong influence on the investment cost.

It is also likely that there could be variations between countries, and according to other factors (e.g., type of technology).

Moreover, the data about operating costs, repair and maintenance costs, are based on set of assumptions (e.g., energy prices, duration considered).

The values presented are therefore indicative benchmarks, and should not be used for a particular case. Moreover, the values are about costs without tax (as taxes vary according to each country)

The main source of these indicative cost values is the preparatory studies in frame of the Ecodesign Directive:

COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document COMMISSION REGULATION (EU) .../... laying down ecodesign requirements for electric motors and variable speed drives pursuant to Directive 2009/125/EC of the European Parliament and of the Council and repealing Commission Regulation (EC) No 640/2009 (SWD/2019/0343 final)

Q & A about the streamSAVE methodology for refrigeration systems

- *Please specify what is meant by "refrigeration systems" in the streamSAVE methodology. For example, does it include process chillers and chillers for comfort cooling?*

Maria Lopez Arias: the streamSAVE methodology is focused on industrial and commercial refrigeration and the utilization of central compression refrigeration units. It does not apply to comfort cooling.

- *About the indicative value of lifetime, 8 years seem short?*

This lifetime is about the energy savings considered in the context of the EED, not about the lifetime of the equipment. The value of 8 years comes from the EC recommendation. This value might have been set to take into account that industrial sites might evolve faster than the lifetime of the equipment (e.g., change in the type or pattern of production, relocation, ...).

The Ecodesign preparatory study[1] mentions a lifetime of about 15 years for the equipment (which is also the value used in the French method).

- *About the indicative cost values: would an investment cost in Euro/kW be more convenient? (instead of an average value, as you mentioned that cost might depend on capacity)*

This could indeed be a relevant indicator. However, in the current version of the streamSAVE methodology it was decided to provide an indicative range of absolute cost values, as this gives an indication of an average project cost about a refrigeration system in industry.

It will be considered whether the streamSAVE methodology could include cost data in terms of euros/kW. This could also be discussed in the streamSAVE online forum.

[1] COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document COMMISSION REGULATION (EU) .../... laying down ecodesign requirements for electric motors and variable speed drives pursuant to Directive 2009/125/EC of the European Parliament and of the Council and repealing Commission Regulation (EC) No 640/2009 (SWD/2019/0343 final)

Calculation methods for refrigeration systems in the French white certificates scheme (Jean-Sébastien Broc, IEECP)

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

(note: this presentation was prepared with the support of Grégory Chedin (ADEME) and Julie Pisano (ATEE)).

The presentation first reminded a few background elements about the French white certificate schemes.

The statistics show that the standardised actions, monitored with deemed savings, represent the largest source of white certificates delivered in the period 2018-2021 (about 87%). It confirms the usefulness to define standardised action types together with deemed savings, thereby facilitating the monitoring of very large numbers of actions.

The French catalogue currently includes 216 types of standardised actions.

Looking more specifically at the action types related to heat recovery and refrigeration systems, they represent a significant share of the white certificates. The action type IND-UT-117 about Heat recovery on cooling units in industry is currently the top1 action, with 21.5% of the “classical” white certificates delivered between January 2018 and June 2019.

About actions on refrigeration systems in industry and services, the most popular action type has been the type IND-UT-116 about Control system to enable refrigeration system to work with high variable pressure, with 2.0% of the white certificates over Jan.2018-June2019. The type IND-UT-113 about Condensing refrigeration unit with high efficiency in industry (further detailed in this presentation) delivered 0.8% of the white certificates, which means about 2.1 TWh_{cumac} (“cumac” stands for lifetime-cumulated and discounted with a discount rate of 4%/year).

The type IND-UT-135 about Freecooling with cooling water instead of a chiller has been published in September 2019. It is expected that this new action type should also deliver significant amount of white certificates. The statistics about white certificates per action type from September 2019 on are not yet publicly available.

The process to specify or revise a type of standardised action is briefly presented, emphasising that it is a collaborative process involving stakeholders and then a validation by ADEME (French agency of ecological transition) and the ministry in charge of energy. This process ensures the reliability and legitimacy of the deemed savings used to credit the actions.

The example of type IND-UT-113 (Condensing refrigeration unit with high efficiency in industry) is then used to illustrate how an action type is specified, including technical specifications, quality and performance requirements, and the explanation of the energy efficiency improvement.

A key component of the factsheet specifying an action type is the calculation formula and related data and assumptions used to define the deemed savings.

The key parameters of the calculation formula for the type IND-UT-113 are briefly discussed, highlighting what values are set in the factsheets and what data need to be reported by a stakeholder submitting a file to get white certificates.

As this calculation formula was first defined about 10 years ago, it is using COP (Coefficient Of Performance) as efficiency indicator. Whereas the streamSAVE methodology uses the more up-to-date efficiency indicators (see SEER and SEPR mentioned above). In the French method, the seasonality is not directly addressed in the efficiency indicator (COP), which is corrected by an adjustment of the duration of use that also enables to take into account the possible over-sizing of refrigeration units.

Q & A about the French methods

- *What about differences with systems using CO2 as refrigerant (different operating temperatures, etc.)?*

Systems using CO2 as refrigerant are addressed in another action type of the French catalogue (cf. type BAT-EQ-117 Refrigeration unit using subcritical or transcritical CO2 in commercial buildings).

- Does the French method about heat recovery on refrigeration systems in commercial buildings cover the case of refrigeration units in supermarkets?

Yes, this action type covers refrigeration units (including the ones used in supermarkets to store food) and space cooling, with specific values for the case of space cooling in data centres.

List of participants

27 participants*

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* 3 participants remain anonymous.

GA N°890147