Section: Planning

Task 8: We identify our energy sources and energy uses, have a data collection plan in place, and collect related energy and relevant variable data. We ensure the accuracy and repeatability of measurements. We analyze our energy use and consumption data.

Getting It Done

1. Identify all energy sources that are consumed within the defined EnMS scope and boundaries.
2. Make a list of energy uses within the scope and boundaries.
3. Identify relevant variables that potentially affect the energy consumption of significant energy uses (SEUs), and would help create meaningful energy performance indicators (EnPIs) and energy baselines (EnBs). Also identify relevant variables that potentially affect the energy consumption within the entire selected scope and boundaries of your EnMS.
4. Develop and implement a data collection plan based upon the data needs, including the key characteristics of ISO 50001.
5. Ensure measurements and metering are conducted accurately and are repeatable
6. Determine appropriate analysis methods, and use them to understand and monitor energy use and energy consumption.

Task Overview

The first step in the data collection process is to identify the energy sources used by your organization within the scope and boundaries of the energy management system (EnMS). To ensure that all energy sources are identified, this effort should include identification of the sites, equipment, systems, and processes associated with each energy source. Understanding the sources of energy used and how they are used sets the stage for determining, collecting, and analyzing the data needed to evaluate your organization’s energy performance, and that will be useful when selecting significant energy uses in Task 9 Significant Energy Uses (SEUs).

The next step in the data collection process is to identify your organization’s data needs. ISO 50001 requires that certain data are included in the energy review, including: energy sources, analysis of past and present energy use and energy consumption, relevant variables, estimates of future energy use and consumption, and data detailing energy uses that have substantial levels of energy consumption. These data will be critical to selecting energy performance indicators (EnPIs), establishing baselines, and setting objectives and energy targets (Task 11 Energy Performance Indicators and Energy Baselines and Task 12 Objectives and Targets).

Once your data needs have been defined, establish a data collection plan that details a process to ensure regular data collection and ensure the collected data are accurate and repeatable. Energy bills

are one type of commonly available data source, but other data will be required to determine energy performance. Based on your identified energy data needs, your organization must develop a data collection process that includes assignment of responsibilities for data collection and handling (see Task 6 Energy Team and Resources).

A 50001 Ready EnMS is data-driven and focused on measurable energy performance improvement. Analysis of energy use and energy consumption are critical not only to the energy planning processes of the EnMS, but also to measure the overall effectiveness of your EnMS. To analyze energy use and consumption data, you must identify or develop methods that are effective and suit your organization's needs.

This guidance is relevant to sections 6.3, 6.6, and 9.1.1 of the ISO 50001:2018 standard.

Associated Resources	Short Description
50001 Ready Playbook Task 08	Energy Data Collection and Analysis
Energy Consumption Tracker	Track Energy Consumption and Relevant Variables
Energy Consumption Tracker with Sample Data	Track Energy Consumption and Relevant Variables
SEEC Energy Footprint Tool	The Energy Footprint Tool is designed to allow users to easily track energy consumption, relevant variables, and energy uses.

Full Description

SEEC Tips

In Saudi Arabia, a relevant variable that is expected to impact the energy consumption of many significant energy uses is average daily temperature, which is best measured using cooling degree days (CDD) or heating degree days (HDD). A good reference for global CDD and HDD data is the Degree Days website (https://www.degreedays.net/), which allows for free downloading of CDD data for different cities across Saudi Arabia (and the world). One note on base temperature: The correct base temperature to use depends on each case such as building use, insulation level, etc. In general, the base temperature for CDD data is defined as the outside temperature above which a building needs cooling. A value in the range of 15 – 20 degrees Celsius is usually acceptable for office buildings, which takes into account both external heat gains (i.e., greenhouse effect) and internal heat gains (people, computers, etc.) that increase indoor temperatures such that they require cooling.

Identify current energy sources

The first step in completing this task is to identify and document your organization's current energy sources. Energy sources (called "energy types" in ISO 50001:2018) are the forms of energy that are consumed by your organization.

Learn More: **Examples of energy sources**

Some examples of energy sources include:

- Electricity
- Natural gas
- Heavy Fuel oil
- Diesel
- Gasoline
- Propane
- Coal
- Wind-based electricity
- Geothermal
- Biomass
- Steam
- Compressed air
- Hot water
- Chilled water
- Crude oil
- Tyres
- Landfill

To help identify all energy sources consumed within the defined boundaries you will want to identify associated sites, equipment, systems, and processes. Use one or more of the following (or other appropriate documents) to help identify energy-using sites, equipment, systems, and processes, and to account for all energy sources:

- Floor plans
- Process flow charts
- Site plan with equipment locations
- Building schematics
- Wiring diagrams
- Utility diagrams
- Equipment lists

Learn More: **Tools to document your organization's current energy sources**

Your organization can analyze and track energy in many different ways, from simple in-house spreadsheets to sophisticated software and web-enabled applications. SEEC provides two tools to assist in documenting your organization's energy sources:

1. **The SEEC Energy Footprint Tool**. This comprehensive macro-enabled Excel tool tracks energy consumption, relevant variables, and energy uses. It provides charts for all tracked data and allows for easy export of data to the SEEC EnPI Lite tool.
    - **Footprint tool inputs:** The Footprint tool can actively track up to 20 types of

energy sources (electricity, natural gas, etc.) and 20 related relevant variables (production levels, degree days, operating hours, occupancy rates, etc.) for up to a 10 year period. Customized energy types and related factors can easily be added as needed. Energy end-use is tracked on an annual yearly basis. Users can create up to 10 major energy end-use groups (process areas, building areas, boiler room, etc.) which each can include up to 30 individual components (boilers, fans, pumps, lights, etc.) which assists in determining the EnMS SEUs.
    - **Footprint tool outputs**: The Footprint tool generates a series of charts and graphs based on the entered data. This allows for the comparison of energy types, monthly and yearly trends, and entered energy consumption (BTUs) vs energy end-use (application of energy). Comparing consumption to tracked end-use can help to determine how accurately the total "bottom-up" end-use compares to the "top-down" metered consumption and how much end-use energy consumption may be unaccounted for. The tool can also output energy data into a format that is compatible with the SEEC EnPI Lite tool in order to perform a regression analysis of energy consumption with other relevant variables like weather, production, and building occupancy.
2. **The Energy Consumption Tracker**. This excel-based tool is a simplified version of the SEEC Energy Footprint tool that is not macro-based. The Energy Consumption Tracker allows users to track energy consumption by source type (electricity, natural gas, etc.) and related relevant variables affecting energy consumption (production levels, degree days, operating hours, occupancy rates, etc.) on a monthly basis for one or multiple years. The tool can also output energy data into a format that is compatible with the SEEC EnPI Lite tool in order to perform a regression analysis of energy consumption with other relevant variables like weather, production, and building occupancy.

Identify energy uses

In ISO 50001 terminology, energy use is not the same as energy consumption. *Energy use* is defined as an "application of energy." Examples include ventilation, heating, cooling, lighting, and transportation. Energy uses are associated with the sites, equipment, systems, and processes that consume energy.

Learn More: **Examples of energy uses**

Some examples of these energy uses are:

- Indoor lighting
- Outdoor lighting
- Space heating
- Space cooling/air conditioning
- Commercial/industrial hot water or steam boilers
- Domestic type hot water heaters

- Distillation tower
- Process heater
- Annealing furnace
- Office equipment
- Maintenance building
- Boiler house
- Gas turbines
- Diesel and Gas engines
- Main production building
- Accounting office
- Air compressors
- Pumps
- Ovens or process heating
- Refrigeration systems
- Conveyors/conveying systems
- Fans and ventilation (not associated with space heating/cooling)
- Cooling towers
- Motors
- Water chillers
- Paint line
- Assembly
- Purchasing
- Information technology

Energy uses can be identified in any way that suits your organization. Earlier in this task you associated energy sources with their appropriate sites, equipment, systems, and processes to ensure all relevant sources were identified. Organize equipment, systems, and processes into logical groupings or categories (i.e., uses) that would best allow you to evaluate and improve energy performance.

Learn More: **Categories of energy use**

Sometimes it is helpful to categorize energy uses. Some potential categories to consider (with examples in parentheses) are:

- Unit operation or processes within a manufacturing facility (e.g., all the equipment associated with a distillation tower)
- Similar equipment (e.g., all air conditioners or all compressors)
- Departments (e.g., the computer lab or the painting department)
- Systems (e.g., lighting systems or compressed air systems)
- Utility distribution (e.g., panel 1 or all 50 amp circuit breakers)
- Specific equipment (e.g., a specific mainframe computer or boiler)
- Sites (e.g., the administration building or the production shop)

Energy uses do not have to be collected into one specific category; a combination of different categories can be used. An example is that the computer lab, the printing process, the boiler, and the electricity used by the remainder of the site could each be identified as separate energy uses.

It is recommended that you make a list of energy uses identified in this task. This list can be used to review energy uses and ensure you are monitoring them appropriately. Additionally, as part of Task 9 Significant Energy Uses (SEUs) you will select individual energy uses to focus your energy performance improvement activities. Making a list now of identified energy uses will aid in the selection of significant energy uses (SEUs) later .

Identify relevant variables

Relevant variables are quantifiable factors that routinely change and have a major impact on energy performance, including the operational performance. As part of ISO 50001:2018, energy consumption values for energy performance indicators (EnPIs), energy baselines (EnBs), and SEUs may need to be "normalized" for relevant variables. Consider potential EnPIs and SEUs and what factors might be relevant variables if the organization determines that the relevant variables significantly affect energy consumption. For commercial or institutional sites, occupancy and weather can often be variables affecting consumption. For industrial sites, production level is generally an additional variable that affects energy consumption. In addition to weather, occupancy, and production, consider the following: operating schedule, product mix, input materials, and season. Understanding the relationship between relevant variables and energy consumption is important in formulating how energy can be controlled and energy performance maximized.

It is also recommended to also identify relevant variables that potentially affect the energy consumption of your selected EnMS scope and boundaries.

An easy way to verify the impact of specific variables is to collect relevant energy data and compare it to appropriate variable data to determine the relationship, if any, of the change in energy consumption coinciding with the change in the variable. One way to define the relationship is to graph the energy data over a defined time period and compare it to a graph of the variable data, such as average daily temperature, over the same period and determine if there are coincidental variations. Consistent variations between the two could indicate a valid relevant variable. Anomalies between the two may indicate other relevant variables that are also a factor. Statistical techniques or more sophisticated engineering calculations may be required for analysis of multiple variables.

The SEEC EnPI Lite software can help you determine if variables significantly affect energy consumption per the SEEC 50001 Ready Measurement and Verification Protocol (English | Arabic). This free online tool can also be used to determine energy performance improvement.

Records of relevant variable data must be retained.

Learn More: **Data source for weather relevant variable**

An important relevant variable that is expected to impact the energy performance for many industrial facilities and buildings is average daily temperature, which is best measured using cooling degree days (CDD) or heating degree days (HDD). A good reference for global CDD and HDD data is the Degree Days website (https://www.degreedays.net/), which allows for free downloading of CDD data for different cities across the world. One note on base temperature: The correct base temperature to use depends on each case such as building use, insulation level, etc. In general, the base temperature for CDD data is defined as the outside temperature above which a building needs cooling. The base temperature should take into account both external heat gains (i.e., greenhouse effect) and internal heat gains (people, computers, etc.) that increase indoor temperatures such that they require cooling.

Identify data needs

In addition to the data needed to measure and monitor energy consumption and relevant variables, you should identify data needs to satisfy the process of conducting an energy review, the “key characteristics” of operations affecting energy performance, and other needs of your organization.

Learn More: **Energy Review**

The energy review is intended to profile your organization’s energy situation and serve as a guide for collecting and analyzing the data needed to determine energy performance and identify improvement opportunities.

ISO 50001 requires that the following data and information be included in the energy review:

- Energy sources
- Analysis of past and present energy use and energy consumption
- SEUs and their current performance
- Relevant variables affecting the SEUs. If seeking SEEC 50001 Ready recognition, relevant variables that affect the energy consumption of the scope and boundaries of your SEEC 50001 Ready EnMS should also be included.
- Estimates of future energy use and energy consumption
- Prioritized opportunities for improving energy performance

In addition to collecting and analyzing data to determine your organization’s energy performance, the energy review provides the basis for establishing the metrics for energy performance measurement and opportunity identification. Use these data for the following purposes:

- Selecting EnPIs

- Establishing the energy baseline
- Setting objectives and energy targets

Learn More: **Key Characteristics**

In addition to the data required for the energy review and those that your organization determines is needed, ISO 50001 requires that some specific data identified as “key characteristics of operations affecting energy performance” be collected in order to evaluate your organization’s energy performance (see Task 21 Monitoring and Measurement of Energy Performance Improvement). These key characteristics include:

- Energy consumption of SEUs and of the organization
- Relevant variables for SEUs
- Static factors, if applicable
- Operational criteria of SEUs
- Data related to action plans

If you have identified relevant variables that affect the energy consumption of the scope and boundaries of your EnMS, these variables are also key characteristics.

A resource such as the optional 50001 Ready Playbook Task 08 worksheet can be used to identify and record the key characteristics and their monitoring and measurement requirements for your organization as you work through the tasks below. The Playbook worksheet is provided to illustrate the types of information that can be captured in planning for monitoring, measurement, and analysis of the key characteristics.

Identify data sources

It is important to know where to locate and how to acquire energy data. Requirements will vary depending on the data to be collected. Energy bills are generally readily available and easy to collect, but other data may require more effort. Metering may not exist for some energy management data, and it may be necessary to evaluate your metering availability and data collection process to determine the most advantageous method(s) to collect the required data. For energy sources that can be metered, there are various sources for energy data collection which can be used, including the following:

- Utility revenue meters and records
- Purchase orders
- Nameplate data
- Portable meters
- Submeters

Collecting Data

Once you have determined the data you need and want to collect and the potential collection mechanism, determine if a collection process is already in place and how you collect the information. If these data are not already collected, evaluate how they are being generated. Then determine if your organization has the means to collect the data. If not, consider acquiring additional metering equipment or devising an alternative form of performance analysis.

Develop a consistent and reliable process for acquiring and recording data. Define the steps to be followed to ensure timely acquisition of accurate energy management related data. The complete collection process includes:

- Energy management data required
- Data location
- How the data are to be collected
- Person (by position) or source keeping the data
- Frequency of data collection
- Data storage method and location
- Method of analysis

The process may include additional steps, but the above steps, at a minimum, are best practice. Your energy team typically oversees this process. The 50001 Ready Playbook Task 08 worksheet or a similar document can be helpful in establishing your data collection process.

How often the data are collected depends on your organization's needs and requirements. The benefit of having a formal data collection process is that it will ensure you collect the appropriate data and record it at the necessary frequency.

Learn More: **Tools to assist in data collection**

Your organization can analyze and track energy in many different ways, from simple in-house spreadsheets to sophisticated software and web-enabled applications. SEEC provides two tools to assist in documenting your organization's energy sources:

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    - **Footprint tool inputs:** The Footprint tool can actively track up to 20 types of energy sources (electricity, natural gas, etc.) and 20 related relevant variables (production levels, degree days, operating hours, occupancy rates, etc.) for up to a 10 year period. Customized energy types and related factors can easily be added as needed. Energy end-use is tracked on an annual yearly basis. Users can create up to 10 major energy end-use groups (process areas, building areas, boiler room, etc.) which each can include up to 30 individual components (boilers, fans, pumps, lights, etc.) which assists in determining the EnMS SEUs.

- **Footprint tool outputs**: The Footprint tool generates a series of charts and graphs based on the entered data. This allows for the comparison of energy types, monthly and yearly trends, and entered energy consumption (BTUs) vs energy end-use (application of energy). Comparing consumption to tracked end-use can help to determine how accurately the total “bottom-up” end-use compares to the “top-down” metered consumption and how much end-use energy consumption may be unaccounted for. The tool helps to determine the energy consumption of various energy end uses and thus help in determining the SEUs. Finally, the tool can also output energy data into a format that is compatible with the SEEC EnPI Lite tool in order to perform a regression analysis of energy consumption with other relevant variables like weather, production, and building occupancy.

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Define and implement an energy data collection plan

ISO 50001 requires a plan for collection of energy data. The energy data collection plan is developed to define, organize, and document monitoring and measurement activities. Each of the key characteristics of operations that affect energy performance listed above is evaluated to determine the appropriate attributes that should be measured or monitored so appropriate data can be collected for analysis.

The optional 50001 Ready Playbook Task 08 worksheet provides a guide to the details required to ensure adequate collection of data for determining energy performance. This form encompasses the relevant key characteristics.

Periodically review measurement needs

Periodically reviewing your organization’s measurement needs ensures that as the key characteristics that affect energy performance change over time, any needed adjustments are made to the energy data collection plan. If there are adjustments, inform relevant personnel of the changes. A practical approach to periodic review of measurement needs and updating the data collection plan involves two elements:

- Defining a minimum frequency (e.g., monthly, quarterly, semi-annually) for the review
- Integrating the review as part of your organization’s “real-time” change management processes (mainly communication)

Ensure accuracy and repeatability of measurements

A calibration program provides the means to ensure monitoring and measuring equipment is properly maintained to provide accurate data. Basic components of a calibration program involve the following:

- Identifying the equipment to be calibrated
- Specifying the method of calibration to be used
- Establishing calibration tolerance and frequency
- Defining and assigning calibration responsibilities
- Maintaining appropriate documentation

Smaller organizations can use simpler plans to assure measurements, monitoring, and metering are accurate and repeatable. Some available resources are located in the optional 50001 Ready Playbook Task 08 worksheet.

Determine data analysis method(s) and assign responsibilities

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2. **The Energy Consumption Tracker**. This excel-based tool is a simplified version of the SEEC Energy Footprint tool that is not macro-based. The Energy Consumption Tracker allows users to track energy consumption by type (electricity, natural gas, etc.) and related relevant variables affecting energy consumption (production levels, degree days, operating hours, occupancy rates, etc.) on a monthly basis for one or multiple years. The tool can also output energy data into a format that is compatible with the SEEC EnPI Lite tool in order to perform a regression analysis of energy consumption with other relevant variables like weather, production, and building occupancy.

Finding an effective data analysis method is important for identifying energy uses with major energy consumption, as well as energy opportunities that lead to cost savings. It will show areas that are significant and deserve the most attention. It will also show trends and anomalies that help direct your energy management efforts. It can also help you identify billing errors and hidden costs within utility rate structures. It will help your energy team communicate the value of energy management to top management and get the resources needed to make the EnMS successful. One of the most important outcomes of this analysis is to find the largest energy consuming systems and equipment, which helps you determine your organization's significant energy uses Task 9 Significant Energy Uses (SEUs).

The data analysis method(s) appropriate to your organization may depend on several factors:

- Data availability
- Desired output
- Level of available competency for data analysis
- Audience

Learn More: **Factors impacting the choice of data analysis methods**

Desired output: What is the output you want to achieve from the analysis? Before determining the analysis method to be used, you should clearly understand the goal of the data analysis. The Task Overview for this task mentions several uses for the data, but you may also want to:

- Determine performance level.
- Monitor operations.
- Evaluate against a benchmark or like equipment or systems.
- Evaluate the result of maintenance or improvement activities.
- Validate the impact of relevant variables.

Consider the output, audience, and level of available competence for data analysis available when you select a method for analyzing data. Many simple analysis methods can be very effective in analyzing data collected in the energy review and providing the desired results. Some of these are discussed below.

Your organization is responsible for selecting one or more data analysis methods for the purpose of

EnMS and energy performance improvement. Examples of common methods include trend analysis, benchmarking, graphing, Pareto analysis, energy balance, heat balance, utility analysis, financial analysis, and regression analysis. Choose the method or combination of methods that meets the specific goals of your organization. Consider learning from other organization's experience with data analysis to determine what will be most effective for you. Common forms of data analysis include the following:

- Trend analysis
- Benchmarking
- Graphs
- Ranking
- Pareto analysis
- Energy balance
- Heat balance
- Utility analysis
- Financial analysis
- Regression analysis

You will continue to regularly collect and update the data to monitor conditions in the EnMS so you can make changes as required. Organizational changes related to processes, equipment, occupancy, improvement projects, etc. may require adjustments to your EnPIs, baselines, SEUs, objectives and energy targets, or other parts of the EnMS. Continue to collect data to evaluate any required adjustments to energy metrics or energy performance.

Learn More: **The SEEC Energy Footprint Tool**

The SEEC Energy Footprint Tool can be used to assist with data collection and analysis and serve as an input to the SEEC EnPI Lite regression analysis tool.

- **Footprint tool inputs:** The Footprint tool can actively track up to 20 types of energy sources (electricity, natural gas, etc.) and 20 related relevant variables (production levels, degree days, operating hours, occupancy rates, etc.) for up to a 10 year period. Customized energy types and related factors can easily be added as needed. Energy end-use is tracked on an annual yearly basis. Users can create up to 10 major energy end-use groups (process areas, building areas, boiler room, etc.) which each can include up to 30 individual components (boilers, fans, pumps, lights, etc.) which assists in determining the EnMS SEUs.
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EnPI Lite tool in order to perform a regression analysis of energy consumption with other relevant variables like weather, production, and building occupancy.