streamSAVE+ Dialogue Meeting #09

Streamlining Energy Savings Calculations

Energy performance and savings in data centres

MINUTES OF THE MEETING

Date: Thursday 22 January 2026 **Duration:** 11.00-12.15 CET
Online

Short summary

The 9th dialogue meeting continued experience sharing and discussions on improving energy efficiency in data centres (see [first meeting on this topic]). This started with the new streamSAVE+ methodologies for calculating energy savings in data centre, covering both ICT-related measures (servers, storage, networking) and cooling infrastructure improvements. The third presentation summarized the main findings from the most recent assessment of the energy performance and sustainability of data centres in the EU, including trends, data gaps, and opportunities for improvement.

Key points raised during this dialogue meeting:

- ICT equipment represents the largest share (about 60%) of data centres' total energy use. The share of cooling tends to decrease in larger facilities due to economies of scale.
- Energy savings in ICT equipment can be up to 40% but vary broadly according to the type of measure. Efficiency measures on servers deliver the largest electricity savings.
- Despite significant efficiency gains in ICT hardware, the rapid growth in workloads (e.g., expansion of cloud computing and AI-related services) offsets these improvements.
- The future growth of data centres' electricity consumption could create major pressure on national energy systems if efficiency measures are not accelerated. Efficiency improvements alone may not fully offset demand growth: sustainable operation will require both, technical measures and broader policy coordination.
- About cooling, technologies using liquid cooling or optimizing two-phase/passive cooling (e.g., thermosiphon loops) reach highest efficiency.
- Importance of baselines, PUE (Power Usage Effectiveness) as a key performance indicator, and consistent benchmarking across different data centre sizes. Due to the rapidly evolving sector, baselines should be updated regularly (notably for ICT measures).
- When multiple measures are combined, overlaps should be consider to avoid overestimations.
- Cooling energy is often not measured separately. Because of this, the streamSAVE+ methodology uses PUE as a proxy indicator to assess infrastructure efficiency.
- The diversity of data centres makes that indicative values should be considered with caution. Availability of monitoring data is uneven across Member States, and transparency about energy performance indicators is limited. The mandatory reporting under the Energy Efficiency

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Directive (EU) 2023/1791 could improve data availability and thereby help with the development of national or site-specific benchmarks.

- The EU assessment found wide variations in the average PUE performance per country, as well as in the average value per country about WUE (Water Usage Effectiveness). Data reported in the European database show a still small reuse of waste heat (except for a few front-runners, as Finland), despite a large potential. However, these data should be considered with caution, as data availability and reliability vary from one country to the other.
- While data centres' operators report a high share of renewables in their electricity supply, this questions whether guarantees of origin are enough.
- Water consumption, waste heat recovery, lifecycle impacts of ICT equipment and infrastructure, data centres' impacts on the electricity system and energy sourcing are not in the scope of the streamSAVE+ methodologies, and are also important to consider.
- A sustainability label could help informing data centres' customers, support a more harmonised and transparent monitoring and reporting by data centres' operators, and guide governments to propose stricter regulations, including minimum performance standards.

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11:20 – 11:25	Q&A
11:25 – 11:40	The streamSAVE+ methodology about savings calculation for cooling of data centres | **Matevž Pušnik** (Jozef Stefan Institute, Slovenia)
11:40 – 11:45	Q&A
11:45 – 12:00	Main findings from the Assessment of the energy performance and sustainability of data centres in the EU | **Simon Hinterholzer** (Borderstep Institute, Germany)
12:00 – 12:10	Q&A and open discussion about energy performance of data centres, data issues and energy savings calculations
12:10 – 12:15	Wrap-up and next steps

streamSAVE+ updates

In addition to the minutes of all dialogue meetings up to now, the online platform also includes now the bi-annual summaries that gather main information per semester:
https://streamsaveplus.eu/article/8-biannual-summaries

Part 1 - The streamSAVE+ methodologies about energy savings in data centres

The streamSAVE+ methodology about savings calculation for IT equipment and systems in data centres, by Pedro Moura (ISR – Coimbra University)

(see also presentation file available on the streamSAVE+ website)

Pedro Moura presented the streamSAVE+ methodology for calculating energy savings related to ICT equipment and IT systems in data centres. He reminded that data centres are becoming one of the fastest growing electricity consumers in Europe due to increasing demand for cloud services and AI workloads. Electricity use of data centres is projected to be about 98 TWh/year by 2030 (i.e. more than 3% of the EU electricity demand). **ICT equipment** represents the **largest share (about 60%) of their total energy use**.

There have been major improvements in the efficiency of IT equipment, but the overall electricity consumption continues to grow due to the very strong and rapid expansion of data centres.

The streamSAVE+ methodology focuses on the main **ICT load categories**:

- servers;
- storage systems;
- network equipment.

Typical **ICT efficiency measures** considered within streamSAVE+ include:

- replacement of inefficient hardware with more energy-efficient technology;
- server consolidation and virtualization;
- improved workload and capacity management;
- activation of power management features.

The calculation approach starts with defining a **baseline** energy consumption of the data centre before improvements are implemented. It depends on the installed IT power and data centre size category. Energy savings are then derived by comparing this baseline with the situation after applying efficiency measures.

Power Usage Effectiveness (PUE) is used as an important indicator to relate total facility energy consumption to the ICT share. Standard EU and ISO references are applied to ensure that results remain comparable across different data centre sizes and configurations, notably:

- Commission Delegated Regulation (EU) 2024/1364 on the establishment of a common Union rating scheme for data centres;
- ISO/IEC 30134-2:2026 about Information technology — Data centres key performance indicators, Part 2: Power usage effectiveness (PUE).

The calculation of energy savings considers **each ICT component** (servers, storage systems, and network equipment) and its related share in the total ICT energy consumption, and then an **energy saving factor according to the type(s) of efficiency measure** implemented.

When **multiple measures** are implemented, savings should not simply be added together but combined carefully to avoid overestimation. In other words, savings should be **combined multiplicatively**, not additively.

The streamSAVE+ methodology provides **ranges of indicative values** for the various parameters included in the calculation formula. Values for calculating the baseline energy consumption are differentiated according to ranges of data centres' power capacity. Values for **energy saving factor** vary **from 0 to 40%** depending on the type of measure. The methodology also includes indicative values about cost data (CAPEX and OPEX) of efficiency measures. These data may evolve rapidly, and should therefore be considered with caution.

It is recommended to **use national values or site-specific values, whenever possible**, considering the diversity of data centres. The indicative values provide a starting point or benchmark. It is expected that **mandatory reporting under the Energy Efficiency Directive (EU) 2023/1791** could improve data availability, and thereby help with the refinement of typical values, and the development of national or site-specific benchmarks.

Servers represent by far the largest share of the ICT load, typically between 60 and 70%. And the types of efficiency measures with the highest savings factors are about servers:

- server virtualisation and consolidation, with a savings factor of 20-40%;
- intelligent workload scheduling, with a savings factor of 10-30%;
- deployment of energy-efficient server hardware of 10-25%.

The **largest electricity savings potential** in the ICT part of data centres therefore lies in **efficiency measures on servers**.

In addition to final energy savings, the methodology allows estimation of impact on primary energy consumption and greenhouse gas emissions savings. Like for data about baseline energy consumption, it is recommended to use national values for the **primary energy factor and emission factor for electricity**, as these factors depend on the electricity mix that may vary significantly from one country to the other.

Overall, the streamSAVE+ methodology is presented as a structured way to translate ICT efficiency actions into measurable and reportable energy savings, applicable across diverse types of data centres and IT configurations, supporting compliance with the EED and benchmarking about data centres.

Q&A

- *Is waste heat reuse or thermal energy included in the ICT methodology?*

This is not covered within the ICT savings calculation. The methodology evaluates only ICT-related improvements such as servers, storage, and networking equipment. Waste heat reuse can however be assessed following the approach presented in the methodology about savings in cooling systems (see answer in the Q&A about this methodology below).

- *Can you clarify the role of obligated parties and reporting requirements?*

Under Article 12 of the EED, large data centres are now required to report key values such as total energy consumption and PUE. These reported indicators will provide better data to define baseline energy consumption. However, the reporting does not include detailed consumption of each individual device, so benchmarking values are still needed to estimate typical savings from actions like server replacement.

- *What happens when equipment is replaced with more powerful hardware but similar energy consumption?*

Data centre energy use may still increase because capacity and demand grow. Therefore, the baseline should not be based only on past consumption, but on a forward-looking comparison, i.e. what would have happened in the absence of the intervention: increasing capacity with standard technology versus increasing capacity with higher-efficiency technology. The increase in energy demand is driven by workload growth, not necessarily by lack of efficiency improvement.

The streamSAVE+ methodology about savings calculation for cooling of data centres, by Matevž Pušnik (Jozef Stefan Institute, Slovenia)

(see also presentation file available on the streamSAVE+ website)

Matevž Pušnik presented the streamSAVE+ methodology for quantifying energy savings in data centres with a specific focus on cooling systems. He reminded that cooling represents one of the major non-ICT energies uses in data centres, and that improving cooling efficiency is one of the most direct opportunities to reduce overall electricity demand.

A key challenge highlighted was that **cooling energy is often not measured separately** in many facilities. Because of this, the methodology uses **Power Usage Effectiveness (PUE)** as a **proxy** indicator to assess infrastructure efficiency, while keeping the IT workload fixed. PUE is a widely accepted and standardized metric defined as the ratio between total facility energy and IT equipment energy, where lower values indicate higher efficiency.

The scope of the methodology was clearly defined as covering interventions related to cooling infrastructure only, while IT equipment itself is treated in this case as a fixed load. Efficiency measures about ICT equipment are indeed addressed in the other methodology presented by Pedro Moura.

The approach about cooling-related savings is intended mainly for:

- retrofits and upgrades;
- modernization of cooling infrastructure;
- operational optimisation measures.

The methodology does not apply to new data centres without a validated baseline, nor to major expansions that significantly alter the IT load, because in such cases comparing PUE values before and after would no longer be meaningful.

The **cooling-related efficiency interventions** addressed within streamSAVE+ include both conventional and advanced technologies, such as:

- upgrades of computer room air conditioning and air handlers;
- chilled water systems;
- direct-to-chip liquid cooling;
- immersion cooling solutions.

All these measures share the characteristic that they improve cooling efficiency without changing the IT workload.

The calculation of final energy savings was presented through a formula based on **three key elements**:

- annual ICT electricity consumption;
- the share of cooling within the non-ICT load (SCooling);
- the improvement in PUE before and after the intervention (ΔPUE).

The **PUE difference** captures how much non-ICT energy per unit of IT load is reduced. The PUE before and after intervention is therefore a key parameter of the calculation formula, together with the **cooling share** that isolates the part attributable specifically to cooling measures.

Because not all input values are always directly metered, the methodology also provides **indicative benchmark values**. Typical baseline and improved PUE values were shown for different cooling technologies, as well as typical cooling shares depending on facility size. **The share of cooling tends to decrease in larger facilities** due to economies of scale: while this share can be up to 80% in the smallest data centres, it can be down to 32% for the largest ones.

Technologies using **liquid cooling** or **optimizing two-phase/passive cooling** (e.g., thermosiphon loops) reach the lowest PUE (highest efficiency).

The methodology is flexible, i.e. agnostic to server types and suitable for Edge to Hyperscale. It provides a harmonised approach for auditors and national authorities in charge of M&V.

A **practical implementation procedure** was summarized as follows:

- define baseline IT consumption and initial PUE;
- classify the data centre by size;
- select an appropriate cooling share factor;
- choose the cooling intervention and expected PUE improvement;
- calculate savings using the streamSAVE+ formula;
- check results against benchmark values for plausibility.

In addition to final energy savings, the methodology also allows estimation of impact on primary energy consumption and greenhouse gas emissions savings. It was also mentioned that the methodology relies on scientific and technical literature sources, including the EU Code of Conduct for Data Centres, industrial studies, and the regulatory framework[1]. Providing economic cost reference values was described as more difficult, since costs depend strongly on specific technologies and site conditions, but a dedicated chapter in the deliverable addresses cost considerations.

The sources show a density advantage: higher density reduces the number of racks required for the same computing power, creating savings in floor area, containment structures and physical racks.

[1] The references can be found in the methodology (see chapter 4)

Q&A

- *Are solutions evolving as fast for cooling solutions as for ICT equipment?*

A bit more slowly, but still possible to fine-tune the baseline values from the mandatory reporting that is now on-going. Moreover, lifetimes are usually about 15 years (vs. 5-6 yeas in the case of IT equipment).

- *New solutions emerge, like evaporating cooling, that improve energy efficiency but increase water consumption. Did you consider possible conflicts between water and energy issues?*

The methodology is currently focused only on the energy aspect, because it is designed to support reporting under the EED, which addresses energy savings only. Water consumption impacts were therefore not included. However, it was noted that the same calculation structure could be applied if relevant data becomes available.

- *Could waste heat reuse be included in the cooling savings calculation?*

It was already clarified that waste heat reuse is not included directly as a separate element. However, if an intervention affects the overall PUE of the facility, then it could indirectly be reflected in the cooling calculation through the PUE change (delta PUE).

- *Are there differences in baseline PUE values across EU countries, and can national values be used?*

No major differences in PUE across EU countries were identified in the available data. Still, if national values exist, countries can use them to fine-tune and update the indicative baseline tables in the future.

- *Can this methodology help ensure comparability of savings across Member States? How to consider differences due to different climate conditions?*

This is to be further investigated.

Part 2 – Insights from European studies on data centres

Main findings from the Assessment of the energy performance and sustainability of data centres in the EU, by Simon Hinterholzer (Borderstep Institute)

(see also presentation file available on the streamSAVE+ website)

Simon Hinterholzer presented research findings on the energy performance and sustainability of data centres, from the study **Assessment of the energy performance and sustainability of data centres in the EU** prepared by EY, the Austrian Institute of Technology and Borderstep Institute, for the European Commission, see: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive/energy-performance-data-centres_en /.

Simon reminded the background of the study (cf. European Union Data Centre Energy Efficiency Assessment and Reporting Scheme – EUDCEAR, in line with Art.12(5) of the EED) and explained that the **European data centre sector is growing rapidly**, driven mainly by cloud computing, increasing digitalisation, and the expansion of AI-related services.

The base for the study was the reporting done in 2023 by data centres' operators in the EU-wide database. A first step was to process / clean the data (including a plausibility check), as many data were incorrect. Therefore, significant data adjustments have been made. Nonetheless, it represented a credible **dataset covering about 760 data centres**, providing a good basis for the assessment. The main results include:

- Wide variations in the average PUE performance per Member State: notably Scandinavian countries (Denmark, Finland and Sweden) have better values, as well as Belgium.
- Also large variations in the average value per country about water usage effectiveness.
- Waste heat reuse is still small for most EU Member States, whereas there is a large untapped potential, especially when district heating is available close by. Finland stands out as a front-runner.
- At the opposite, renewable energy covers a high share of the energy used in data centres. However, this questions whether guarantees of origin are enough. Maybe another metric would be more relevant.

It was noted about water resources that the data available does not cover the local constraints (including possible stress on water resources).

The study highlighted that data centres already represent a significant share of electricity demand, and that future growth **could create major pressure on national energy systems** if efficiency measures are not accelerated. At the same time, data centres were described as a sector with **high potential for efficiency improvements** and climate benefits if best practices are applied.

Several major sustainability challenges were identified, including:

- rising electricity consumption linked to growing workloads;
- uneven availability of monitoring data across Member States;
- limited transparency regarding energy performance indicators;
- the need for stronger regulatory and reporting frameworks.

It was noted that one of the key difficulties is the lack of consistent and comparable data across Europe. Therefore, **EU-wide reporting obligations** were introduced (Art 12 of EED) to improve transparency and allow benchmarking of energy efficiency indicators such as total consumption and PUE.

The presentation also addressed the role of technological measures, stating that efficiency gains are expected from both IT-side improvements and infrastructure-side solutions, including cooling optimisation. However, the study emphasised that efficiency improvements alone may not fully offset demand growth, meaning that sustainable operation will require both technical measures and broader policy coordination.

The findings also discussed additional **sustainability aspects beyond electricity use**, that should be more carefully assess in future to show the complete picture:

- water consumption of cooling technologies;
- reuse of waste heat from data centres;
- life-cycle impacts of ICT equipment and infrastructure.

The study developed a proposal of label to provide energy and sustainability information on data centres in a harmonised way. This could support **Minimum Performance Standards for data centres**, which would cover energy efficiency (through PUE), water efficiency (through WUE – Water Usage Efficiency) and energy sourcing (cf. renewables). For example, existing DC should have a PUE of less than 1.5 by 2030. This may not be mandatory. Nonetheless, it should be assessed locally and may encourage the implementation of stricter regulations at national level.

Overall, the EU assessment provides an important evidence base, that also supports streamSAVE+ work. As it shows that harmonised methodologies, improved reporting, and coordinated efficiency actions are essential for ensuring that the future growth of data centres remains compatible with EU energy and climate targets.

Simon concluded with referring to the EU Data centre Energy Efficiency Package (DCEEP) announced by the Commission early 2026 (see: https://energy.ec.europa.eu/news/rating-scheme-data-centres-eu-commission-launches-call-feedback-2026-03-27_en).

Q&A

— *Can you, please, explain little bit more about the data on heat reuse in the different Member States?*

The data collection is controversial. Some countries reported extremely few data points, which may not accurately reflect the condition throughout the country. One may expect data centres to reuse over 60% of their heat. Scandinavian countries, for example, have major potential for heat reuse. It is also expected that the next reporting round will provide more data, and therefore that the reliability of these statistics will improve.

— *Which aspects should be addressed to gain a better understanding of the impact on the grid?*

The impact on the grid is extremely important. Most of the new data centres are huge projects, i.e. above 100 MW. These represent significant constraints for the electricity system, and the topic is widely discussed. Discussions are ongoing between the transmission operators and the data centres' operators, about how to deal with this issue, including about flexibility.

— *Do you believe that the developed indicators, such as PUE and WUE, are sufficient to conduct a comprehensive assessment of data centres?*

The development of the proposed label included consultations with the data centres' industry to determine the minimal indications required to conduct a thorough analysis. PUE and WUE are the most important indicators, however they must indeed be properly examined. For the PUE, for example, it is not enough to have a low PUE if the energy source is not sustainable. The same is true for WUE. Even a small amount of water used can have a significant influence in a region with water scarcity.

— *Who would be the users of the label? (Who is the label meant for? Customers of data centres?)*

The proposed label is critical for the customer to evaluate the PUE and WUE levels and select their priorities. It should reflect the overall sustainability of the data centre. However, sustainability is a complex concept. The label will rather illustrate the matrix how the data centres operate. This can help with monitoring and reporting. For example, for local governments to propose new measures and see the progress in their data centres sustainability.

Open discussion

- *Should the streamSAVE+ methodologies to calculate energy savings also include broader sustainability impacts such as water use, waste heat reuse, or embodied emissions?*

Current scope is limited strictly to energy savings, because the methodology is designed to support reporting under the Energy Efficiency Directive. Other sustainability aspects may be relevant, but they are not included at this stage. Water consumption can be extremely important in countries with water scarcity.

- *How reliable are benchmark and default values if many data centres do not provide detailed monitoring data?*

Benchmark values are necessary because sub-metering is often missing. EU reporting obligations are expected to improve transparency over time, allowing benchmarks to become more accurate and updated in the future.

- *Can efficiency improvements still lead to increasing total electricity consumption due to AI workload growth?*

It was confirmed that this is a major concern. Even if technologies become more efficient, rapidly growing demand (especially from AI and cloud services) may offset these gains, so total sector electricity use may continue rising.

- *Can Member States adapt baseline values and parameters to national conditions, especially considering the climate conditions?*

National adaptation is possible if better country-specific data exists, but the overall calculation framework should remain harmonised to ensure comparability across the EU. Possible further development could be to include climate factors.

Further readings

Proceedings of the previous dialogue meeting on data centres:
https://streamsaveplus.eu/article/33-dialogue-meeting-5-data-centres-savings-data-potential-action

New streamSAVE+ methodologies (see chapters 3 and 4 about data centres):
https://streamsaveplus.eu/storage/app/media/uploaded-files/d22-extended-guidance-for-standardized-savings-methodologies-indicative-values.pdf

Acton, M., Booth, J., Paci, D. (2025). 2025 Best Practice Guidelines for the EU Code of Conduct on Data Centre Energy Efficiency. Joint Research Centre report JRC141521.

Brocklehurst, F. (2024). Public Data on Data Centre Energy Use. Report for the 4E TCP (Technology Collaboration Programme on Energy Efficient End-Use Equipment) – EDNA (Efficient, Demand Flexible Networked Appliances Platform).

Heatubun, D., Dragan, I., Bolchi, M., Hinterholzer, S., Hintemann, R., Marx, N. O., & Furda, P. (2025). Assessment of the energy performance and sustainability of data centres in EU. First technical report to the European Commission, July 2025.

Hinterholzer, S., Lopes Bautista, P., Marx, N., Furda, P., Bolchi, M., Dragan, I., Beucker, S., Heatubun, D., Hintemann, R. (2025). Assessment of next steps to promote the energy performance and sustainability of data centres in EU, including the establishment of an EU-wide rating scheme. Second technical report to the European Commission, October 2025.

Kamiya, G., Coroamă, V.C. (2025). Data Centre Energy Use: Critical Review of Models and Results. Report for the 4E TCP (Technology Collaboration Programme on Energy Efficient End-Use Equipment) – EDNA (Efficient, Demand Flexible Networked Appliances Platform).

Montevecchi, F., Stickler, T., Hintemann, R., Hinterholzer, S. (2020). Energy-efficient Cloud Computing Technologies and Policies for an Eco-friendly Cloud Market. Final Study Report by Austria's Environment Agency and Borderstep Institute for the European Commission.

Yilmaz, C. (2023). Achieving Sustainable Digitalization: Strategies for Energy Savings in Data Centres. Presentation at the final dialogue meeting of streamSAVE.

Information and links on energy performance of data centres on the European Commission's website: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en#energy-performance-of-data-centres

List of participants

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