Footprint
Energy & CO$_2$ calculator – background & specs

Description

Footprint Energy & CO$_2$ calculator is a web-based tool for performing early-stage energy calculations to estimate potential energy, CO$_2$ emission and financial savings. It can be used for both new and existing buildings and estimates how energy performance is impacted by BACS (Building Automation and Control Systems) in general, and Swegon product, system and optimization functionality in particular.

The tool is based on an independent European ISO standard (ISO 52120-1:2021) that is included in the Energy Performance of Buildings Directive (EPBD). This standard defines how to calculate potential energy savings based on the level of automation and control systems that are used in a building. The standard includes two methods, a factor based, and a detailed method. The Footprint calculation tool uses the factor-based method. The tool is to be used in an early stage, it does not consider the building envelope or geographical location and should not be mistaken for an indoor climate and energy simulation software.

As a user you simply select the building application, type and size in sqm. In addition, you also select the heating and cooling production source and based on this, the tool will calculate the energy usage of the building as well as potential savings in kWh. CO$_2$e (operational carbon footprint) is calculated by multiplying the energy usage and savings with the carbon footprint of the selected energy source (kg CO$_2$ equivalents) with a given energy mix. Financial savings are calculated by multiplying kWh with the average cost per kWh in your selected country. All data is based on independent sources and databases and editable in the tool.

With this data the calculator will estimate the total energy consumption needed to reach C-class, which is the reference level, and the minimum required energy level for new buildings today (read more about energy efficient buildings and EPBD here: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings_en). See also the table in the end of this document "Minimum BACS requirement (C-class)".

By selecting from Swegon's product, system and optimization functionalities the tool calculates additional energy savings compared to C-class energy performance of the building.

Savings calculation - new building:

The Footprint calculator assumes that a new building is at least C-class energy performance according to BACS (minimum requirements when building new). By using Swegon's product, system and optimization functionalities additional savings can be made, in addition to C-class.

Savings calculation - existing building (renovation):

The Footprint calculator assumes that an existing building has D-class energy performance according to BACS and that a renovation, at least upgrades the building from D to C-class. Savings are thus displayed based on D-class energy performance.

*) Sqm refers to the area enclosed by the inside of the building envelope of all floors including cellars and attics for temperature-controlled spaces that are intended to be heated to more than 10°C. The area occupied by interior walls, openings for stairs, shafts, etc., are included.

Building Automation and Controls Systems (BACS)

BACS refers to integrated systems that monitor, control, and optimize building services like HVAC, lighting, and energy management to improve comfort, efficiency, and sustainability.

The core functions of BACS are as follows:

- Maintain control of the building's environment
- Operate systems according to occupancy and energy demand
- Monitor and adjust the performance of systems

The facilities that can be controlled by BACS include:

- Mechanical systems
- Plumbing
- Electrical systems
- Heating, ventilation and air-conditioning (HVAC)
- Lighting
- Security and surveillance
- Alarms
- Lifts

ISO 52120-1:2021

Energy performance of buildings — Contribution of building automation, controls and building management

This standard belongs to the family of standards aimed at international harmonization of the methodology for the assessment of the energy performance of buildings. Throughout, this group of standards is referred to as "EPB set of standards". The standard specifies:

- A structured list of control, building automation and technical building management functions which contribute to the energy performance of buildings; functions have been categorized and structured according to building disciplines (heating, domestic hot water, cooling, ventilation and air conditioning, lighting, blinds, technical home and building management) and building automation and control (BAC).

- A method to define minimum requirements or any specification regarding the control, building automation and technical building management functions contributing to energy efficiency of a building to be implemented in building of different complexities.

- A factor-based method to get a first estimate of the effect of these functions on typical building types and use profiles.

- Detailed methods to assess the effect of these functions on a given building.

The calculation method includes a list of automation controls for each discipline: heating, domestic hot water, cooling, ventilation and air conditioning, lighting, blinds and technical home and building equipment.

Each function may have different saving potential depending on the application. Included applications are offices, lecture halls, education buildings (incl. schools), hospital, hotel, restaurant, and wholesale/retail.

Buildings are divided into four different energy classes
D – Non energy efficient BAC, in this calculation equivalent to an existing building
C – Standard BAC, in this calculation equivalent to a new building
B – Advanced BAC
A – High energy performance BAC

Energy, cost and environmental impact – Default values and database sources

Footprint energy & CO_2 calculator is using the ISO 52120-1:2021 standard to calculate potential savings for both thermal and electrical energy. To be able to calculate energy savings in kWh, CO_2 emission savings (kg CO_2 equivalents) and financial savings (local currency) it uses default values (shown below) which are editable in the tool.

Energy use new building

Delivered energy, excluding operational electricity
Legal minimum demand (kWh/sqm/year)

Data source:
Using local legislations that defines max allowed energy use of a new-built commercial building.

Energy use existing building

Delivered energy, excluding operational electricity

Data source:
Using locally defined levels of average energy use for existing buildings

Energy cost

- Electricity, LOC/kWh

- Gas, LOC/kWh

- Oil, LOC/kWh

- Distr. Heat, LOC/kWh

- Distr. Cooling, LOC/kWh

Data sources:
Electricity, gas: Using the average of EU countries presented in EUROSTAT database 2025-10-22
Oil: Weekly Oil Bulletin 2025-10-27
District heating: Estimated average including fixed and variable cost
District cooling: Estimated average including fixed and variable cost

Energy efficiency factor

- SCOP (Seasonal Heating coefficient)   3,2   kW/kW
- SEER (Seasonal Cooling coefficient)   4,1   kW/kW
- Electricity   1   kW/kW
- Gas   1   kW/kW
- Oil   1   kW/kW
- District heating   1   kW/kW
- District Cooling   1   kW/kW

Green House Gas equivalent

- Electricity (CO_2e/kWh)
- Gas (CO_2e/kWh)
- Oil (CO_2e/kWh)
- Distr. Heating (CO_2e/kWh)
- Distr. Cooling (CO_2e/kWh)

<u>Data sources:</u>

Electricity: EEA 2025 Residual mix
Gas & Oil: DEFRA 2025
District heating: Estimated average emissions
District cooling: Estimated average emissions

Energy division

	Offices	Lecture hall	Education Schools	Hospital	Hotels	Restaurants	Wholesale/ retail
Heating	50%	65%	65%	65%	65%	65%	65%
Cooling	15%	5%	5%	5%	5%	5%	5%
Domestic hot water	5%	5%	5%	5%	5%	5%	5%
Building electricity	30%	25%	25%	25%	25%	25%	25%
Operational electricity	0%	0%	0%	0%	0%	0%	0%
Sum needs to be:	100%	100%	100%	100%	100%	100%	100%

Data sources:

Due to a lack of comprehensive and relevant data sources, the energy division is based on estimates. As the energy consumption mix will differ between countries as well as building types (office, hospital etc.), it is recommended that the user of the calculation tool review and edit these values.

Weighting of Energies to Estimate the Building's Total Energy Use

To calculate the potential energy savings for an entire building, a weighting method has been applied. Within each technical building system (heating, cooling, etc.), the potential savings are calculated as the average of all included functions. To determine the potential energy savings for the whole building, the weighting between the different technical building systems has been divided according to the table below.

Category	Thermal	Thermal (no cooling)	Electricity	Electricity (no cooling)
Heating	40 %	67 %	25 %	33,3 %
Domestic hot water	20 %	33 %		
Cooling	40 %		25 %	
Ventilation			25 %	33,3 %
Lighting			5 %	6,7 %
Sun shading			10 %	13,3 %
Technical home/building equipment			10 %	13,3 %

Formula to calculate the Non-renewable energy.

$$EP_{pet} = \frac{\sum_{i=1}^{6} \left(\frac{E_{uppv,i}}{F_{geo}} + E_{kyl,i} + E_{tvv,i} + E_{f,i} \right) \times VF_i}{A_{temp}}$$

Weighting factors for alternative energy carriers

Energy Carrier	Weighting Factor
Electricity	1.8
District Heating	0.7
District Cooling	0.6
Biofuels	0.6
Oil	1.8
Gas	1.8

Minimum BACS requirements (C-class) – ISO 52120-1:2021

Table 6 - Function list and assignment to BAC efficiency classes			Definition of classes			
			Non residential			
			D	C	B	A
1		**Heating control**				
1.1		**Emission control**				
		The control function is applied to the heat emitter (radiators, underfloor heating, fan-coil unit, indoor unit) at room level; for Type 1, one function can control several rooms				
	0	No automatic control	x			
	1	Central automatic control	x			
Minimum requirement	2	Individual room control	x	x		
	3	Individual modulating room control with communication	x	x	x	x[a]
	4	Individual modulating room control with communication and occupancy detection (not applied to slow reacting heating emission systems, e.g. floor heating)	x	x	x	x
1.2		**Emission control for TABS (heating mode)**				
	0	No automatic control	x			
Minimum requirement	1	Central automatic control	x	x		
	2	Advanced central automatic control	x	x	x	
	3	Advanced central automatic control with intermittent operation and/or room temperature feedback control	x	x	x	x
1.3		**Control of distribution network hot water temperature (supply or return). Similar function can be applied to the control of direct electrical heating networks**				
	0	No automatic control	x			
Minimum requirement	1	Outside temperature compensated control	x	x		
	2	Demand based control	x	x	x	x
1.4		**Control of distribution pumps in network**				
		The controlled pumps can be installed at different levels in the network				
	0	No automatic control	x			
Minimum requirement	1	On off control	x	x		
	2	Multi-stage control	x	x	x	
	3	Variable pump-speed control (pump unit (internal) estimations)	x	x	x	x
	4	Variable pump-speed control (external demand signal)	x	x	x	x
1.4a		**Hydronic balancing heating distribution (including contribution to the balancing to the emission side)**				
		Hydronic balancing is applied to an emitter or a group of heat emitters greater than 10				
	0	No balancing	x			
	1	Balanced statically per emitter, without group balance	x			
	2	Balanced statically per emitter, and a static group balance	x			
Minimum requirement	3	Balanced statically per emitter, and dynamic group balance	x	x		

				Non residential			
				D	C	B	A
1.5			**Intermittent control of emission and/or distribution**				
			One controller can control different rooms/zones having same occupancy patterns				
	0		No automatic controls	x			
Minimum requirement	1		Automatic control with fixed time program	x	x		
	2		Automatic control with optimum start/stop	x	x	x	
	3		Automatic control with demand evaluation	x	x	x	x
1.6			**Heat generator control (combustion and district heating)**				
	0		Constant temperature control	x			
Minimum requirement	1		Variable temperature control depending on outside temperature	x	x		
	2		Variable temperature control depending on the load	x	x	x	x
1.7			**Heat generator control (heat pump)**				
Minimum requirement	0		Constant temperature control	x			
	1		Variable temperature control depending on outside temperature	x	x		
	2		Variable temperature control depending on the load	x	x	x	x
1.8			**Heat generator control (Outdoor unit)**				
	0		On/off-controll of heat generator	x			
Minimum requirement	1		Multi-stage control of heat generator	x	x	x	
	2		Variable control of heat generator	x	x	x	x
1.9			**Sequencing of different heat generators**				
	0		Priorities only based on running time	x			
Minimum requirement	1		Control according to fixed priority list	x	x		
	2		Control according to dynamic priority list	x	x	x	
	3		Control according to prediction based dynamic priority list	x	x	x	x
1.10			**Control of thermal energy storage (TES) operation**				
	0		Continuous storage operation	x			
Minimum requirement	1		2-sensor charging of storage	x	x	x	
	2		Load-prediction-based storage operation	x	x	x	x

				Non residential			
				D	C	B	A
2		**Domestic hot water supply control**					
2.1		Control of DHW storage charging with direct electric heating or integrated electric heat pump					
	0	Automatic on/off control		x			
Minimum requirement	1	Automatic on/off control and scheduled charging enable		x	x		
	2	Automatic on/off control and scheduled charging enable and multi-sensor storage management		x	x	x	x
2.2		Control of DHW storage charging using hot water generation					
	0	Automatic on/off control		x			
Minimum requirement	1	Automatic on/off control and scheduled charging enable		x	x		
	2	Automatic on/off control and scheduled charging enable and demand-based supply temperature control or multi-sensor storage management		x	x	x	x
2.3		Control of DHW storage charging with solar collector and supplementary heat generation					
	0	Manual control		x			
Minimum requirement	1	Automatic control of solar storage charge (prio 1) and supplementary storage charge (prio 2)		x	x		
	2	Automatic control of solar storage charge (prio 1) and supplementary storage charge (prio 2) plus demand based supply temperature control or multi-sensor storage management		x	x	x	x
2.4		Control of DHW circulation pump					
	0	No control, continouos operation		x			
Minimum requirement	1	With time program		x	x	x	x

				Non residential			
				D	**C**	**B**	**A**
3			**Cooling control**				
3.1			**Emission control**				
			The control function is applied to the emitter (cooling panel, fan-coil unit or indoor unit) at room level; for Type 1, one function can control several rooms				
		0	No automatic control	x			
		1	Central automatic control	x			
Minimum requirement		2	Individual room control	x	x		
		3	Individual modulating room control with communication	x	x	x	x[a]
		4	Individual modulating room control with communication and occupancy detection (not applied to slow reacting cooling emission systems, e.g. floor cooling)	x	x	x	x
3.2			**Emission control for TABS (cooling mode)**				
		0	No automatic control	x			
Minimum requirement		1	Central automatic control	x	x		
		2	Advanced central automatic control	x	x	x	
		3	Advanced central automatic control with intermittent operation and/or room temperature feedback control	x	x	x	x
3.3			**Control of distribution network chilled water temperature (supply or return).**				
		0	Constant temperature control	x			
Minimum requirement		1	Outside temperature compensated control	x	x		
		2	Demand based control	x	x	x	x
3.4			**Control of distribution pumps in network**				
			The controlled pumps can be installed at different levels in the network				
		0	No automatic control	x			
Minimum requirement		1	On off control	x	x		
		2	Multi-stage control	x	x	x	
		3	Variable pump-speed control (pump unit (internal) estimations)	x	x	x	x
		4	Variable pump-speed control (external demand signal)	x	x	x	x
3.4a			**Hydronic balancing cooling distribution (including contribution to the balancing to the emission side)**				
			Hydronic balancing is applied a group of cooling emitters (cooling panel, fan-coil unit or indoor unit) greater than 10, in addition to static balancing at individual cooling emitters				
		0	No balancing	x			
Minimum requirement		1	Balanced statically per emitter, without group balance	x			
		2	Balanced statically per emitter, and a static group balance (e.g with balancing valve)	x			
		3	Balanced statically per emitter, and dynamic group balance	x	x		
		4	Balanced dynamically per emitter	x	x	x	x

			Non residential			
			D	C	B	A
3.5		**Intermittent control of emission and/or distribution**				
		One controller can control different rooms/zones having same occupancy patterns				
	0	No automatic controls	x			
Minimum requirement	1	Automatic control with fixed time program	x	x		
	2	Automatic control with optimum start/stop	x	x	x	
	3	Automatic control with demand evaluation	x	x	x	x
3.6		**Interlock between heating and cooling control of emission and/or distribution**				
	0	No interlock	x			
Minimum requirement	1	Partial interlock (dependent on the HVAC system)	x	x	x	
	2	Total interlock	x	x	x	x
3.7		**Generator control for cooling**				
		The goal consists generally in maximizing the chilled water supply temperature				
	0	Constant temperature control	x			
Minimum requirement	1	Variable temperature control depending on outside temperature	x	x	x	
	2	Variable temperature control depending on the load	x	x	x	x
3.8		**Sequencing of generators for chilled water**				
	0	Priorities only based on running times	x			
Minimum requirement	1	Fixed sequensing based on loads only	x	x		
	2	Priorities based on generator efficiency and characteristics	x	x	x	
	3	Load predicition-based sequencing	x	x	x	x
3.9		**Control of thermal energy storage (TES) charging**				
	0	Continuous storage operation	x			
Minimum requirement	1	Time-scheduled storage operation	x	x		
	2	Load-prediction-based storage operation	x	x	x	x

			Non residential			
			D	C	B	A
4		**Ventilation and air-conditioning control**				
4.1		**Supply air flow control at the room level**				
	0	No automatic control	x			
Minimum requirement	1	Time control	x	x	x	
	2	Occupancy based control	x	x	x	
	3	Demand based control	x	x	x	x
4.2		**Room air temperature control (all-air systems)**				
	0	On-off control	x			
Minimum requirement	1	Continuous control	x	x		
	2	Optimized control	x	x	x	x
4.3		**Room air temperature control (combined air-water systems)**				
Minimum requirement	0	No coordination	x			
	1	Coordination	x	x	x	x
4.4		**Outside air (OA) flow control**				
	0	Fixed OA ratio or OA flow	x	x		
Minimum requirement	1	Staged (low or high) OA ratio or OA flow (time schedule)	x	x	x	
	2	Staged (low or high) OA ratio or OA flow (occupancy)	x	x	x	
	3	Variable control	x	x	x	x
4.5		**Air flow or pressure control at the air handler level**				
	0	No automatic control	x			
Minimum requirement	1	on off time control	x	x		
	2	Multi-stage control	x	x	x	
	3	Automatic flow or pressure control (without reset)	x	x	x	x
	4	Automatic flow or pressure control (with reset)	x	x	x	x
4.6		**Heat recovery control: icing protection**				
	0	Without icing protection	x			
Minimum requirement	1	With icing protection	x	x	x	x
4.7		**Heat recovery control: prevention of overheating**				
	0	Without overheating control	x			
Minimum requirement	1	With overheating control	x	x	x	x
4.8		**Free mechanical cooling**				
	0	No automatic control	x			
Minimum requirement	1	Night cooling	x	x		
	2	Free cooling	x	x	x	
	3	Enthalpy based cooling	x	x	x	x
4.9		**Supply air temperature control**				
	0	No automatic control	x			
Minimum requirement	1	Constant setpoint	x	x		
	2	Variable setpoint with outside temperature compensation	x	x	x	
	3	Variable setpoint with load dependant compensation	x	x	x	x
4.10		**Humidity control**				
	0	No automatic control	x			
Minimum requirement	1	Dew point control	x	x		
	2	Direct humidity control	x	x	x	x

				Non residential			
				D	**C**	**B**	**A**
5			**Lightning control**				
5.1			**Occupancy control**				
		0	Manual on/off switch	x			
		1	Manual on/off switch + additional sweeping extinction signal	x	x		
Minimum requirement		2	Automatic detection (auto on)	x	x	x	x
		3	Automatic detection (manual on)	x	x	x	x
5.2			**Light level/daylight control**				
Minimum requirement		0	Manual (central)	x	x		
		1	Manual (per room/zone)	x	x		
		2	Automatic switching	x	x	x	
		3	Automatic dimming	x	x	x	x

				Non residential			
				D	**C**	**B**	**A**
6			**Blind control**				
		0	Manual operation	x			
		1	Motorized operation with manual control	x			
Minimum requirement		2	Motorized operation with automatic control	x	x		
		3	Combined light/blind/HVAC control	x	x	x	x

				Non residential			
				D	**C**	**B**	**A**
7			**Technical home and building management**				
7.1			**Setpoint management**				
		0	Manual setting room by room individually	x			
Minimum requirement		1	Adaption from distributed decentralized plant rooms only	x	x		
		2	Adaption from central room	x	x	x	
		3	Adaption from central room with frequent set back of user inputs	x	x	x	x
7.2			**Runtime management**				
		0	Manual setting (plant enabling)	x			
Minimum requirement		1	Individual setting following a predefined time schedule including fixed preconditioning phases	x	x		
		2	Individual setting following a predefined time schedule; adaption from a central room; variable preconditioning phasesincluding fixed preconditioning phases	x	x	x	x
7.3			**Detecting faults of technical building systems and providing support to the diagnosis of these faults**				
		0	No central indication of detected faults and alarms	x			
Minimum requirement		1	With central indication of detected faults and alarms	x	x		
		2	With central indication of detected faults and alarms/diagnosing functions	x	x	x	x
7.4			**Reporting information regarding energy consumption, indoor conditions**				
Minimum requirement		0	Indication of actual values only (eg temperatures, meter values)	x	x		
		1	Trending functions and consumption determination	x	x	x	
		2	Analysing, performance evaluation, benchmarking	x	x	x	x
7.5			**Local energy production and renewable energies**				
Minimum requirement		0	Uncontrolled generation depending on the fluctuating avaliability of RES and or runtime of CHP; overproduction will be fed into the grid	x	x		
		1	Coordination of local RES and CHP with regard to local energy demand profile including energy storage management; optimization of own consumption	x	x	x	x
7.6			**Waste heat recovery and heat shifting**				
Minimum requirement		0	Instantaneous use of waste heat or heat shifting	x			
		1	managed use of waste heat or heat shifting (including charging/discharging TES)	x	x	x	x
7.7			**Smart grid integration**				
Minimum requirement		0	No harmonization between grid and building energy systems; building is operated independently from the grid load	x	x		
		1	Building energy systems are managed and operated depending on grid load; demand side management is used for load shifting	x	x	x	x