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Energy management in buildings

A practical guide for building managers and technicians

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Content

Energy management in buildings

Energy management is a systematic work process that allows the building manager to incorporate energy efficiency measures in the daily building operation. It also gives way for monitoring the energy consumption in the building and can thereby identify unnecessary energy use.

Energy management implies various work processes, not only technical measures. If you only work with technical measures as energy efficiency in buildings, it will not guarantee you continuous energy savings.

This guide will show you the practical way of introducing energy efficiency and of implementing energy management measures in your daily building operation.

How to work with energy efficiency in buildings

Usually when you think of energy efficiency in buildings, it comprises of an energy audit that lists the different potential technical measures that would lead to energy savings. After receiving the audit report, it can be decided to go ahead and implement some of the measures if there are financing. But after that, what then? There is normally hardly any evaluation or follow up on the technical measures to investigate if the measures did deliver the guarantied energy savings.

Figure 1: The traditional method of energy efficiency measures

This is why energy management is important as it incorporates building operation and takes account for the behavioural aspects of both the building users and the building technicians.

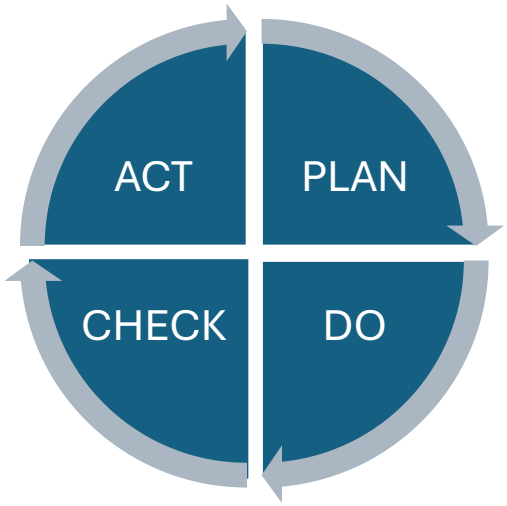


Figure 2: The circular work progress of Energy Management

The work process behind energy management consists of four phases throughout the year starting with the planification of actions and measures and ending with an evaluation of the actions as well as the lections learned from the behavioural aspects. In that way, the building management will have insight in what worked and what didn't. Also, in how people reacted to the different measures. And so initiating improvement in the work processes each year.

How to implement Energy Management

Where to start?

Implementation of energy management starts with the organization. It is necessary to have a person responsible for energy consumption in the building. In many cases, this person is the building manager.

But we need to understand the current conditions of the building management and the building use before introducing energy management.

Ask yourself these questions:

- How is the building management organized?
- What is the function of the building?
- Who are the building users?
- How is the building operated and by whom?
- How is the way of communication from building management to building technician to users?

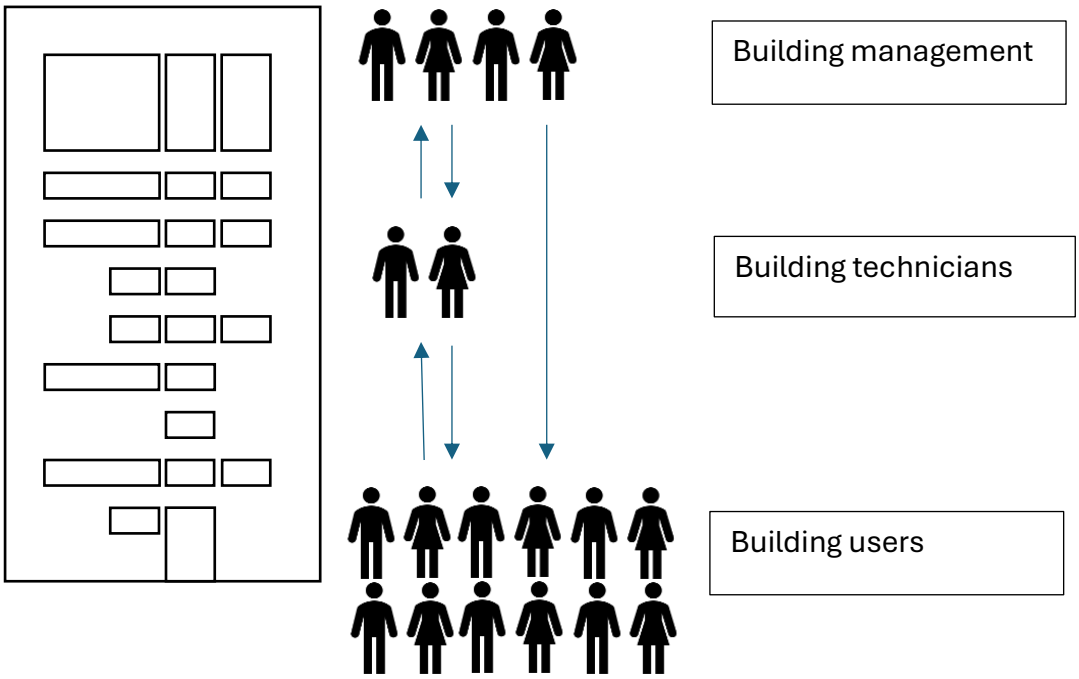


Figure 3: The different groups of people within a building and their communication ways

When you have understood the context of the building and especially the organization behind it, then you can better identify which areas that need to be strengthened. For example, if the building users have direct access to the cooling units, they can thereby control the indoor temperature. This can result in high electricity consumption as they might set the temperature either very low or very high. The most optimal solution is that the building technicians have control over the cooling system and can set the temperature after consulting with the building users. Afterwards, the building management can set requirements for the indoor temperature such as the minimum temperature is 21°C and maximum 23°C. These temperatures ensure a comfortable indoor climate. In this way, the building users can't require temperatures lower or higher than that.

This is Energy management.

Energy management organization and policy

To ensure the implementation of energy management in the building management, it is highly recommended that the top management sets an energy efficiency policy and target(s) for energy consumption. This gives the energy manager the mandate to work effectively with energy management and can thereby change the building management's current work routines.

See the figure below for an example of the organization where energy management is implemented in the building management. With an energy efficiency policy, the entire

building management is accountable for obtaining the target while the energy manager is responsible for the performance of the energy management system.

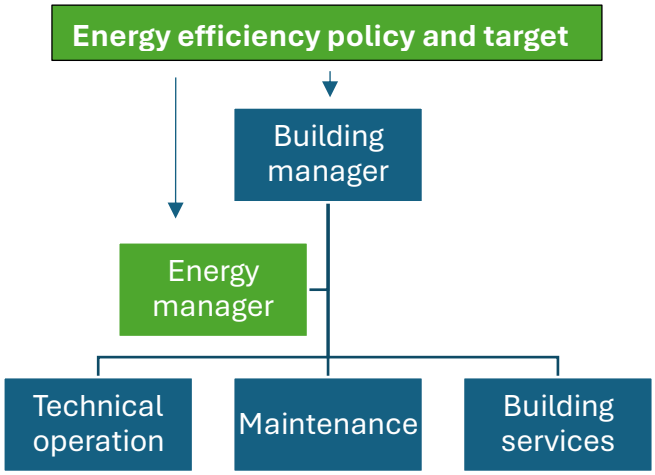


Figure 4: An example of energy management implemented in the building management organization

The role of the energy manager

The role of the energy manager is quite extensive and covers many functions which does require a full-time employee. However, in most cases the building manager is also the energy manager. That means that a lot of the functions of the energy manager are hard to cover when you also are responsible for the general building operation. In an organization where there are several buildings such as a municipality, it is recommended to appoint an energy manager responsible for all buildings. In this way, this appointed person will have the full overview and can thereby better benchmark the buildings with each other.

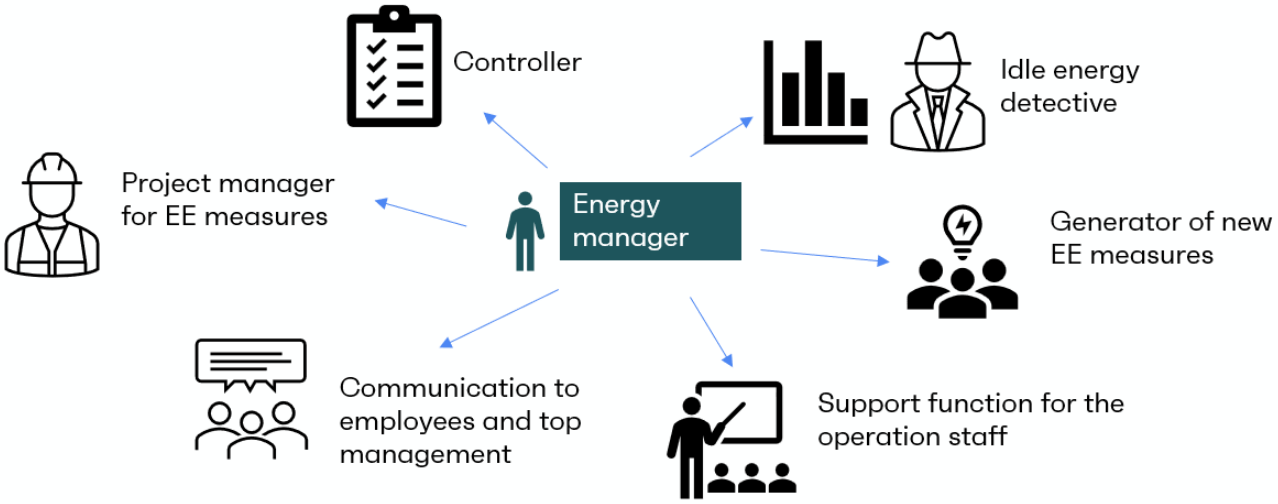


Figure 5: The many functions of the energy manager

In the following, the different functions of the energy manager are described.


Idle energy use detective

The energy manager analyses the monitored energy consumption of the building either per week or per month. If there is an increase in the consumption, the energy manager must figure out why this is as a detective. Depending on the quality of the energy data and the number of meters in the building, it is possible to identify the area of high consumption. If you only have one meter, then you must go through the building and its installations to investigate if there are any malpractice, disfunctions or just wrong settings. It can also be that you must ask the building operation staff if they know any of these issues. Sometimes, the weather could have been the issue if there were some days with higher temperatures than usual.

When the idle energy use has been identified, it must be rectified.

Generator of EE measures

As an energy manager you need to assess what kind of energy efficiency measures can be done in your building. These measures can originate from an energy audit, an energy screening, and a general observation of the building's maintenance level.

The identified possible energy efficiency measures should be listed according to energy saving potential, priority (need to have vs. nice to have), and the estimated investment. In this way, you as the energy manager can better present the different measures as a business case to order to obtain financing.

Support function to the building management staff

To secure that the efforts in energy efficiency are achieved, it is necessary that building management staff knows how to operate the building energy efficiently. That means that your role as energy manager is to ensure that they get the proper support and training. You are also the person that they can ask if they have any questions on the building operation and maintenance. If there are more technical questions that you cannot answer, it is recommended to call a technician. The technician can then support and guide the building management staff.

Communication with the building users

Energy management is achieved through partly technical measures and partly communication. The behaviour of the building users has a great

effect on the energy consumption as they in many cases can control the cooling unit. For many building-users comfort comes before energy savings. However, in these cases the problem could be that some windows or doors were not closed properly letting in hot outside air. The building users are not aware of this and simply turns the temperature further down on the cooling unit. Your role as energy manager is make them aware of the impact of their habits but also teach them about energy efficient behaviour.

Project manager on the technical energy efficient measures

After planning the measures and presenting the business cases, some measures could be selected for financing. In this case, your role as energy manager is to be the project manager for these energy efficiency projects as well. It requires the same project management as for any other projects: contracting entrepreneurs, setting a time schedule, overviewing the economy etc. Making sure that the project is executed as planned.

Controller

Properly the most important part of energy management is the controller function. As an energy manager you must control if the energy efficiency measures throughout the year have had any reducing effect on the energy consumption. The control consists of the monitoring of energy consumption and analysing the consumption before and after an energy efficiency measure. Another equally important task of the control is to evaluate the effect of energy management in the building operation and management. Is the building operation still energy efficient or is there a need for further support? This kind of evaluation will give input the next year's planning.

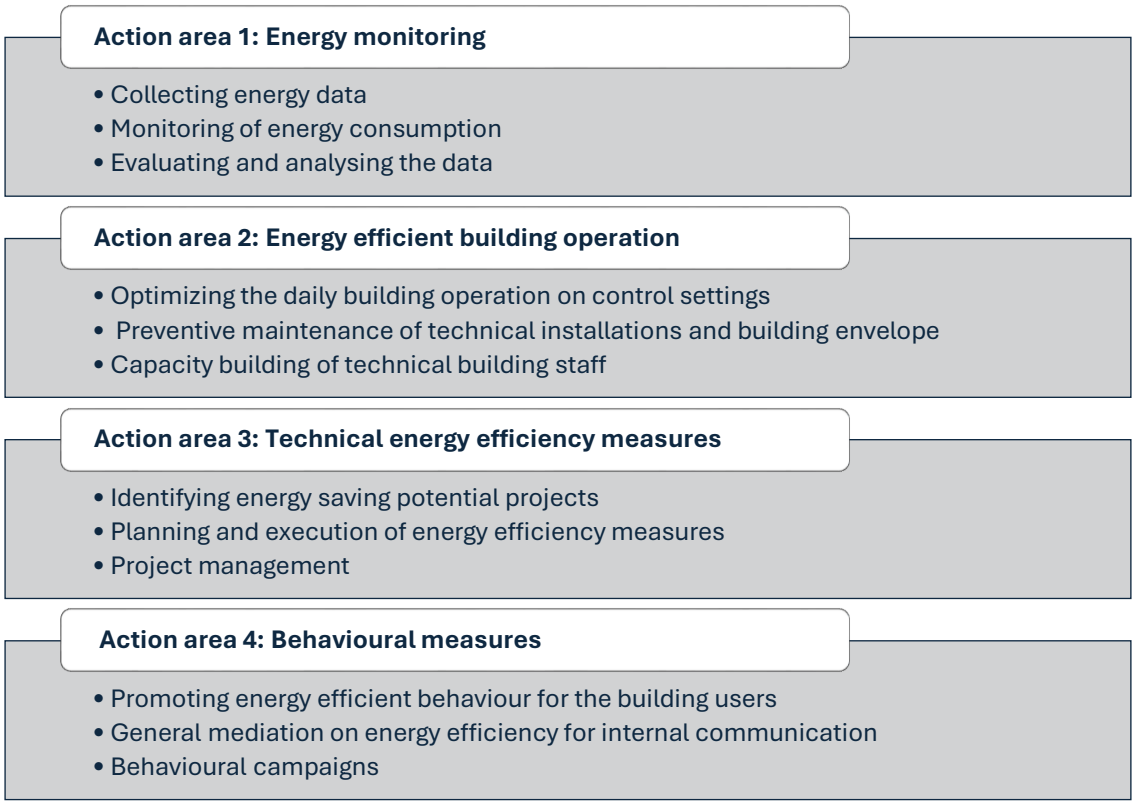
The tasks of the energy manager

The energy manager must ensure:

1. Energy efficient operation of facilities / technical systems / installations
2. Optimizing of energy efficiency in technical installations
3. Documentation on energy consumption development
4. Evaluation of the work process of the energy management system

Energy management action plan

Since energy management is mainly management and not only technical solutions, it must be imbedded in the building management, operation and planning. This guide will show you how to approach energy management on a more practical level by providing this action plan layout.



In the following chapters, the four action areas will be explained further and give you guidelines on how to work with energy management.

Action area 1: Energy monitoring

Knowledge about the energy consumption in your building is essential in the work of energy management. With the knowledge that data can give us about a building, it is possible to get a better overview of the building's condition, the actual period of use and the users' behavior. Energy data combined with building data such as the building floor area makes it possible to benchmark between buildings – possibly divided into different functional groups (offices, schools, sports facilities, etc.). Data on the actual use of the buildings provides value in relation to the regulation of the daily building operation.

To get the most out of this action area, set yourself these goals for Energy monitoring:

Goals for action area 1 - Energy monitoring:

- **Collect data monthly**
- **Store the data in a systematic way to get a graphic overview**
- **Analyze the energy consumption data continuously throughout the year**

In the following, this manual will guide you on how to work with Energy Monitoring.

How to collect and store energy data

First, we need to know how to collect the energy consumption data. Data collection can be done either by reading the meters or getting the information from the energy bills.

Make sure to have a routine for collecting the energy data either by the end or beginning of each month. In this way, you can better benchmark the consumption from month to month.

If the building has solar panels installed, make sure to also include the electricity production in the data collection. This is necessary as the solar panels provide electricity to the building and thereby is part of the total electricity consumption. If we only look at the consumption from the electricity grid, we will not get the actual consumption in a building with solar panels.

How to read the meter

To read your utility meter in Ukraine, you will need to identify the type of meter you have and follow specific instructions for reading it.

How to read an electricity meter

Reading the electricity meter depends on the type of meter.

Single-tariff digital meters:

- These meters have a single electronic display.
- Record the numbers from left to right.
- Ignore any digits after a decimal point, which may be red.

Two-tariff digital meters:

- These meters display usage for "day" (peak hours) and "night" (off-peak hours) separately to enable lower electricity costs during nighttime.
- The meter will either display the readings in a cycle or require you to press a button to switch between them.
- Common display codes for different meter brands include:
    - **GAMA:** Day is 15.8.2; Night is 15.5.1; General consumption is 15.8.0
    - **NiK:** Day is 1.8.2/15.8.2/T22; Night is 1.8.1/15.8.1/T21; General consumption is 1.8.0/15.8.0/T2
    - **MTX:** Day is 1.8.2; Night is 1.8.1; General consumption is 1.8.0
- Record the numbers for each zone separately, ignoring any digits after a decimal point.

Dial meters:

- These older meters have multiple small clock-like dials.
- Read the dials from left to right.
- If a pointer is between two numbers, always record the lower number. The only exception is if the pointer is between 9 and 0, in which case you write down 9.
- If a pointer is exactly on a number, check the dial to its right. If the next dial has passed zero, record the number. If it has not passed zero, record the lower number.

Please note that the display codes shown here are only approximate information. Details should be checked according to the instructions for the device or with your service provider.

How to read a gas meter

Both digital and dial gas meters measure in cubic meters (m^3).

- For digital meters, record the first five digits from left to right, ignoring any red digits or numbers after a decimal point.
- For dial meters, read the dials from left to right, recording the lower number when pointer is between two numbers. If the pointer is exactly on a number, check that the next dial has passed zero before recording the number.

Convert the number to kWh: The gas reading gives you a value in m^3, which you must convert to kWh. 1 m^3 gas equals with 11,63 kWh. Multiply this number with your reading and you'll get the value in kWh.

How to read a district heating meter

Locate the display: The meter will have a digital screen that cycles through several different readings. It may also have buttons to manually cycle through the screens.

Find the correct reading: Look for the consumption value, which is usually displayed in Gigacalories (Gcal), Megajoules (MJ), or kilowatt-hours (kWh). Your specific unit of measurement will be based on the provider and your contract.

Record the reading: Once you find the correct unit, record the full number displayed. You may be able to ignore any digits after a decimal point but check the manufacturer's instructions to be sure.

Convert the number to kWh: If the reading is in other units than kWh, you must convert the number to kWh. In the table below, you can see the kWh values for Gcal or MJ. Multiply the number with your reading and you'll get the value in kWh.

Conversion	1 Gcal	1 MJ
	1163 kWh	0,2778 kWh

Table 1: Conversion table for district heating units

How to collect data on solar electricity production

You can read the produced electricity from a Photovoltaic (PV) system primarily through three components: the Inverter Display, a dedicated Monitoring App/Web Dashboard, or a separate Generation Meter.

The inverter display (local reading)

The inverter is the central piece of equipment that converts the DC electricity from your solar panels into usable AC electricity for your home or the grid. Most modern inverters have a built-in screen that provides immediate data.

Metric	Unit	What is represents
Current power output	kW	The instantaneous power your system is generating at that moment. This value constantly changes based on cloud cover and time of day
Daily energy	kWh	The total electricity production today.
Total energy	kWh	The cumulative energy generated by the system since it was installed. This is your lifetime production number.
System status	Text	Indicates the operational state (e.g., "Producing," "Waiting," "Grid Fault," or an Error Code)

Table 2: The information shown directly on the inverter display

The inverter display will not provide data on how much of the electricity produced is used by the building and how much is exported to the grid.

Monitoring app or web dashboard (remote reading)

This is the most common and user-friendly way to track your system, providing historical data and detailed analysis.

1. **Access the platform:** Most modern solar systems connect to the internet via Wi-Fi or Ethernet. You access the data through a mobile app or a dedicated manufacturer's website.
2. **View key data:** The dashboard visually displays your electricity generation in graphs and charts, typically showing:
    - **Daily Production Curve:** A graph showing power output (kW) peaks during the day.
    - **Historical Totals:** Total energy generated (kWh) by day, week, month, and year.
    - **System Status & Alerts:** Notifies you immediately if a fault is detected (e.g., a drop in production due to shading or a component failure).
3. **Consumption Data (if a Smart Meter is integrated):** Many systems include an extra meter to track your building's electricity consumption and how much solar energy is being exported to the grid versus consumed directly by your home. This gives you the full energy picture.

The dedicated generation meter (billing reading)

Some systems, particularly in regions with feed-in tariffs, have a separate physical meter installed specifically to measure and record the total electricity produced for billing or incentive purposes.

- This is a standalone meter, often installed near your inverter or main electrical panel.
- The meter only tracks total electricity generated by the PV system; it does not track what you use or export.
- You may be required to submit this reading to your utility provider periodically.

Do not confuse the solar Generation Meter with your main utility Import/Export Meter (Net Meter). The latter measures only the net difference between the electricity you consume from the grid and the excess solar electricity you send back to the grid. It does not measure the total electricity your panels produced.

How to store the energy data

The simplest way to store the data collected either from the electricity meter or bill is to insert it in the data tool, Energy Registration.

The excel tool allows you to get a graphic overview of your data and gives you an indicator on the development in electricity consumption throughout the year. However, it requires that you insert consumption data for each month.

How to work with the data tool

Start with the basic information on the building such as the building name, address and the total building floor area. Insert information on the total electricity consumption for the past year and if the building has solar panels, the total solar electricity production used in that year. Of course, only if you have that information.

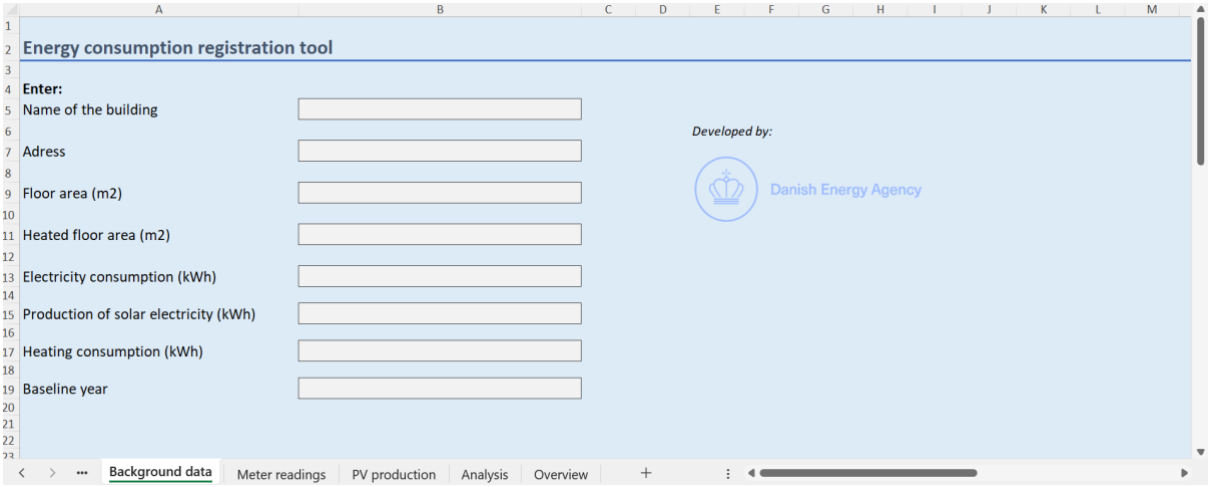
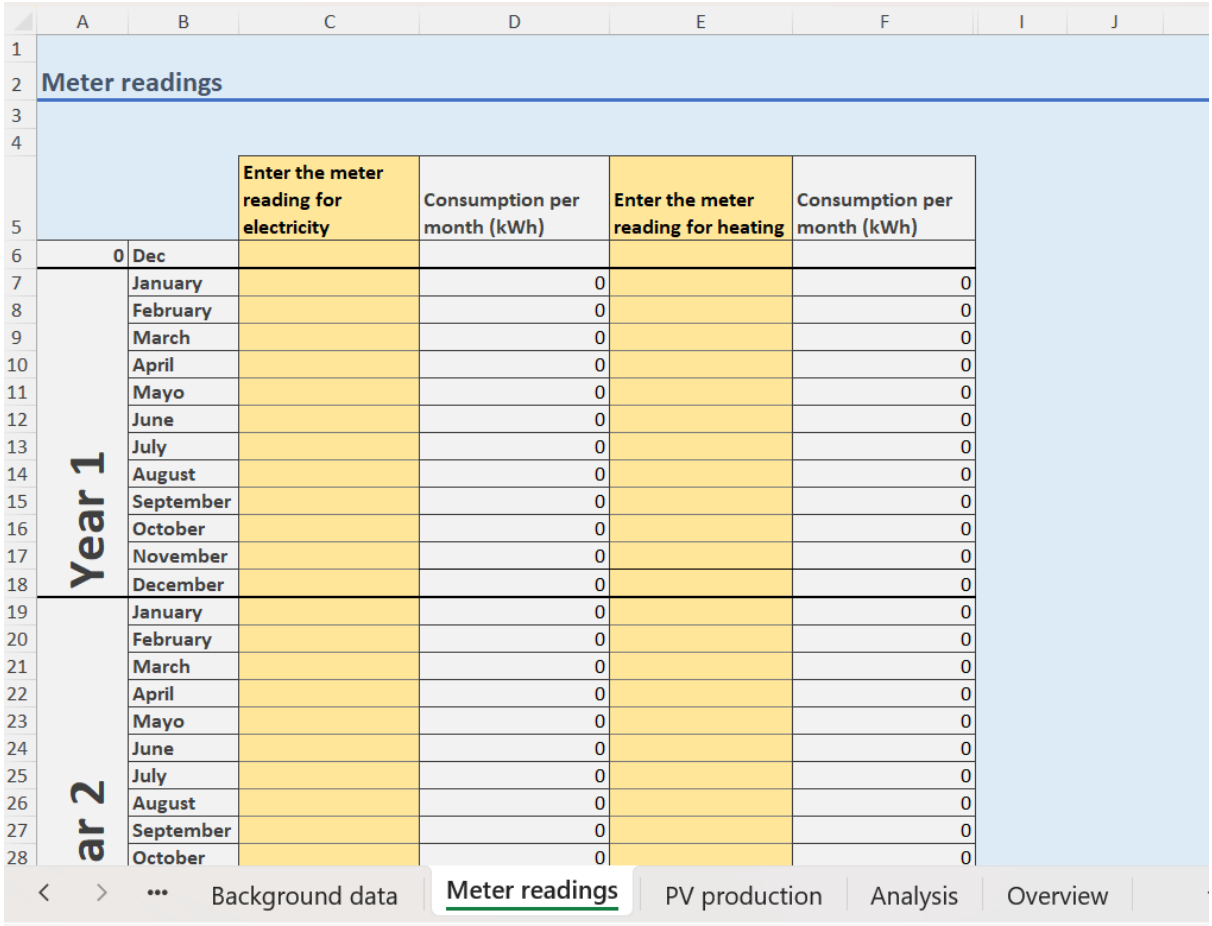


Figure 6: Front page for the data tool developed by the Danish Energy Agency, 2025

The tool is designed for a period of three years, starting with the last meter reading from December the year before this period. However, you can start any month and continue from that. So, if you don't have data for the previous months, don't worry.

There are two ways to insert data into the tool. Preferably insert your meter readings in the yellow area by the end or beginning of each month. Please don't skip a month as the tool includes some very simplified calculations that cannot compensate for the missing data.

If you don't have meter readings but get your information from the electricity bills, you can insert the consumption data directly in the white box named "Consumption per month (kWh)" under the tab "Meter Readings". Make sure that the unit is correct.



Meter readings

		Enter the meter reading for electricity	Consumption per month (kWh)	Enter the meter reading for heating	Consumption per month (kWh)
0	Dec				
Year 1	January		0		0
	February		0		0
	March		0		0
	April		0		0
	Mayo		0		0
	June		0		0
	July		0		0
	August		0		0
	September		0		0
	October		0		0
	November		0		0
	December		0		0
ar 2	January		0		0
	February		0		0
	March		0		0
	April		0		0
	Mayo		0		0
	June		0		0
	July		0		0
	August		0		0
	September		0		0
	October		0		0

Background data | Meter readings | PV production | Analysis | Overview

Figure 7: The tab "Meter readings" for insertion of electricity consumption data, Energy data tool

Please remember to indicate the year in the text boxes "Year 1", "Year 2" etc. It will then automatically show in the overview.

Solar electricity consumption data

If the building has solar panels, you can insert the data for the solar electricity used in the building each month in the data tool. See below for an example.

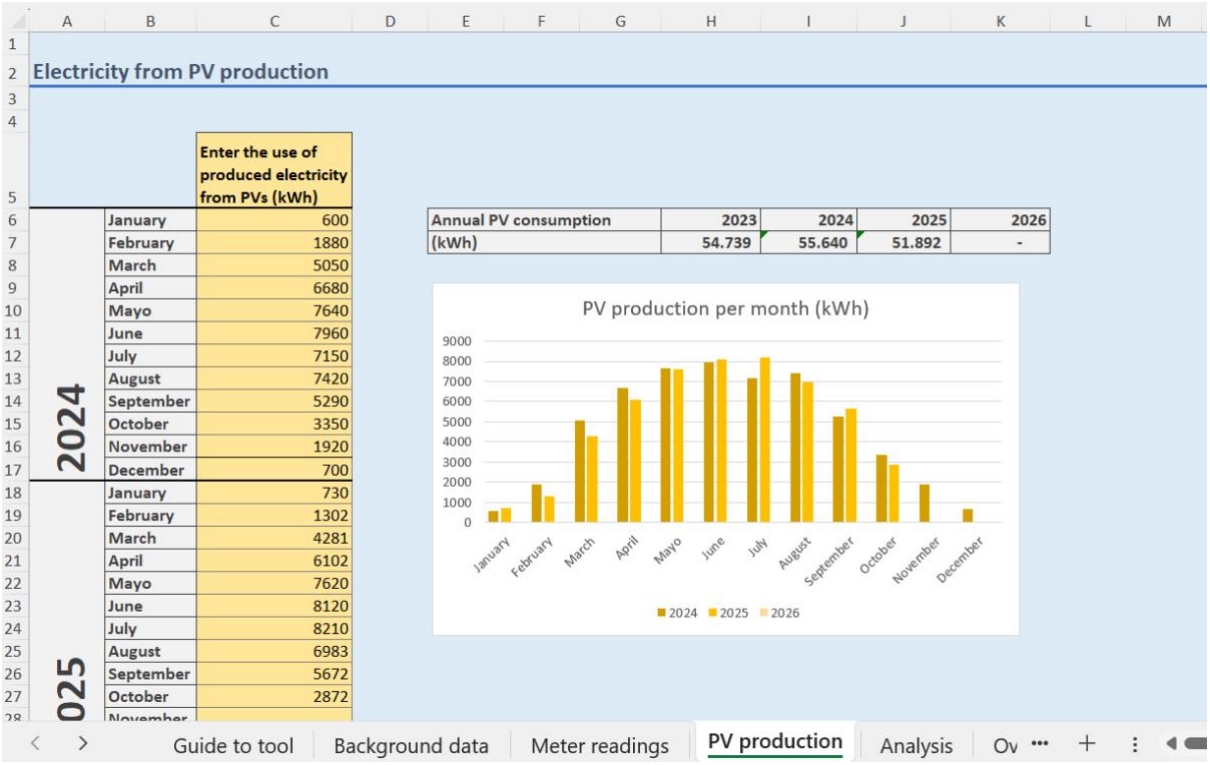


Figure 8: The tab for insertion of solar energy consumption data including example, Energy data tool

Please remember to indicate the year in the text boxes "Year 1" and "Year 2". It will then automatically show in the overview. As seen in the example above.

Graphic overview

The data tool provides you with several graphic overviews of the electricity consumption:

- Electricity consumption per month (kWh/month) excluding the PV electricity use
- Heating consumption per month (kWh/month)
- Total energy consumption per year (kWh/year) including the PV electricity use
- Energy performance indicator per year (kWh/m2)

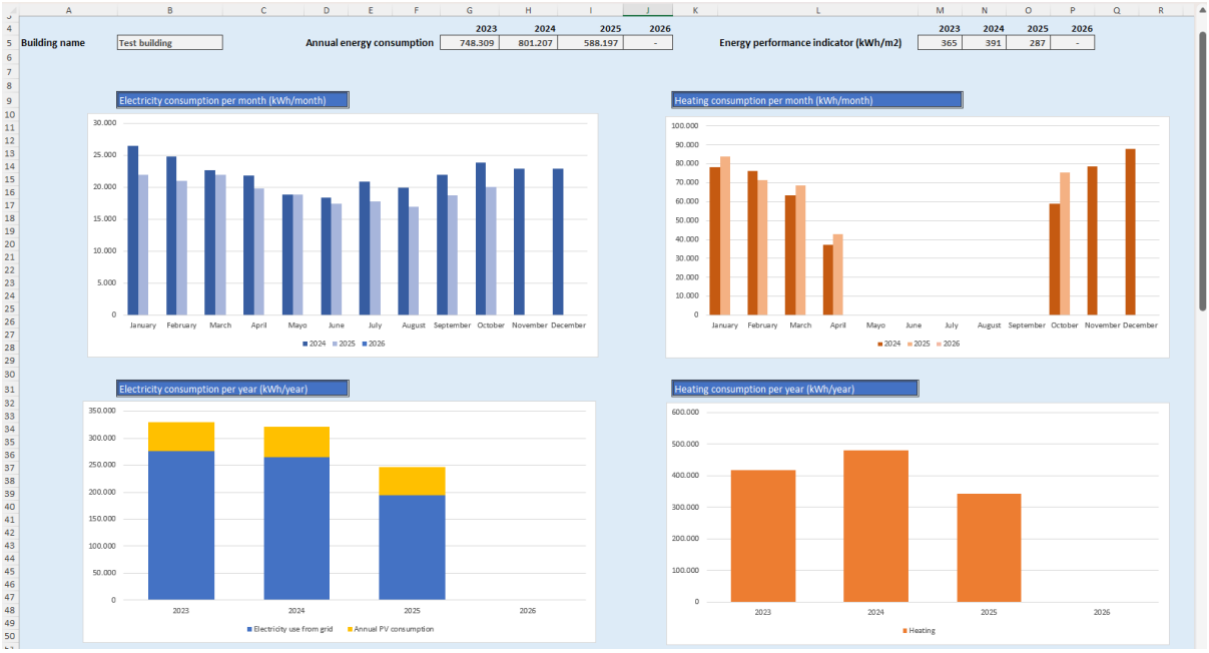


Figure 9: Example of the graphic overview of energy consumption per month and year divided in electricity and heating, Energy data tool

In the example above, you can see that the electricity consumption (given either by meter readings or by the electricity bills) are shown for all the months in 2024 and for 2025 up to the current month of entry. The heating consumption is also shown per month, showing the typical heat curve of a building. In this example, the heating system is completely turned off during the summer months.

If you have inserted PV electricity data, the data tool will include it in the electricity consumption per per year as shown in Figure 9. In this way, you can get a better understanding of what the actual electricity consumption is for your building.

The total energy consumption (electricity + PV electricity + heating) is then shown per year to give you an overview of the development in consumption over the years, see Figure 10. Here you can see that there is a significant increase in the heating consumption from the previous year (2024) to 2025.

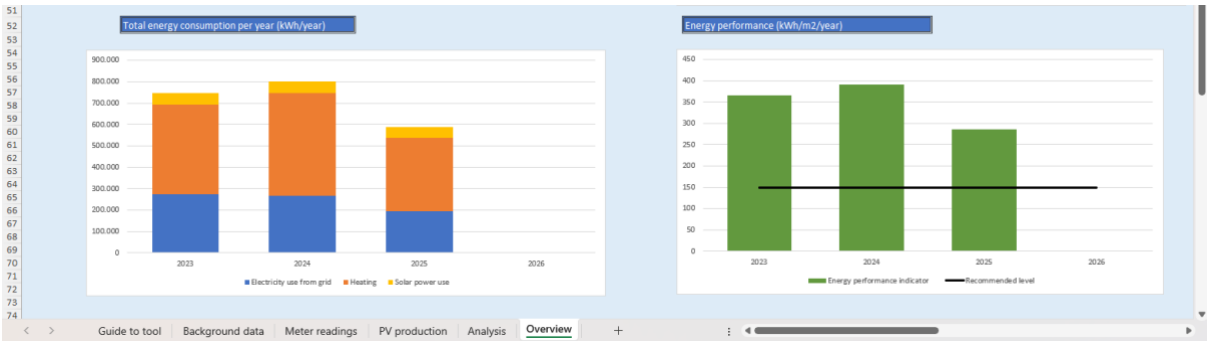


Figure 10: Example of the graphic overview of the total energy consumption including solar electricity production

The data tool will also provide the energy performance indicator for your building based on the floor area and the total energy consumption. This is to benchmark your building's performance and energy efficiency with other buildings.

How to analyse the energy data

With the graphic overview provided by the data tool you can make a quick analysis of the energy consumption in your building. There are three different analyses that you can make – consumption per year and per month together with the energy performance analysis.

Typically, the distribution of energy consumption by the commercial and public services in Ukraine is found to be 35 % for electricity use and 63 % for heating (both space and water heating)[1].

See an example of the distribution in an office building in the figure below.

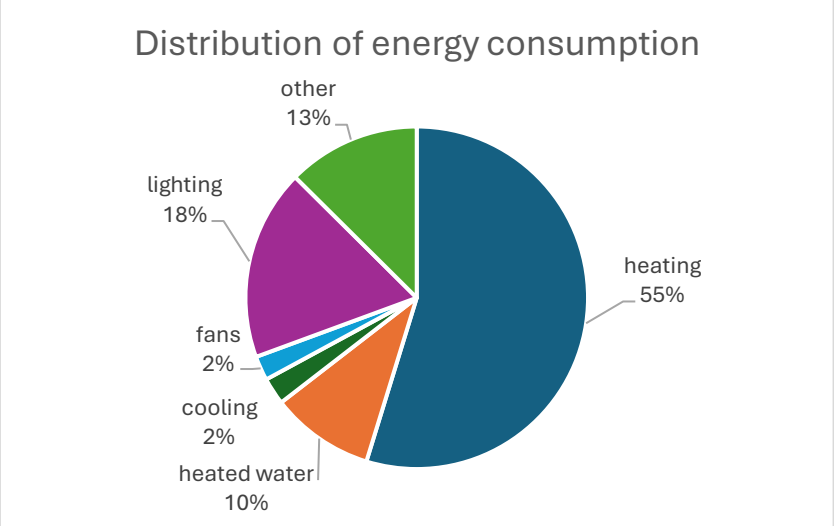


Figure 11: An example for an administrative building in Kiev based on energy audit made in the spring of 2025

It is important to note that heating takes up most of the energy consumption. So, whenever there are variations in the consumption, look to the heating use first.

In this case, the high consumption of heating is due to a poor insulated building envelope and not only the heating system in itself.

Energy consumption per year

It is important to evaluate the development of the consumption by the end of each year in order to report on the progress with energy management to the top management. For

[1] According to International Energy Agency (IEA), 2023

the analysis you need to account for the development of the energy consumption and if the goals/targets in the energy policy have been achieved.

For the yearly consumption analysis, you need to describe the reasons for the development. It is therefore recommended that you can account for some of the activities in your building that might have had an impact on the consumption during that year.

As shown the example in Figure 12, the yearly consumption went down in 2020 which is mainly due to the restrictions caused by the Covid pandemia. However, the figure also shows that the consumption increased both in 2021 and 2022. In this case, there is no accounted reasons for this increasement. So, the conclusion is that it is caused by the behavioural activities.

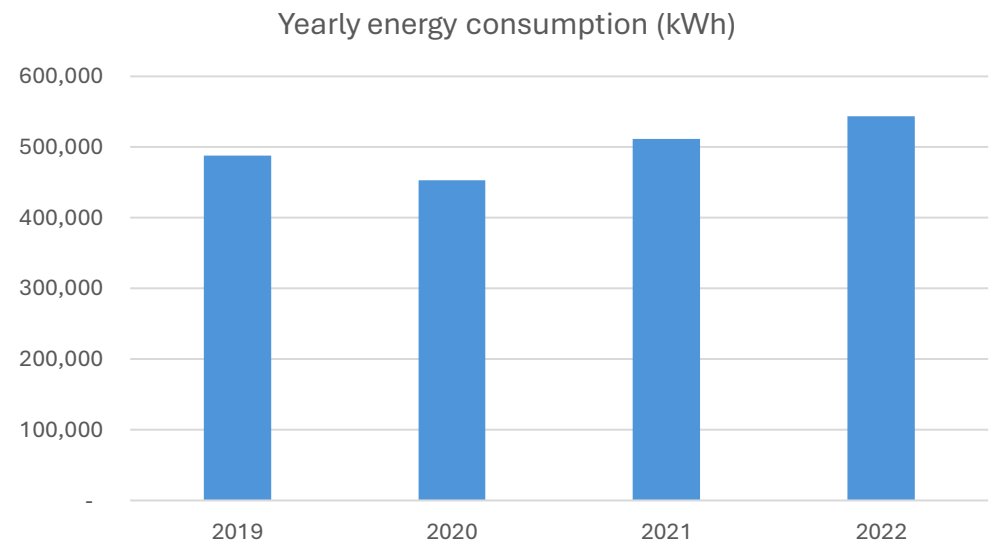


Figure 12: Example of the energy consumption per year for an office building

Energy consumption per month

Looking at the development from month to month, you can quickly see if the consumption is rising or falling. However, consider that there will be variations in the heating consumption during the winter season both month to month but also year to year. If you have cooling in your building, you should then also take into account the different need for cooling during the summer. Very hot periods will of course affect the energy consumption in the building.

If you see some very big variations in the consumption and especially increasement over many months, then you must take action and investigate what is causing these increasements. Start investigating the technical installations and their operation.

The example in Figure 13 shows the monthly electricity consumption over the period of almost two years. There are several indications that we can detect in the graph. First, the consumption in 2025 is lower for almost all months up till October which can indicate energy saving efforts. If you as the energy manager had implemented energy efficiency measures, this overview will help you to check if the measures have had an energy saving impact.

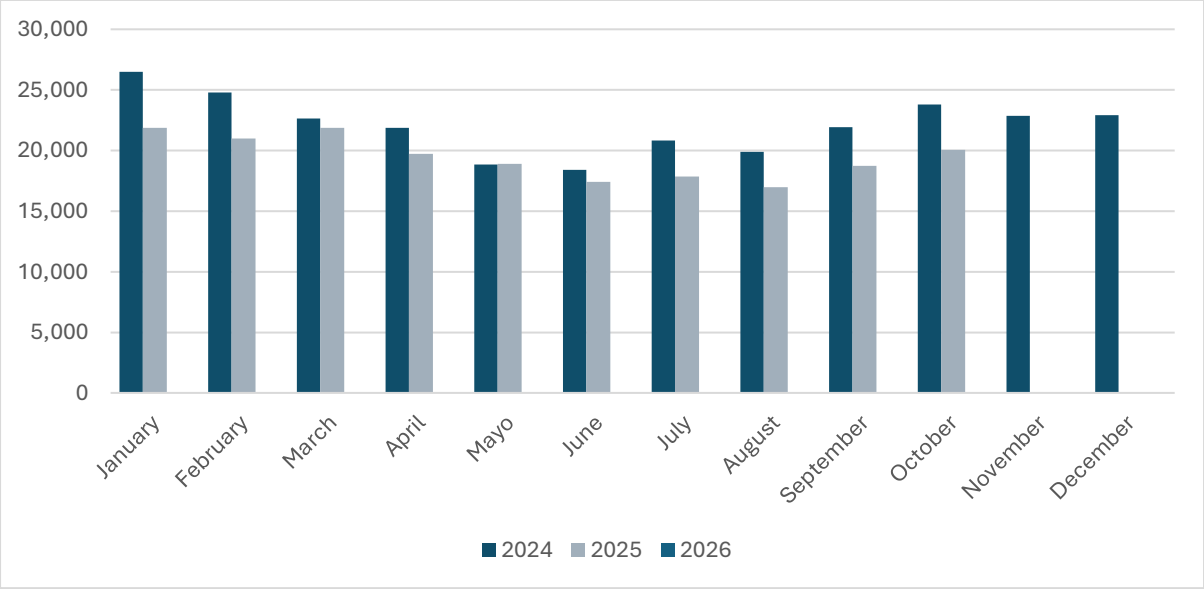


Figure 13: Example of monthly overview of the electricity consumption in a fictive office building

Second, there is tendency of increasing consumption in the months from August to October for both years. This can indicate a pattern of usage. If you know that the central heating system is shut down until October and the building has AC mini split units for colling, then you can assume that the mini split units might also be used for heating. Especially in October where there is no need for cooling. However, this is the assumption derived from data, you still need to investigate on site whether this is true.

Energy performance analysis

Another way to analysis the energy consumption of your building is to look at the parameter called Energy Performance Indicator. The indicator is based on the energy consumption per square meter constructed floor area. It can also be per building user. However, it is recommended to use the indicator per square meter as the constructed floor area does not change from year to year unless major changes are made in the construction.

For office/administrative buildings in Ukraine, the energy performance indicator should be 150 kWh/m^2 to obtain the minimum energy efficient performance for an existing building. The minimum requirement on new construction is approximately 90kWh/m^2.

In the example shown for a fictive building in Figure 14, the energy performance lies around 300-400 kWh/m^2 and can therefore not be regarded as energy efficient.

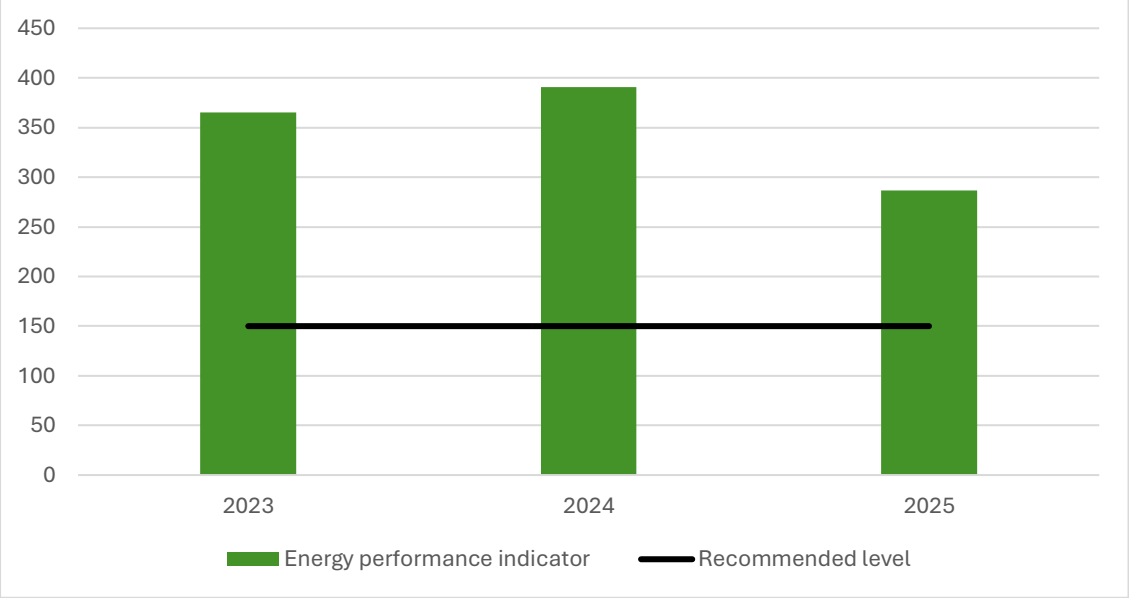


Figure 14: An example of the energy performance indicator for a fictive office building

The energy performance indicator is also a great benchmarking tool if you are responsible for several buildings. In that case, you can benchmark each building with each other and then identify which building is performing poorly energy wise.

The difference between the electricity consumption from grid and the actual consumption (if you have PV system)

If your building has solar panels and you only look at your electricity bill, the consumption will seem minor. However, remember that the solar electricity production covers a lot of the actual electricity consumption in the building. So, it might seem that you are reducing the consumption, but you are only reducing the costs.

An example is shown in Figure 15 and Table 3 for an fictive office building that installed a PV system in 2022 and later in 2023 and 2024 installed batteries for storing the solar power. Here you can see that the electricity consumption from the grid is reduced by 19 % from 2021 to 2024. But with the use of solar power, the actual electricity consumption has increased with 5 % in the same period.

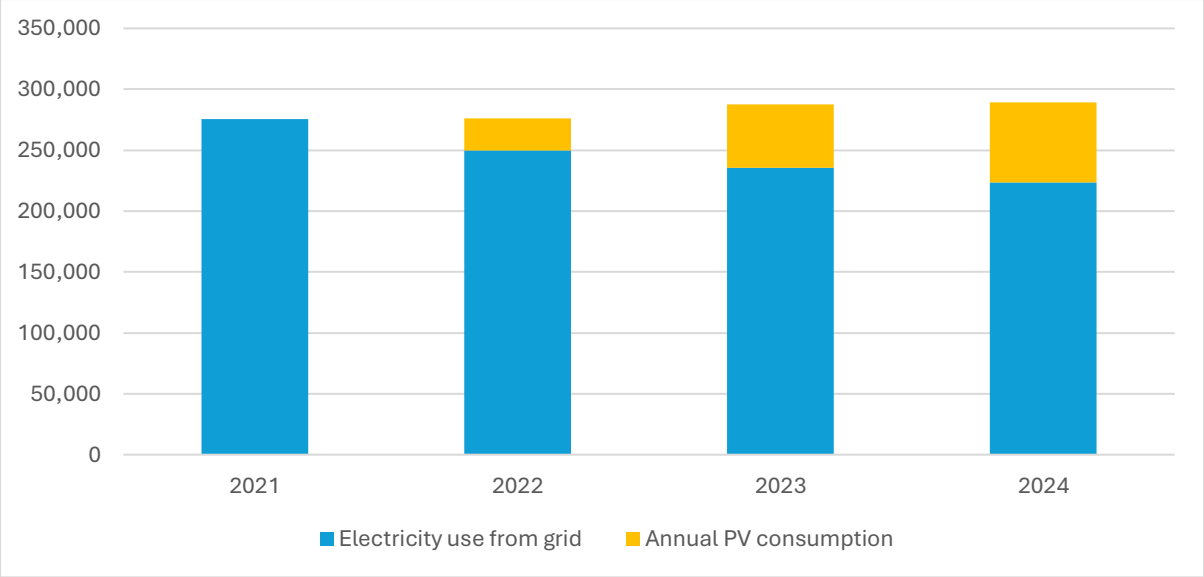


Figure 15: Example from a fictive office building with solar panels

Annual electricity use (kWh/year)	**2021**	**2022**	**2023**	**2024**	**Difference from '21-'24**
Electricity use from grid	275.433	250.018	235.372	223.628	**- 19 %**
Solar power use		*26.166*	*52.332*	*65.415*	
Total	**275.433**	**276.184**	**287.704**	**289.043**	**5 %**

Table 3: The data for the electricity use for the example in Figure 15.

This means that the total electricity consumption in the building has not decreased at all. That's why it is important to take the use of solar power into account in your analysis.

Action area 2: Energy efficient building operation

Energy-efficient building operation is a strategic approach to managing buildings. It focuses on reducing energy consumption while maintaining the comfort for the building users. It involves implementing new operational procedures and/or changing the current procedures to achieve energy savings and lower operational costs.

To get the most out of this action area, set yourself these goals:

Goals for action area 2 - Energy efficient building operation:

- Optimizing the daily building operation on control settings
- Preventive maintenance of technical installations and building envelope
- Capacity building of operational staff

In the following, this manual will guide you on how to work with Energy efficient building operation.

How to optimize the daily building operation

There are two main measures for optimizing the building operation. Firstly, it is very important to get an overview of what kind of technical installations and equipment there are in the building and how they operate. Especially if they are manually operated and therefore need daily or monthly attending. When you know what you have to work with, then you can start to look at the operation settings. In the following subsections, these measures are specified.

Map the technical installations and equipment

Start with mapping the technical installations and equipment in the building and how these are controlled. In this way, you have a better overview of the buildings technical facilities and will get an idea of where to improve the building operation.

For the technical mapping, note the following:

- **Installation type**
  - What kind of installation or equipment is it?
- **Brand and model**
  - If possible, note the brand and model of the installation
- **Age**
  - How old is it? Sometimes it is possible to find the year of installation on a name plate on the installation/equipment as well as model number.
  - Yellowing of the plastic covers will also give a good indication of the age. The more yellow, the older the equipment.
- **Number of units**
  - Are there more than one unit of the same model? In many cases, even though it is the same kind of installation like AC mini split units, most of them are different models and variate in age. Make sure to map each one.
- **Coverage**
  - Note what the installation covers of area and/or function. For example, a chiller (for centralized cooling system) covers the cooling of 2 floors of the building only.
- **Control**
  - What kind of control system does the installation have? Such as centralized control through remote control (typical for cooling systems), decentralized control though sensors and timers (f.ex. motion sensors for lighting control, timer for water coolers etc.) or manual control connected directly to the installations (typical on/off switches).
  - Also note who has access to the control systems. In many cases, the building users have control of the cooling system.
- **Control settings**
  - If there are control systems, note the current settings of the system. That could be the set temperature for the cooling systems, the automatic settings of the motion sensors and operation time settings.

This mapping will also give you knowledge on the functionality of the installations and equipment. Old equipment will normally have a low efficiency as energy efficiency deteriorates over time. If you find old or malfunctioning installations/equipment, note them as potential energy efficiency projects such as replacement or repair.

Align the control settings with the needed operation time

After you have mapped the technical installations and equipment, you now know which installation and/or equipment have a control system. In these cases, you must also map the settings in the control system to get an overview of the operation time.

For example, you have a ventilation system that ventilates the 2nd and 3rd floor of your building, and it has a timer control system. The operation time is set to start at 6 am and stop at 9pm on all days. However, the needed operation time for your building is from 8 am to 6pm on workdays as it is an office building. In this case, you must set the control settings to start ventilating an hour before and after working hours to accommodate those working outside of the normal working hours. Set only the ventilation system to operate on the weekdays where it is needed.

Ventilation system	**Current situation**	**Recommended**
Operation time	6 am – 9 pm, all days	7 am – 7 pm, Monday - Friday
Total hours per week in operation	105 hours	60 hours
Reduction	-	57 %

Table 4: An example of mapping the operation time for a ventilation system and what is needed

Therefore, in this example it is possible to reduce the ventilation system's operation hours down to 60 hours per week and achieve savings of 57 % only by aligning the control settings. Proving that energy efficient building operation is the most cost-efficient measure in energy management.

Preventive maintenance

Besides the daily building operation, it is also necessary to consider the maintenance of both the technical installations, equipment and building envelope. Poorly maintained installations will rapidly lose their energy efficiency and start using more energy than intended.

Consequences of an HVAC system not being maintained:

1. Reduced heating/cooling capacity
2. Increased energy consumption
3. Inefficient refrigerant cycle process
4. Poor air distribution
5. Decreased life span

Figure 16: Example of cooling system leaking refrigerant

Especially the decreased life span will have a negative effect on the building operation as the technical installations must be replaced more often leading to increased maintenance costs.

Preventive maintenance in buildings is a proactive approach to maintaining the building's systems and equipment to prevent breakdowns and ensure optimal performance. It involves regular inspections, servicing, and repairs at scheduled intervals, regardless of the current condition of the equipment. Thereby minimizing unexpected maintenance costs by addressing minor issues before they escalate into major problems.

Preventive maintenance also ensures that safety systems like fire alarms, sprinklers, and emergency lighting are always in optimal working condition, ensuring the safety of building users.

Key aspects of preventive maintenance in buildings:

- **Regular Inspections:** Periodic checks of equipment and systems to identify potential issues like wear and tear, leaks, or malfunctions.
- **Servicing:** Routine tasks such as cleaning, lubricating, and adjusting equipment to maintain its efficiency and prevent deterioration.
- **Repairs and Replacements:** Addressing minor issues promptly and replacing worn-out parts before they cause major failures.
- **Record Keeping:** Maintaining detailed records of maintenance activities, inspections, and repairs to track the condition of the systems and equipment. Making it possible to plan future maintenance.

To help you with implementing preventative maintenance, there is a guideline on Energy Efficient Building Operation that includes a checklist on the different focus areas and the recommended intervals. See an example from the guideline below.

Cooling systems	Activity	Maintenance frequency	Notes
AC units and chillers	Check for visible faults and defects	Every month	If any faults or defects, call technician
	Check the operation settings	Every month	Set the unit to operate within working hours only
	Check the supply temperature	Every month	Set point should not be lower than 8 degrees
	Check and clean the filter	Every month	
	Check condition of pipe insulation	Every month	Repair or replace if deteriorating or damaged
	Check for visible leaks	Every month	If any, call technician
	Clean outlet	Every month	

Table 5: Example of a checklist for cooling systems from the guideline on energy efficient building operation

Maintenance of the building envelope

In many cases, maintenance of the building envelope is not prioritized in the building operation. Neglecting building maintenance is a classic example of "pay now or pay much, much more later." It leads to a deteriorating building that is uncomfortable, unhealthy, unsafe, and incredibly expensive to rectify in the long run.

Neglecting building maintenance can result in structural damage caused by water infiltration through unrepaired roof leaks and cracked foundations. This is perhaps the most damaging issue as the water infiltration leads to the growth of mold and mildew, which are health hazards and can cause wood to rot and other materials to degrade.

Gaps and cracks in the building envelope provide easy entry points for insects, rodents, and other pests, which can cause further damage to wiring, insulation, and structural elements. Neglecting drainage or foundation cracks can lead to settling, shifting, and even structural instability.

Figure 17 shows an example of typical cracks in a building's external walls and the different degree of damage. On the image to the left, you can see that the plaster has fallen off the façade close the rainwater drainage. If the drain is also leaking, then there will be a high risk of water infiltration. On the image to the right, you see a very visible deep crack in the exterior wall resulting in a very high risk of water infiltration and risk for severe structural damage.

Figure 17: Examples on cracked building façade

Figure 18 shows an example of gaps between the exterior wall and the window which is the result of deteriorating plaster around the window frame. Leading to air infiltration that affect both the indoor comfort and the energy consumption in the building. In this case, the air infiltration was examined with a thermographic camera that can show the surface temperature differences (image on the left, Figure 18). As you can see, the gaps around the window results in cold air coming in from outside. The picture was taken in the late spring which means that the window area will feel much colder in the winter.

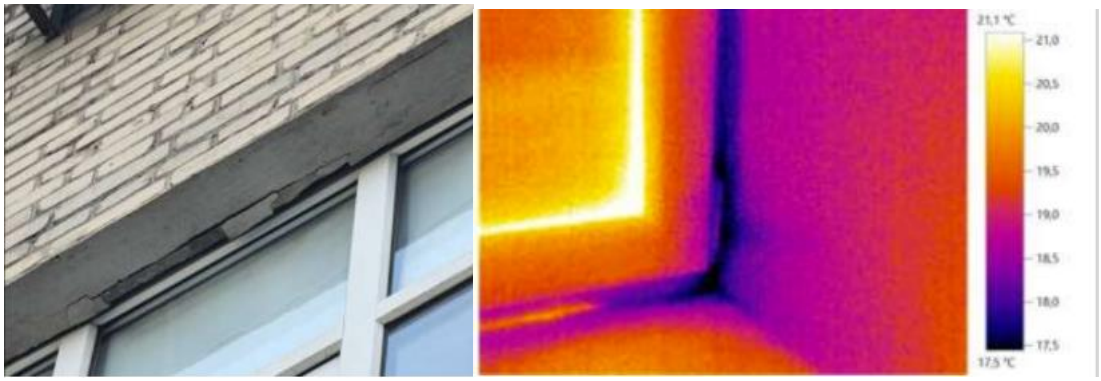


Figure 18: Examples on gaps between exterior wall and window and thermographic image of air infiltration

In essence, a well-maintained building envelope is key to a durable, energy-efficient, and comfortable building.

Training programs for operational staff

Energy efficient building operation is driven by the technical building staff. However, this requires knowledge on how to do it correctly and knowledge of the consequences of one's actions.

Therefore, it is important to give the technical staff the knowledge and the know-how to start acting more energy efficient. Furthermore, the capacity building of the technical staff will give them a sense of importance and a purpose. As an energy manager, you are dependent on these people to obtain an energy efficient building.

Mapping the needed competences of the staff

It is therefore important to get an overview of the technical staff's competences and their different roles and responsibilities. In this way, you will be able to support the staff with tailor made capacity building on specific areas. As some operational staff members have the responsibility for specific systems such as the cooling systems while others are responsible for the elevator system for example.

This mapping will give you an overview of what area of training or capacity building is needed and give you some insight into which staff member can be the guiding frontrunner for the other staff members.

Make several training sessions

For each specific system, there is a need for different competences and knowledge, but all building operation staff members must get an introduction to why it is important to have energy efficiency in buildings and their important role in achieving that.

It is recommended that the building operation staff receives several training sessions on the following:

1. Overall introduction to energy efficiency in buildings and why it is important
2. Energy efficient building operation in general
3. Specific training on different technical systems (most importantly on cooling systems)

Action area 3: Technical energy efficiency measures

The third action area in Energy Management is the technical energy efficiency measures such as replacement of inefficient equipment/installations. These measures need to be planned for the upcoming year while also executing measures for the current year. Thereby resulting in overlapping actions of planning and executing technical measures.

It is therefore recommended to make continuous screening of new potential measures for future planning. In the case of budget planning, you can easily summit your proposals for financing as you have worked on the business cases during the year.

To get the most out of this action area, set yourself these goals:

Goals for action area 3 – Technical energy efficiency measures:

- **Work on the following continuously throughout the year:**
  - **Identify potential projects for energy efficiency measures**
  - **Plan the projects for next year**
  - **Execute the EE project for this year**
- **Plan the projects so they also can accommodate other maintenance issues**

How to identify potential energy efficiency measures

There are two ways to identify potential energy efficiency measures, one you can do yourself while the other requires an energy auditor. See below the definition of the two screening methods and what they consist of.

1. **Preliminary screening – energy screening**

- Building overview
- Insider knowledge from building management staff
- Input from building users
- Mapping technical installations (also covered in the building operation action area)
- Energy data review

2. **Secondary screening – Energy audit**

- Energy data analysis in detail
- Review of operational processes
- In-depth energy and financial calculation of proposed EE measures
- Business case for implementing EE measures

Figure 19: Example of an energy audit in a fictive public administration building

It’s important to do the preliminary screening first as it will give you an insightful knowledge of your building and the state of the equipment and installations. If you are also getting an energy audit, this information will be very useful for the energy auditor.

Energy screening

Energy screenings in buildings are like a quick check-up for how efficiently a building uses energy. Think of it as a preliminary assessment to identify obvious areas where energy is being wasted. Unlike a full energy audit, a screening is typically less detailed and less costly if performed by an energy auditor.

Basically, it involves looking at the building's characteristics, its energy-consuming systems (like cooling, lighting, and equipment), and how it's being operated. You'll gather some basic data, make some observations, and then use that information to pinpoint areas where energy efficiency improvements could be made. It's not a deep dive like a full energy audit, but it gives you a solid initial understanding and helps prioritize your next steps.

In action area 2, Energy Efficient Building Operation, you have mapped the equipment and installations in your building. This information can be used as a part of the energy screening, especially if you have noted malfunctions or low efficiency on some of them.

It’s also useful to gather information from both the building users and the building operation staff as they may have valuable insights into comfort issues or operational practices that affect energy use negatively.

How to make an energy screening

Energy screening in a building involves a systematic approach to quickly identify potential areas for energy savings.

Here's the general steps of how to conduct one:

Step 1: Preparation and Data Collection

- **Gather building information:** Collect basic details about the building, such as its size, type (office, retail, etc.), age, occupancy schedule, list of equipment, and any available architectural drawings or floor plans.
- **Review energy data:** Obtain and analyze at least 12 months of historical energy data to understand energy consumption patterns and costs. Look for trends, spikes, and seasonal variations.
- **Collect existing documentation:** Gather any existing energy audits, past improvement reports, equipment manuals, or maintenance records.
- **Identify the Significant Energy Users (SEUs):** Identify the technical equipment or installations that uses the most energy in the building. You can do this either through measuring or by assumption. Most likely you would already know which installations uses the most energy.

Step 2: Visual inspection (Walk-through)

- **Building envelope:**
  - Check windows and doors for air leaks, drafts, and the condition of weather stripping and caulking. Note any broken or single-pane windows.
  - Examine the roof and walls for any signs of damage or deterioration that could allow air infiltration.
  - Check the level of insulation and its condition for the roof and exterior walls (if possible)
- **Heating systems:**
  - Observe the age and condition of the equipment.
  - Check for obvious issues like unusual noises, excessive dust, or leaks.
  - Note temperature settings and whether programmable settings are in use and properly scheduled for the heating season.
- **HVAC systems:**
  - Observe the age and condition of the equipment.
  - Check for obvious issues like unusual noises, excessive dust, or leaks.
  - Note temperature settings and whether programmable settings are in use and properly scheduled.
  - Inspect visible ductwork and pipe insulation for leaks or damage.
  - Check air filters for cleanliness.
- **Lighting:**
  - Identify the types of light fixtures and bulbs used throughout the building (e.g., incandescent, fluorescent, LED).
  - Observe if lights are left on in unoccupied areas.
  - Note the presence and functionality of any lighting controls such as occupancy sensors or timers.
  - Assess daylighting potential and whether it's being utilized.
- **Electrical systems and equipment:**
  - Look for older, less efficient appliances and equipment.
  - Identify any equipment that seems to be left on unnecessarily.
  - Check for the use of power strips and whether they are switched off when not in use.
- **Water heating:**
  - Check for any signs of leaks.
  - Observe the thermostat setting, if accessible.
  - Inspect insulation on hot water pipes.

Step 3: Simple analysis and identification of opportunities

- **Identify obvious energy waste:** Based on your visual inspection and data review, list the most apparent areas where energy is being wasted (e.g., single-pane windows, lights left on, old appliances).
- **Brainstorm Low-Cost/No-Cost measures:** Think about simple actions that can be taken immediately to reduce energy consumption (e.g., adjusting cooling settings, turning off lights, unplugging unused devices).

Step 4: Reporting (Optional but recommended)

- **Summarize findings:** Briefly document your observations, noting the areas with the most significant potential for energy savings.
- **List potential opportunities:** Outline the identified low-cost/no-cost measures and suggest areas that might benefit from more detailed investigation (e.g., a professional energy audit).
- **Provide recommendations:** Suggest next steps, such as implementing the low-cost measures or commissioning a comprehensive energy audit.

This is just a guide, so don't be discouraged by the format. Focus on the obvious issues. The goal is a quick assessment, so don't get bogged down in highly technical details.

Energy audits

Energy audits will give you a more detailed mapping of energy efficiency measures than a simple energy screening. An auditor will analyse the energy consumption in your building to identify the energy performance level and can identify areas of potential savings if given consumption data on the technical systems.

The energy audit comprises on the data analysis together with a physical technical review of the building. On the technical review, the auditor will note the condition of the building and its facilities and technical systems together with the operational aspects of the building. This will be input to the calculation of the potential energy efficiency measures.

Different levels of auditing

In Europe, the levels of energy audits are standardized by the EN 16247 series of European standards, which are based on the ASHRAE model and define three primary levels of audit. These levels progress in detail and depth: Level 1 is a basic, high-level

walkthrough and analysis for identifying low-cost measures; Level 2 provides a more detailed analysis with financial evaluation for specific systems; and Level 3 is an investment-grade audit that offers comprehensive modelling and precise financial analysis for major capital upgrades.

Level 1: Basic walkthrough and analysis

- Basic walk-through assessment
- Review of energy and operating data
- Proposed EE measures

Level 2: Detailed energy survey and analysis

- Build on from level 1
- In-depth energy and financial calculation of proposed EE measures
- Business cases for suggested EE measures

Level 3: Detailed survey and investment-grade analysis

- Build on from level 2
- A higher level of detail and analysis
- Include sub-metering and direct measurements
- Higher level of accuracy – better for the business case

However, it is recommended that the energy audit is at a level 2 audit as the technical systems in buildings are not as advanced as in the industrial sector.

What does an energy audit consist of?

In the following, the progress of an energy audit is described so that you know what to require from an energy auditor and what the audit report should cover.

1

Scope and background information

Scope:

- Description of the purpose and the aim to achieve, e.g., energy cost savings, carbon footprint reduction, or equipment upgrades.

Background information on the covered building(s):

- Construction year
- Building function
- Floor plans and floor area
- Information on building users
- Technical installation and equipment specifications
- Specifications on control systems

2

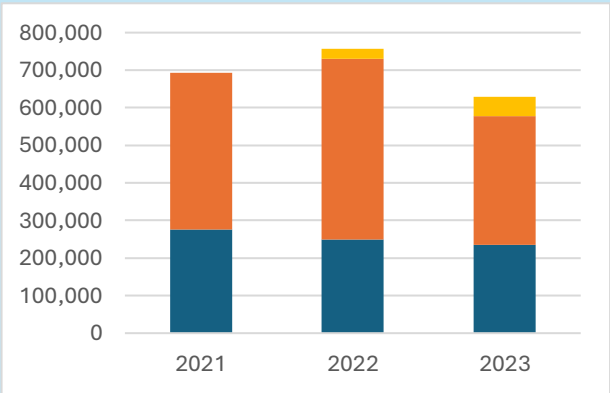
Energy data analysis

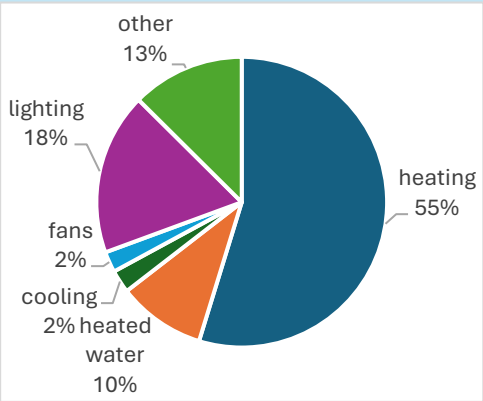
Analysis of the Historical Energy Data:

- Consumption development over minimum 3-5 years
- Energy performance indicators (ex. kWh/m^2)

Identification of key systems and areas:

- Pointing out the Significant Energy Users like heating systems, lighting, and pumps.





3

The Technical On-Site Inspection

Meeting with energy management:
Dialogue with the energy responsible to get more detailed information or follow up on data that has not been delivered yet.

Walkthrough survey:
Inspection of the facility to identify energy inefficiencies and potential savings.

Evaluate systems and equipment:

Examination of lighting, cooling system, pipe insulation, and appliances.

Identify operational practices:

Assess how staff uses equipment and systems and note any wastage.

Document observations:

Record inefficiencies, equipment conditions, and areas for improvement.

4

Identifying Energy-Saving Opportunities

Short-Term Solutions:

Recommendations on low-cost or no-cost measures like turning off unused equipment or adjusting thermostats.

Long-Term Investments:

Recommendations of capital-intensive upgrades like replacing old equipment, improving insulation, or installing renewable energy systems.

Evaluate Return on Investment (ROI):

Prioritization of measures based on cost-effectiveness and payback

5

Develop an Energy Audit Report

Summarize Findings:

Provide a detailed overview of energy usage and inefficiencies.

Propose Solutions:

List actionable recommendations with cost estimates and expected savings.

Include Visuals:

Use charts, graphs, and photos to illustrate findings.

Highlight Benefits:

Emphasize cost savings, energy reduction, and environmental impact

Energy efficiency project list

The EE project list is based on brainstorms, simple energy screenings and/or energy audits. It will consist of a lot of project ideas, and it will not be possible to realize all of them at once. It is therefore recommended to **prioritize the currently most relevant projects**. This can depend on management prioritisation, maintenance/operational issues and/or energy costs savings.

For the project planning, it is important to describe further details:

- Type of project
- Budget for investments and engineering
- Expected benefits (energy saving, saving in maintenance etc.)
- Time schedule
- Responsibilities and key actors
- Success parameters
- Evaluation

Also, note the prioritization of the project proposal on a scale from 1-5 where 1 is the highest prioritization to execute within a year. A prioritization of 5 is more a “nice to have” measure than “need to have”.

From paper to project

When you have listed a number of energy efficiency projects and prioritized them, then the ones with the highest priorities must be acted upon. But how do you go from a project on paper to execution?

First of all, technical energy efficiency measures need financing. How to finance depend on whether you can finance it yourself or need to seek financial support. In most cases, you need to apply for the finance from the accounting/economy department. To ensure that you will get the finance needed, you must make your EE project a compelling case that has more benefits than costs.

Usually, the direct benefits are the cost savings in a reduced energy consumption and reduced maintenance costs due to the project. But it is also important to highlight the more indirect benefits such as improved indoor climate and comfort for the building users resulting in reduced sick days. Even though it is difficult to quantify these benefits, it still has a high relevance for the EE project.

The best way to argument for an EE project is to make a business case. In the next section, you'll get a step-by-step guide.

How to make a business case for EE projects

The business case for an energy efficiency project should clearly and concisely outline the project's rationale, benefits, costs, and potential risks.

Here's a breakdown of the key components:

Step 1: Define the project

- **Describe the current situation**
  - Clearly define the current situation and the inefficiency being addressed
  - Explain the negative impacts of the current situation (e.g., high energy bills, environmental concerns, equipment issues).
- **Describe the energy efficiency project**
  - Specify the technologies or measures to be implemented.
  - Explain how the proposed solution will address the identified problem.
  - Include any relevant technical specifications or details.

Step 2: Define the benefits

- **Cost Savings:** Quantify the expected reduction in energy consumption and associated cost savings (e.g., annual savings).
- **Environmental Benefits:** Describe the positive environmental impact, such as reduced greenhouse gas emissions (e.g., kg of CO_{2e} avoided).
    - *Energy savings (kWh)*Emission factor (g CO_{2e} per kWh)/1000*
    - *Emission factor was 207.1 g CO_{2e} per kWh in 2023*
- **Operational Improvements:** Highlight any potential improvements in operational efficiency, equipment lifespan, or maintenance costs.
- **Other Benefits:** Include any other relevant benefits, such as improved comfort, enhanced public image, or compliance with regulations.

Step 3: Define the costs

- **Initial Costs:** Itemize all upfront costs associated with the project (e.g., equipment purchase, installation, engineering fees).
- **Operating Costs:** Outline any ongoing costs associated with the new system (e.g., maintenance, any new consumables).

Step 4: Make a financial analysis

- **Simple Payback Period:** Calculate the times (in years) it takes for the cumulative cost savings to equal the initial investment.
    - *Initial Costs / Annual Cost Savings*
- *(Optional but Recommended)* **Return on Investment (ROI):** Calculate the percentage return on the initial investment over a specific period.
    - *((Total Savings - Total Costs) / Total Costs) * 100%*

Step 5: Define the risks and mitigation

- Identify potential risks associated with the project (e.g., delays in implementation, lower than expected savings, technical issues).
- Outline mitigation strategies to address each identified risk.

Step 6: Define the execution/implementation plan

- Provide a timeline for the key stages of the project (e.g., planning, procurement, installation, commissioning).
- Identify the key stakeholders and their roles.

All these steps might seem quite comprehensive, but you can also simplify the business case with these key considerations:

- **Focus on the most significant factors:** Prioritize the most impactful benefits and costs.
- **Use clear and concise language:** Avoid technical jargon where possible.
- **Keep it brief:** Aim for a document that is easy to understand and digest quickly.
- **Use visuals (if helpful):** Simple charts or graphs can help illustrate key data.

Execution and quality control

When you have the financing and planning in place, you're ready to implement your EE project. This section will help you with the implementation phase where you should focus on on-time delivery, budget adherence, and quality assurance.

In the following, the actions are described for the implementation phase.

Step	Action Item	Key Deliverable
Project kick-off and site mobilization	Hold an initial meeting with the installation team and stakeholders to review scope, schedule, safety protocols, and communication channels.	Kick-off meeting minutes
Implementation & installation	Manage the execution of the EE project according to the approved design and schedule. Ensure minimal disruption to building users.	Installation progress reports

Quality Assurance & Inspections	Conduct regular site visits, verify materials/equipment match specifications, and ensure installation quality meets engineering and safety standards.	Quality checklists & inspection logs
Stakeholder communication	Provide regular updates on progress, budget status, and any deviations or issues encountered.	Weekly status reports
Issue resolution	Promptly identify and resolve technical or logistical challenges, logging all changes and approvals (change of orders).	Change of order log

Monitoring and verification (M&V)

After the implementation of your EE project, you need to evaluate the project's success, verify the savings, and formally conclude the work.

In the following are listed the different steps of actions in the final phase of the project which are often overlooked.

Step	Action Item	Key Deliverable
Commissioning and acceptance testing	Conduct final system tests to confirm all new equipment operates as designed (Functional Performance testing).	Functionality test
User training and handover	Train maintenance staff and building operators on the operation and required maintenance of the new energy-efficient systems.	Operator training records and manuals
Project evaluation documentation	Compile all final documentation, warranty information, Operation &	Complete Project File

	Maintenance manuals, and lessons learned.	
Financial reconciliation	Review final costs against the budget and formally approve the financial closeout.	Final Financial Report

Action area 4: Behavioural measures

How to promote energy efficient behaviour for the building users

Promoting energy-efficient behaviour among building users requires a combination of **information, technology, engagement, and incentives**. Since building users can influence a significant portion of a building's energy consumption, behavioural changes are crucial for maximizing efficiency.

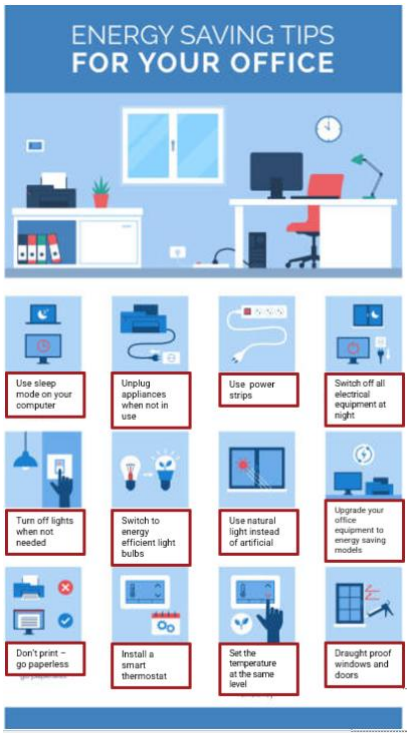
A very good behavioural measure is nudging. Nudging is about subtly influencing choices in a way that makes it easier for people to make decisions that are good for them, without taking away their freedom. Thus, making the energy efficient option easier for the building user. An example can be the on and off switch for all your computer equipment (screen, pc, keyboard etc.).

To get the most out of this action area, set yourself these goals:

Goals for action area 4 – Behavioural measures:

- **Create awareness through information material and campaigns**
- **Collect and share the good examples on energy efficient behaviour to be showcased**
- **Make clear directions on what is considered energy waste for the building users**

In the following, this manual will guide you on how to work with Behavioural measures.



Increase awareness and education

Inform the building users about the impact of their actions and provide clear instructions on how to save energy.

- **Educational campaigns:** Deploy clear, consistent awareness campaigns using posters, emails, and internal communication channels.
- **Specific instructions:** Provide simple, actionable tips, such as:
    - Turn off lights when leaving a room or when natural light is sufficient.

    - Unplug non-essential electronics or use smart power strips to eliminate "phantom load" (standby energy use).
    - Adjust blinds/shades—open them for warmth (sunlight) in winter and close them to reduce heat gain in summer.
- **Onboarding & reminders:** Incorporate energy-saving practices into new user/employee orientations and place small, polite reminders (e.g. stickers) near light switches, thermostats, and windows.

Provide Feedback and Data

People are more likely to change their behaviour when they can see the direct results of their actions.

- **Real-Time energy dashboards:** Install visual displays in high-traffic areas (like lobbies or break rooms) that show the building's current energy consumption, historical data, and progress toward efficiency goals.
- **Peer comparison:** Use the concept of social norms by anonymously comparing one user group's or floor's energy use against a similar group's average to encourage friendly competition (e.g., "Your department used 10% more energy than the average this month").
- **Personalized reports:** For sub-metered offices, provide building users with regular (monthly/quarterly) reports on their own energy usage and cost savings.

Implement Engagement and Competition

Use social and motivational strategies to make energy saving fun and competitive.

- **Energy-saving competitions:** Host competitions between different floors, departments, or other units to see who can achieve the greatest percentage reduction in energy use over a set period.
    - *Gamification:* Frame the effort as a game with clear rules, milestones, and a final goal.
- **Green Teams/Energy Champions:** Establish a volunteer group of motivated building users who can act as internal advocates, share best practices, and collect feedback from their peers.
- **Host events:** Organize "Lunch & Learns" or workshops focused on energy-efficient working to foster a sense of shared responsibility.

Incentivize and Recognize Efforts

Make sure to acknowledge the building users' efforts and reward positive changes to reinforce the new behaviour.

- **Recognition:** Provide public recognition for success (e.g., "Energy Saver of the Month" title, featuring the winning team on the energy dashboard).
- **Rewards:** Offer tangible rewards for achieving goals, such as cash bonuses, extended lunch breaks, priority parking spots, or a donation to a charity in the winning group's name.

Enable Energy-Efficient Behaviour

Ensure that the building and its systems make it easy for users to act efficiently.

- **Optimize building controls (Automation):** Implement smart technology like occupancy sensors for lighting and HVAC so that systems automatically power down in empty spaces, taking the burden of remembering off the user.
- **User control:** Give occupants sufficient, but controlled, ability to adjust their own environment (e.g., personal fans, controllable task lighting, operable windows with automated alerts for optimal use) to increase comfort and buy-in.
- **Efficient equipment and appliances:** Ensure the default equipment and appliances are energy-efficient (e.g., energy efficiency certified appliances such as laptops, screens etc.) so that even neutral behaviour is efficient behaviour.

Limitation

However, there are some areas where the building user should not have a complete influence on. Such as setting the indoor temperature on the heating system. Especially, if the office space has several smaller heating/cooling units like the mini split AC units. In this case, there will be a remote accessible for the building users for each unit and they will have complete control. It will result in different set temperatures and higher/lower temperatures than recommended. All leading to inefficiency and a high energy demand.

The solution is then to remove the control, so that it is only the building operation staff that can access the units. So, every morning, the operation staff can start the AC units at the recommended indoor temperature and if there are any issues the building users must turn to the operation staff for help.

Evaluation and management review

You've put in the work: setting policies, establishing targets, and implementing efficiency measures. But how do you know if your efforts are truly paying off? That's where Energy Management Evaluation and Review come in.

Doing the evaluation and management review will ensure your Energy Management System stays on track and continues to deliver maximum value. Evaluation is the ongoing, hands-on process of monitoring your daily performance and analysing the energy data — summarized in the Energy Accounting Report.

The formal Management Review, by contrast, is a high-level, strategic checkpoint. It's the critical step where top management takes the performance data, assesses the overall system, and makes binding decisions on budget, resources, and future targets.

By making both evaluation and the formal management review on a yearly basis, you move beyond merely consuming less energy; you embed a culture of continuous energy improvement that saves money, reduces risk, and enhances sustainability.

Energy Accounting Report

Make annual Energy accounting for a management review. This should be made as a report explaining any variations in the development on the development of the energy consumption for the past.

The energy account report should provide a clear, comprehensive, and actionable summary of the building's energy use and performance over a specific period. If you are responsible for more than one building, then include all buildings in one report. This also allows you to benchmark your buildings by energy performance.

In the following, the content is listed and explained a bit further.

Section 1: Executive summary

This section is the report summary that should not be more than a half page.

- **Period Covered:** Clearly state the reporting timeframe
- **Key Findings:** A brief overview of the most significant results (e.g., "Total consumption increased by 5%, but electricity consumption decreased by 3% in comparison with last year").
- **Energy performance:** Quick highlights of overall energy performance compared to benchmarks.

- **Top recommendations:** List the 2-3 most impactful actions to do next year recommended from the report.

Section 2: Energy consumption analysis

This section details *what* energy was used and *where*.

- **Period Covered:** Clearly state the reporting timeframe.
- **Total Usage:** Total energy consumed, usually in a standardized unit (e.g., kWh or MWh).
- **Source Breakdown:** Break the energy consumption down in energy sources:
    - Electricity
    - Natural Gas
    - Fuel Oil/Diesel
    - Renewable Sources (Solar, Wind)
- **Consumption by building:** Usage segmented by building to identify major consumers. Only applies if you are reporting on several buildings.
- **Historical Comparison:** Comparison of current usage with the previous period (e.g., Q4 2023 vs. Q4 2024) and/or the same period of the previous year.

Section 3: Energy Performance and Benchmarking

This section highlights how efficient the building has been by highlighting the energy performance indicators. This will give some actionable insights by benchmarking the energy performance with other similar buildings/facilities.

- **Energy Performance Indicator:** The most critical metric. Usage normalized by a relevant operational factor:
    - Energy per square meter (accommodates any changes in the built area and is the most used indicator for benchmarking)
    - Energy per user (accommodates office buildings with a high number of users)
- **Weather normalization:** Data adjusted for weather variations (Heating Degree Days/Cooling Degree Days) to show genuine performance change.
- **Benchmark comparison:** Comparison against internal targets, best practices, or similar facilities.
- **Savings tracking:** Quantification of savings achieved from previously implemented EE projects.

Section 4: Findings and Recommendations

This is the most critical section for driving future action.

- **Problem identification:** Clearly articulate areas of inefficiency (e.g., "HVAC consistently runs 2 hours past occupancy hours").
- **Recommended measures:** Specific, prioritized list of energy efficiency projects or operational changes (e.g., LED upgrade, compressor maintenance, replacement of circulation pump).
- **Estimated impact:** For each recommendation, provide an estimated:
    - Annual energy savings (in kWh or MWh)
    - Annual cost savings (in currency)
    - Simple payback period (in years)

Figure 20: Illustration of an energy accounting report designed to be clear and informative

Please bear in mind that this is the ideal product for an energy accounting report. In the beginning, a summary like the first section described in this guidebook will be sufficient.

Evaluation on EMS work progress

As an energy manager you must evaluate the energy management system on an annual level to ensure that all areas are covered within the time frame and its effectiveness.

What to evaluate and consider for next year:

1. Evaluate the process with EMS both the technical efforts and the organizational process (*what have we learned?)*
2. Consider changes in the work process based on the knowledge obtained by the evaluation (*what can we improve?)*

The evaluation report should also specify if the objectives and targets set for the reporting period were met. If so, consider proposals for increasing goal ambitions and/or setting other goals (*can we do more?)*. If not, consider if the goal ambitions were too high to begin with.

Energy management review

An Energy Management Review (EMR) is a formal, periodic evaluation conducted with top management to ensure the organization's Energy Management System remains suitable, adequate, and effective. The EMR is a strategic meeting designed to make decisions and allocate resources for the next period.

The presentation is prepared before the management review. The presentation must include the evaluation of the energy management system and any recommendations for changes or new initiatives. These can be the following:

- **Decisions on continual improvement:** Specific, measurable actions to enhance energy performance (e.g., launching a major lighting upgrade project or implementing a new sub-metering system).
- **Revised objectives and targets:** Decisions on new or adjusted energy targets for the upcoming period, aligned with the organization’s overall strategy.
- **Energy policy update:** A decision regarding the continued suitability of the organization’s Energy Policy, including necessary amendments if major changes have occurred.
- **Resource allocation:** Formal decisions on the need for and allocation of resources, including budgetary approval for projects, staffing and training.
- **Communication plan:** Decisions on how the results of the EMR, including new objectives and resource availability, will be communicated to relevant teams and management levels.

By consistently executing the Energy Management evaluation and review, you will ensure that energy efficiency strategies are constant in focus within the top management driving continual improvement in energy efficiency.