Section: Performance Evaluation

Task 21: We monitor and measure the key characteristics of processes that affect our energy performance. We define the methods used, the frequency of the monitoring and measurement, and when the results are analyzed and evaluated. We evaluate our energy performance improvement and investigate and respond to significant deviations in energy performance.

Getting It Done

1. Determine what needs to be monitored and measured for energy performance, including the key characteristics of operations affecting energy performance. Use the data and information you generated in the energy review, energy data collection plan, analysis of significant energy uses (SEUs), your energy performance indicators (EnPIs), and energy baselines (EnBs).
2. For each datum/metric, define the method used for monitoring, measuring, analysis, and evaluation. Define how often and when the results are to be analyzed and evaluated.
3. Implement all needed monitoring, measurement, and analysis if not already in place from prior Navigator tasks.
4. Evaluate your organization’s energy performance by comparing EnPI values to the corresponding EnB.
5. For each performance metric in the energy measurement plan, define the criteria or parameters for a significant deviation in energy performance.
6. Establish a process for investigating and responding to such deviations and for retaining records of the results.
7. Train the appropriate personnel on how to identify and respond to significant deviations in energy performance.
8. Record results from monitoring and measurement.

Task Overview

Monitoring, measurement, analysis, and evaluation of performance metrics is the logical extension of the data analyses conducted for the energy review in Energy Data Collection and Analysis. Effective decisions on energy management rely on the ongoing collection and analysis of energy and other data.

Monitoring, measurement, analysis, and evaluation enable your organization to determine if:

- significant energy uses are being appropriately managed,
- current objectives and energy targets are being met,
- EnPI and other energy performance trends are focused in the desired direction, and
- energy performance improvement can be demonstrated.

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Monitoring, measurement, analysis, and evaluation is applied to the “key characteristics” of the organization’s operations that affect energy performance in order to assist organizations in making these determinations. These key characteristics include the effectiveness of the action plans and EnPIs, operation of SEUs, and actual versus expected consumption. The evaluation of energy performance improvement is determined by a comparison of the EnPI value(s) against the corresponding EnB(s)

The data specified in the energy data collection plan in Task 8 Energy Data Collection and Analysis are inputs to the monitoring, measurement, analysis, and evaluation of the key characteristics. They also are inputs to the monitoring and measurement of data needed for the energy review.

SEUs are an important focus of the energy management system (EnMS). Monitor the energy performance of your SEU(s), as small changes in their operation or deviations in procedures, equipment, or maintenance can significantly affect your organization’s overall energy consumption.

Significant deviations in energy performance are defined by your organization. When a significant deviation occurs, your organization must investigate and provide an appropriate response and record the results of the response. The data you collect by monitoring and measuring the key characteristics of operations that determine energy performance is used to identify significant deviations. Your organization determines what will be considered a significant deviation but, in general, it is a departure from a level of energy performance that is acceptable, defined, or expected.

This guidance is relevant to Section 9.1.1 of the ISO 50001:2018 standard.

Associated Resources Short Description
no resources for this questions

Full Description

Determine and implement what needs to be monitored and measured for energy performance

A foundational requirement of ISO 50001 is to demonstrate energy performance and energy performance improvement. Doing so will help you understand that you are establishing an infrastructure of “data connections” between the processes of the energy review, EnPIs, EnBs, objectives, energy targets, action plans, energy data collection plan and the monitoring, measurement, analysis, and evaluation activities of the EnMS. You have been working on these data connections and been evaluating energy performance and energy performance improvement as you have worked through the previous Navigator tasks. Up to this point you have completed the following:

- In Task 8 Energy Data Collection and Analysis, the collection and analysis of energy consumption by energy type and other data in the energy review determined your organization’s energy performance and provided the basis for establishing the energy performance metrics (i.e., EnPIs, EnBs).
- Also in Task 8 Energy Data Collection and Analysis, you implemented an energy data collection plan and collected data, including relevant variables for SEUs, energy consumption, operational

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criteria for SEUs, static factors (if applicable), and data specified in action plans.
- In Task 9 Significant Energy Uses (SEUs), you analyzed data to determine the SEUs, performed analyses to determine SEU relevant variables and SEU current energy performance, and implemented associated monitoring activities.
- In Task 11 Energy Performance Indicators and Energy Baselines, you implemented monitoring and analysis of the EnPIs and EnBs.
- In Task 12 Objectives and Targets, you set and then implemented monitoring of the objectives and energy targets.
- In Task 13 Action Plans for Continual Improvement, you defined how the results of the action plans would be evaluated, including the energy performance improvement verification methods to be used.

In this task, you can ensure that your processes for data collection, monitoring, measurement, analysis, and evaluation are properly established and implemented, and include all the relevant data and information, especially as related to the key characteristics of operations that affect energy performance (see Task 8 Energy Data Collection and Analysis). This is the data infrastructure needed to monitor energy performance and demonstrate energy performance improvement.

Your efforts in this task should include reviewing and pulling together what you developed in the tasks above as related to monitoring, measurement, analysis, and evaluation of energy performance.

For energy performance, your organization must determine and implement the following:

- What needs to be monitored and measured
- The methods you will use to ensure valid results from monitoring, measurement, analysis, and evaluation (as applicable)
- How often the monitoring and measurement will be done
- When the analysis and evaluation of results will be done

At a minimum, your organization must monitor and measure the key characteristics of operations that affect energy performance. The key characteristics include:

- Effectiveness of the action plans in achieving objectives and energy targets
- EnPIs
- Operation of SEUs
- Actual versus expected energy consumption

Some of the data needed to monitor these key characteristics already are being collected as part of your energy data collection plan (see Task 8 Energy Data Collection and Analysis). And, as indicated by the list of tasks you have completed, much of this information already has been determined, especially what needs to be monitored and measured and the methods of analysis that will be used (see Task 8 Energy Data Collection and Analysis).

Some organizations choose to add the following information into the energy data collection plan:

- What is to be monitored and measured

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- How often it will be monitored and measured
- Methods to be used for monitoring, measurement, analysis, and evaluation
- When analysis and evaluation is to be done.

This information transforms this effort into a more comprehensive data collection and measurement plan. There is no specific required format; your organization decides how and in what format to capture this information.

Learn More: **Discussion of data that determine energy performance**

Discussion of monitoring and analyzing energy consumption for all energy types, along with further discussion of monitoring, measuring, analyzing, and evaluating the key characteristics of operations that determine energy performance, is provided below:

Energy consumption for all energy types: Energy types were identified, and past and present energy consumption data were initially collected and analyzed, as part of the energy review (see Task 8 Energy Data Collection and Analysis). This information was used to accomplish the following:

- Profile your organization's energy use and energy consumption
- Determine your organization's significant energy uses
- Identify and prioritize energy performance improvement opportunities
- Develop energy performance indicators and baselines needed to evaluate energy performance

Energy consumption needs to be continually monitored, as it is a key component of energy performance evaluation, and using less energy is the goal of energy performance improvement. Present energy consumption is compared against past consumption. Various methods of data analysis were discussed in Task 8 Energy Data Collection and Analysis. Energy consumption data should be:

- monitored and measured prior to any change being made (baseline).
- monitored and measured after the change is implemented and compared with the baseline (or pre-implementation measurement).
- representative of normal operating conditions.
- reflective of consistency in factors that can affect energy performance, such as weather, occupancy, production, or hours of operation.

Effectiveness of actions plans in achieving the objectives and energy targets: In Task 13 Action Plans for Continual Improvement, action plans to achieve the objectives and targets were developed. Action plans are monitored, measured, analyzed, and evaluated to ensure that the objectives and targets are being met effectively. Recall that the data specified in action plans are among the data to be collected under the energy data collection plan (see Task 8 Energy Data Collection and Analysis). Also, actual versus expected consumption is a key characteristic that must be monitored and measured. The expected energy consumption associated with an action plan that is implemented is compared to the actual results after the project is completed. This comparison tells you whether the energy savings you expected were actually achieved. The methods to perform

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this verification were defined in the action plan.

Successful action plans are analyzed and evaluated for appropriate reproduction in other processes or areas. Projects where energy targets are not met are analyzed and evaluated to determine the reason(s) for the shortfall, and appropriate follow-up is planned and implemented. Action plans that are not generating the intended results (i.e., ineffective) are modified as needed. The following are indicators that action plans may not be effective:

- Objectives' not met
- Energy targets not met
- Unable to meet due dates
- Personnel not available
- Budget not sufficient/available
- Inadequate technology
- Change in priorities

EnPIs: Setting, monitoring, and analyzing EnPIs and EnBs was addressed in Task 11 Energy Performance Indicators and Energy Baselines and Task 9 Significant Energy Uses (SEUs). Recall that under the energy data collection plan, relevant data being collected includes energy consumption related to the organization and SEUs, relevant variables for SEUs, and static factors (if applicable). These data, along with the relevant variables you determined significantly affect energy performance, helped you establish, monitor, and analyze EnPIs for the organization and your SEUs. To evaluate energy performance improvement, the EnPI values are compared against the corresponding EnB.

Operation of SEUs: Data on the SEU relevant variables, energy consumption of SEUs, and operational criteria for SEUs are being collected under the energy data collection plan. In Task 9 Significant Energy Uses (SEUs), you determined relevant variables and current SEU energy performance and implemented associated monitoring.

Monitoring the energy performance of an SEU can involve measuring energy consumption, related operational and maintenance parameters, relevant variables associated with the SEU, or some combination of these. (Monitoring of EnPIs is discussed in Task 11 Energy Performance Indicators and Energy Baselines.

Actual versus expected energy consumption: Implementing energy opportunities is accomplished through action plans. Action plans should include estimates for energy performance improvement expected from the action plan's implementation. Analyze variances between the action plan's actual versus expected results and evaluate that information to identify elements that improve performance or identify problems to address. The results of this analysis should be recorded as feedback for the corrective action process, to improve future action plan implementation and energy performance improvements.

Future energy use and energy consumption was estimated as part of the energy review (see Task 8 Energy Data Collection and Analysis). Your organization decides for itself what period of time is considered to be "future" and monitors the assumptions (or criteria) that you used to make the

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estimates. Make sure you have a process to review and update those estimates as needed on a regular basis and in response to major changes to sites, equipment, systems, and processes.

Once all the needed monitoring, measurement, analysis, and evaluation is determined, it must be fully implemented. The output of the monitoring, measurement, analysis, and evaluation is knowledge of your energy performance trends and calculations of energy performance improvement(s) achieved.

Set and implement criteria for significant deviations

A deviation may be identified by a specific level of variation or can be evaluated by knowledgeable personnel to determine if it is significant and if action is required. Examples of methods for specifying significant deviations can include the following:

- Values outside of control limits
- Percent variation in value
- Trends identified
- Specified variation in EnPIs
- Specified variation in SEU performance
- Level of variance between expected and actual performance
- Change in equipment efficiency
- Variation in specific relevant variable performance
- Failure to meet objectives and energy targets
- Failure to meet a specific performance level

Once you determine the method(s) for identifying a deviation, you must determine the criteria you will use to evaluate if the deviation is significant. Your organization determines the method and criteria in accordance with what you deem acceptable or unacceptable relative to the impact on energy performance. A significant deviation can be an improvement or a decline in energy performance. An improvement in energy performance is a deviation (although generally desired), and you must investigate if it is deemed significant.

Learn More: **Significant deviation example**

Your organization may decide that if electricity consumption for the current month increases by more than 10 percent over the previous month, that will be considered a significant deviation. To be more proactive about improving energy performance, you may decide to set a 5 percent or more increase as the deviation to be considered significant.

Alternatively, the criteria could be *any change* in consumption of 5 percent or more comparing the current month to the previous month will be considered a significant deviation. In this case, a 5 percent or more improvement would require that your company investigate the deviation and respond.

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Consider documenting the criteria for significant deviations within the energy data collection plan (see Task 8 Energy Data Collection and Analysis).

Significant deviations are also related to operational and maintenance controls, as discussed in Task 17 Operational Controls. The methods for identifying significant deviations relative to operational and maintenance controls would be similar to the process for key characteristics discussed here. Operational and maintenance criteria could be a factor in the determination of significant deviations, and Task 17 Operational Controls lists significant deviations that could be the result of operational or maintenance issues.

Develop and implement investigation process

Once you have set the criteria for determining a significant deviation for each of the key characteristics that are measured and monitored, you must investigate and respond if the deviation occurs. Many organizations use the corrective action process to address significant deviations, which is a best practice (not a requirement).

A well-developed and implemented corrective action process can be an effective tool for investigating significant deviations. However, the ISO 50001 standard only requires that you investigate and respond to significant deviations. It does not require that they be addressed by your corrective action process.

The investigation addresses normal operation, as well as evaluation of energy use and consumption expected as the result of process changes or implementation of improvement opportunities.

Learn More: **Example investigation**

As an example:

You may decide that improvements achieved as the result of planned activities will not be considered significant deviations if the actual results are in line with pre-project estimates. On the other hand, if there is a difference of 5 percent or more between the actual and estimated results, you may decide this is a significant deviation. If the results were better by 5 percent or more, this would require an investigation into why the results were better than the estimates.

Significant deviations that result in improved energy performance can be analyzed for actions to be replicated in other energy systems.

You must develop a response as a result of the investigation. Your response will likely be some type of action that is required to alleviate a significant deviation that results in declining energy performance or reproducing the conditions in other areas if performance is improved. However, note that a decision not to respond can be a legitimate response. This can occur if the significant deviation, for example:

- is a one-time occurrence.

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- is the result of an improvement that will persist.
- is the result of process changes.
- is the result of a simple mathematical error.
- is too expensive to fix.
- requires currently unavailable technology.

You must record the results of the investigation and the response(s). If your corrective action process is used to investigate significant deviations, then the record requirements would already be addressed (ISO 50001 requires records of the nature of nonconformities, the actions taken and the results of corrective actions). Otherwise, decide on how the results of the investigation and the response will be recorded and retained

Learn More: **Items to consider recording**

There are no specific record requirements for investigations of significant deviations beyond records of the investigation results and the response taken; however, items to consider recording include the following:

- Responsibilities
- Time frames
- Activities undertaken
- Resources consulted
- Equipment/meters used
- Analysis conducted and results
- Response
- Effectiveness of response

Record results from monitoring and measurement

The results of the monitoring and measurement activities must be recorded and retained. This can be done in a variety of ways, including the use of spreadsheets, databases, log sheets, or other formats.

Decarbonization

Effective decisions on energy management rely on the ongoing collection and analysis of energy, energy-related GHG emissions and other data. When adding energy-related GHG emissions to the EnMS, monitoring measurement and analysis must include consideration of energy-related GHG emissions. Monitoring, measurement, analysis, and evaluation enable your organization to determine if:

- SEUs are being appropriately managed,
- Objectives and targets are being met,
- EnPIs and other performance trends are focused in the desired direction, and

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- Energy performance improvement and energy-related GHG emission reductions can be demonstrated.

Establishing a new EnMS prioritizing decarbonization

If you do not have an existing 50001 Ready-based EnMS and want to build one that also helps your organization manage energy-related GHG emissions, you should follow the guidance in the "Full Description" tab keeping the following in mind:

1. Make sure your processes for data collection, monitoring, measurement, analysis, and evaluation include the necessary elements to manage GHG emission performance. These processes include:
    - Task 8 Energy Data Collection and Analysis
    - Task 9 Significant Energy Uses (SEUs)
    - Task 11 Energy Performance Indicators and Energy Baselines
    - Task 12 Objectives and Targets
    - Task 13 Action Plans for Continual Improvement
    - Task 20 Monitoring and Measurement of the EnMS
2. Make sure your criteria for significant deviations considers GHG emissions.

Adapting an existing EnMS to prioritize decarbonization

If you have an existing 50001 Ready-based EnMS and want to adapt it to manage energy-related GHG emissions, you should:

1. Review your processes for data collection, monitoring, measurement, analysis, and evaluation to ensure they include the necessary elements to manage GHG emission performance. These processes include:
    - Task 8 Energy Data Collection and Analysis
    - Task 9 Significant Energy Uses (SEUs)
    - Task 11 Energy Performance Indicators and Energy Baselines
    - Task 12 Objectives and Targets
    - Task 13 Action Plans for Continual Improvement
    - Task 20 Monitoring and Measurement of the EnMS
2. Review your criteria for significant deviations to ensure GHG emissions are considered. If the criteria require changes, update the criteria and review the investigation process to see if it also needs to be updated.

Commercial ERP

The guidance for this task is from the following sections from the ERP Framework: Implement the Plan.

With a robust system in place to evaluate emissions reduction progress, organizations are poised to identify what's working, revise the plan when necessary, recognize ongoing achievements, and transparently share their results.

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Industrial ERP

Monitoring and measuring GHG emissions in a rigorous and transparent manner is essential for proper target setting and emissions reporting and dovetails well with monitoring and measuring energy performance improvement.

The guidance for Task 21 is found within the following section of the ERP Industrial Framework:

Ongoing Implementation:

Measure and verify GHG emissions reductions – Establish a procedure for quantifying emissions reduction. Most commonly, organizations report their GHG emissions reduction based on the reduction in fuel consumption or refrigeration leaks. Companies can also conduct project-based GHG emissions reduction accounting according to “The GHG Protocol for Project Accounting” standard. This accounting method can be used for emissions reduction for a particular project to assess the actual reduction. This provides vital feedback to inform future efforts and even potential ERP revisions. Organization leadership should regularly communicate implementation progress and status towards the goals.

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