Energy performance and savings in data centres

The streamSAVE+ methodology about savings calculation for IT equipment and systems in data centres

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Context and Objectives

- Data centres are the physical backbone of **ICT services** (cloud, digital services, AI)
- EU data centre **electricity use** projected at ~98 TWh by 2030 (≈3.2% of EU demand)
- **ICT equipment** (servers, storage, networks) represents the core electricity demand (about 60%) of data centres
- Despite significant efficiency gains in ICT hardware: Rapid **growth in workloads** increasingly offsets these improvements
- ICT therefore represents both:
  - A major **driver of energy demand**, and
  - A **key opportunity for energy efficiency** gains through better technologies and system-level optimisation

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Scope of the Methodology

- Focus on IT equipment and systems inside data centres

- Covered **load categories**:
  - Servers (compute)
  - Storage systems
  - Network equipment

- Typical **energy efficiency measures** addressed:
  - Technology replacement (more efficient IT hardware)
  - Server consolidation
  - Virtualisation
  - Improved capacity management and right-sizing

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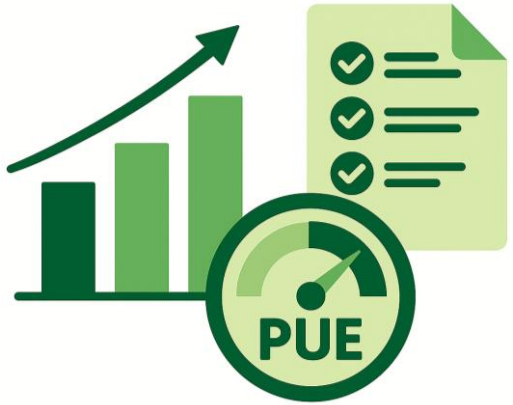
Baseline, Scope and Indicators



- Method based on the calculation of **final energy savings** (kWh/year)
- **Baseline energy consumption**:
  - Energy demand of the data centre before implementation of any measure
  - Depends on installed IT power and data centre size category
- Data centre **size classificatio**n aligned with:
  - Commission Delegated Regulation (EU) 2024/1364
  - Ensures consistency with EU monitoring, reporting and benchmarking
- **Power Usage Effectiveness** (PUE) is used to relate total facility energy to IT energy
  - Dimensionless indicator of energy delivery efficiency
  - Determined according to ISO/IEC 30134-2:2016

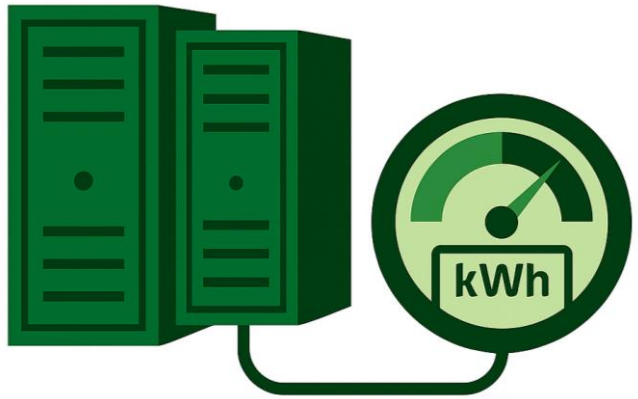
Calculation of Final Energy Savings

$$TFES = \frac{EC_{before}}{PUE} * ICT_{load} * ES_m$$

TFES	Total final energy savings [kWh/a]
EC_{before}	Energy consumption before the implementation of the action [kWh/a]
PUE	Power Usage Effectiveness [dimensionless]
ICT_{load}	Proportion of ICT energy consumption attributed to each load component [%]
ES_m	Energy savings by type of efficiency measure [%]

- Each component is assigned a **share of total ICT energy** consumption:
  - Energy savings effect (ESm) applied per efficiency measure
  - Can be adapted to national or site-specific conditions
  - Associated with a typical lifetime (years)

- ICT energy consumption disaggregated into **main loads**:
  - Servers
  - Storage
  - Network equipment



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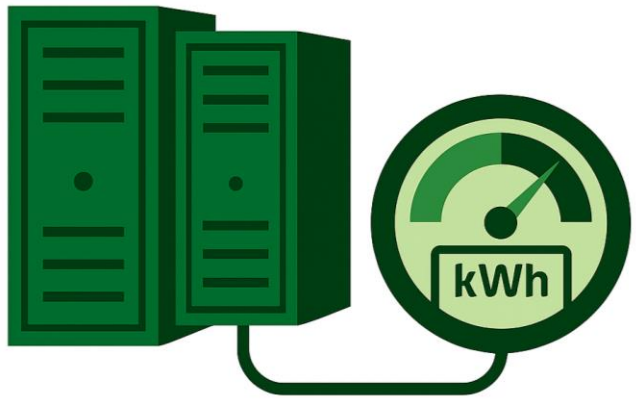
Calculation of Final Energy Savings

$$TFES = \frac{EC_{before}}{PUE} * ICT_{load} * ES_m$$

- Final energy savings calculated by **applying ESm** to the energy share of each ICT component

- When **multiple measures** apply to the same component:
  - Savings combined multiplicatively, not additively
  - Example: 15% and 10% → 1 − (1 − 0.15) × (1 − 0.10) = 23.5%
  - Total ICT savings obtained by **summing savings across all ICT loads**



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Indicative Values

Category	IT Power	[MWh/a]	PUE
Very Small	100–500 kW	650 – 4,000	1.5 – 1.8
Small	500–1,000 kW	3,250 – 8,000	1.4 – 1.7
Medium	1–2 MW	6,500 – 17,000	1.3 – 1.6
Large	2–10 MW	14,000 – 85,000	1.3 – 1.5
Very Large	>10 MW	>85,000	1.1 – 1.4

Load	%
Servers	60 – 70%
Storage Devices	10 – 15%
Networking	10 – 15%
Other ICT Loads	5 – 10%

Measure / Servers	%	Lifetime
Server virtualisation and consolidation	20 – 40%	6
Decommissioning obsolete servers	5 – 15%	3
Deployment of energy-efficient server hardware	10 – 25%	5
Intelligent workload scheduling	10 – 30%	4
Activation of power management features	5 – 20%	4
Efficient virtualisation/container platforms	10 – 20%	5
Monitoring and analytics for server energy use	0 – 5%	2

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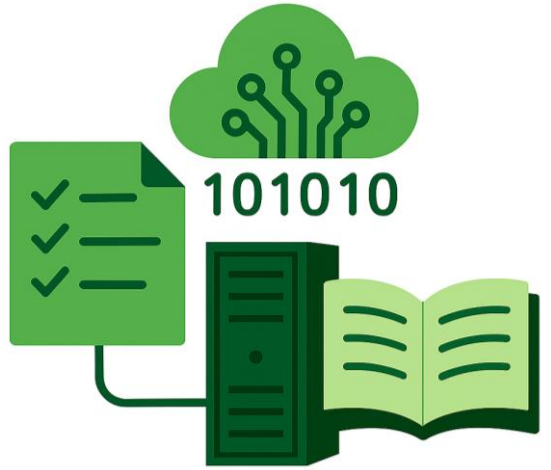
Indicative Values

Measure / Storage	%	Lifetime
Data management optimisation	5 – 15%	4
Storage tiering and energy-aware systems	10 – 20%	5
Modernisation of storage hardware	10 – 20%	5

Measure / Netword	%	Lifetime
Efficient network design and topology optimisation	5 – 15%	4
Energy-efficient network equipment	5 – 15%	5
Intelligent port and link management	5 – 10%	4
Monitoring network device consumption	0 – 5%	2

Data Sources for Indicative Values

- Methodology **avoids fixed indicative values** due to the diversity of data centres
- Calculations rely on **benchmarks and empirically validated** parameters
- Priority given to measured or calculated data, supported by **typical ranges**
- **Key inputs** from recognised EU and international sources
  - IT energy use, ICT load distribution and PUE
  - Operating hours and energy use by data centre size
- **Mandatory reporting** under Directive (EU) 2023/1791 will enable:
  - Refinement of typical values
  - Development of national or site-specific benchmarks
  - Ensures results remain robust and up to date



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Overview of Costs Related to the Action

- Included cost components
  - Investment costs (CAPEX): purchase and setup of energy-efficient servers, storage and network equipment
  - **Fixed OPEX**: maintenance contracts, software licences, support services
  - Variable OPEX: electricity use, updates, service-level adjustments
  - Where relevant, baseline costs of legacy systems should be included to assess net impacts

Category	Investment Cost (€/kW ICT capacity)	Fixed OPEX (€/kW/year)
Servers	2,000 – 3,500	100 – 250
Storage Devices	1,500 – 2,500	80 – 200
Network Equipment	1,200 – 2,000	60 – 150

Impact on Energy Consumption and CO_2

$$EPEC = FEC_{Baseline} \cdot f_{PE,electricity} - FEC_{Action} \cdot f_{PE,electircity}$$

EPEC	Effect on primary energy consumption [kWh/a]
FEC	Annual final energy consumption [kWh/a]
fPE,electricity	Factor to convert final to primary energy savings for electricity [dmnl]
Baseline	Index for the baseline situation of the action
Action	Index for the situation after the implementation of the action

$$GHGSAV = TFES \cdot f_{GHG,electricity} * 10^{-6}$$

GHGSAV	Greenhouse gas savings [t CO2e p.a.]
FEC	Annual final energy consumption [kWh/a]
fGHG,electricity	Emission factor for electricity [g CO_2/kWh]

Thank you for your attention!

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Project partners

Thank You

Get in touch for more information!

Project coordinator – Jiří Karásek, SEVEn

All project reports will be available for download on the streamSAVE+ website **https://streamsaveplus.eu/**

And the platform

https://streamsaveplus.eu/priority-actions

Email the project at **jiri.karasek@svn.cz**

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