TECHNICAL SPECIFICATION

ISO/TS 50008

First edition
2018-11

Energy management and energy savings — Building energy data management for energy performance — Guidance for a systemic data exchange approach

Reference number
ISO/TS 50008:2018(E)

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Published in Switzerland

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 301, *Energy management and energy savings*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The successful implementation of an energy management system (EnMS), particularly ISO 50001, requires information to complete almost every action. In some situations, the data required to provide this information will be readily available or easy to access; whereas in other situations the required data can be difficult to obtain. The availability of data may affect which energy performance goals or indicators can be used by the organization. Establishing regular information transfers for an EnMS, whether based on ISO 50001 or another similar approach, is often one of the most challenging implementation tasks. This document provides a process for the energy management team (EnMT) to use in situations where the required data are difficult to obtain. It also provides high-level guidance useful for planning and maintaining information access. This document is about the management process and not the technology of data measurement or transfer.

Establishing regular information collection or data transfers for an EnMS, for example to determine, calculate or evaluate the values of energy performance indicators (EnPIs), may require the EnMT to work with other parts of the organization to obtain the necessary data. Regular information or data transfers can be facilitated by implementing a formal data interface or transfer capabilities as part of the organization's standard business practices. These capabilities can be described in a data management plan (DMP). In the best case, data transfers can be automated. Formal data transfer capabilities, whether automated or not, can increase uniformity and consistency, and can reduce the risks, costs and errors associated with the implementation of an EnMS.

In presenting guidance on management processes, this document emphasizes that when the decision is made to incorporate specific data into the EnMS, particular attention should be paid to:

a) management need for that data (e.g. objectives, targets) as used in the organization's EnMS;

b) data definition, attributes and formats.

The aim of this document is to facilitate the work of the EnMT. Since data often comes from outside their activities, the providers of these data can also be interested in the requirements of the EnMT. Accordingly, users of this document can include:

— EnMTs, including those implementing ISO 50001 or calculating EnPIs;

— building energy managers;

— equipment manufacturers and instrumentation engineers;

— building information system (BIS) managers;

— organizations that operate buildings.

This document provides guidance on documenting data and the associated processes.

Figure 1 shows the relationship of this document to ISO 50001, which uses the Plan-Do-Check-Act (PDCA) cycle and concept of an EnPI. The straight arrows in the figure indicate where data may be needed in the PDCA process.

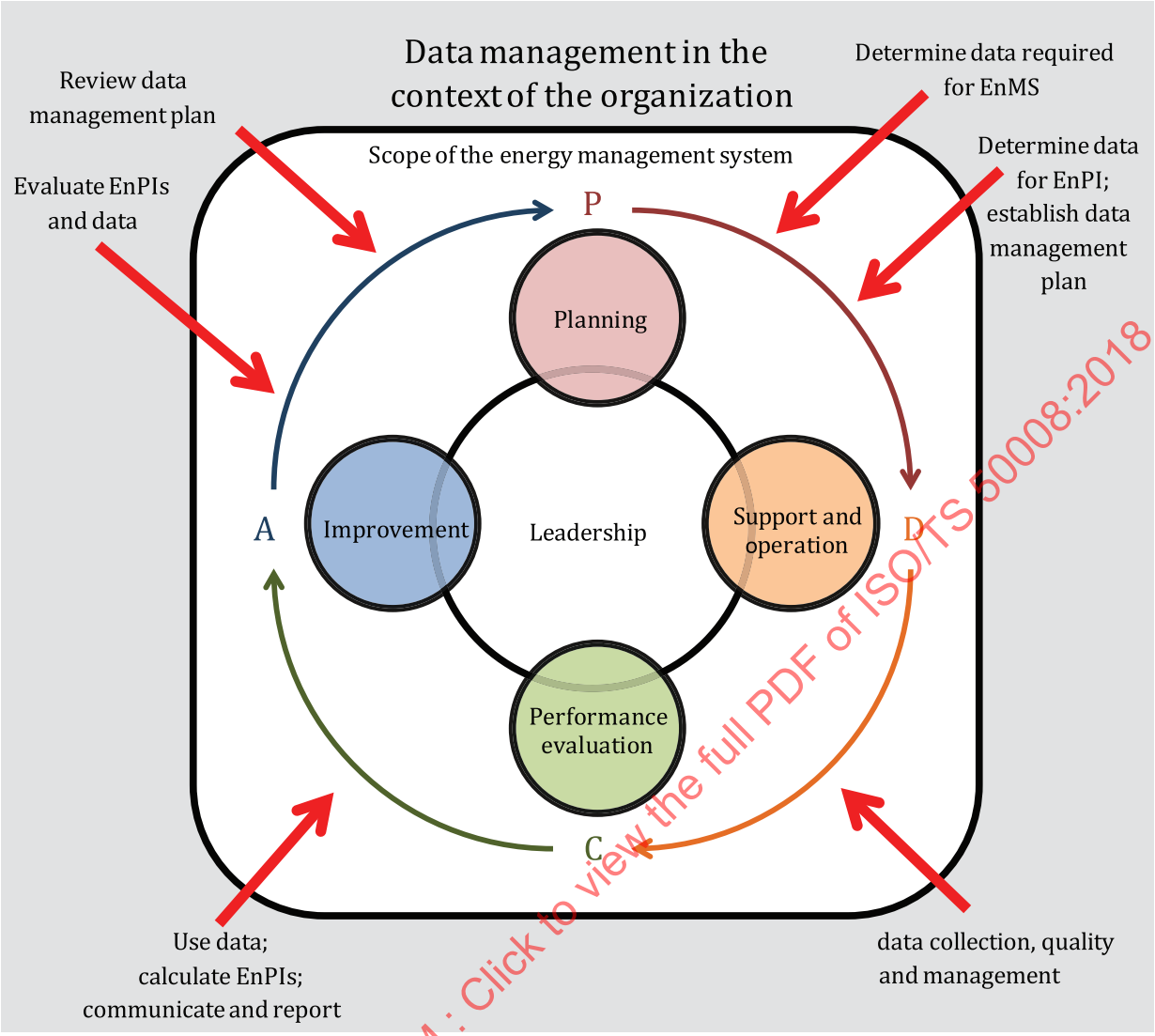

Figure 1 — Relationship to ISO 50001

Energy management and energy savings — Building energy data management for energy performance — Guidance for a systemic data exchange approach

1 Scope

This document gives guidelines for how the energy management team (EnMT) in an organization can define, request and regularly access the data and information needed to implement an energy management system (EnMS) designed to continually improve energy performance in buildings.

It is applicable to data provided by human processes or by building automation, control, information technology, or even accounting systems. If the building information system (BIS) is accessible by the EnMT, the BIS can facilitate the provision of data and information. This could include data used in determining significant energy uses (SEUs), managing to improve energy performance (including energy consumption, energy use and energy efficiency) through to the use of energy performance indicators (EnPIs).

This document does not apply to:

— residential or industrial buildings;

— buildings containing an industrial process where the industrial processes cannot be separated from other uses.

However, many of the principles in this document can be applied to these or other types of buildings.

NOTE Industrial processes can include manufacturing, packaging, transportation, assembly, etc.

It does not apply to building automation data communication protocols themselves.

It is does not consider the selection of energy management software, hardware and control algorithms for automatically managing buildings.

2 Normative reference

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
building information system
BIS
systems, processes and sources of data about a building or its pattern of use

Note 1 to entry: This may include data output from a building management system (BMS), lighting management system, or other automated systems, as well as from security, control, information technology or even accounting systems.

Note 2 to entry: Elements of a BIS can be computerized or may require manual data collection.

3.2
data management plan
DMP
plan prepared by the *energy management team* (3.4) covering the determination, collection, maintenance and storage of *energy data* (3.3)

Note 1 to entry: ISO 50001 refers to an energy data collection plan, which covers some of the elements of a DMP.

3.3
energy data
data including energy consumption and other variables used to calculate or evaluate energy performance

Note 1 to entry: Energy data are collected and used for *energy performance improvement actions* (3.6) to evaluate energy performance.

Note 2 to entry: "Other variables" can include *relevant variables* (3.9) and *static factors* (3.10).

3.4
energy management team
EnMT
person(s) with the responsibility and authority for effective implementation of EnMS activities and for delivering energy performance improvement

Note 1 to entry: The size and nature of an organization and available resources are taken into account when determining the size of an EnMT. A single person can perform the role of the team.

[SOURCE: ISO 50001:2018, 3.2.5, modified — The abbreviation "EnMT" has been added and "an energy management system" has been changed to "EnMS activities".]

3.5
energy performance improvement action
EPIA
action or measure or group of actions or measures implemented or planned within an organization intended to achieve energy performance improvement through technological, management, behavioural, economic, or other changes

[SOURCE: ISO 50015:2014, 3.5]

3.6
energy performance indicator
EnPI
measure or unit of energy performance, as defined by the organization

Note 1 to entry: EnPIs can be expressed by using a simple metric, ratio, or a model, depending on the nature of the activities being measured.

[SOURCE: ISO 50001:2018 3.4.4, modified — Note 2 to entry has been deleted.]

3.7
energy use
application of energy

EXAMPLE Ventilation, lighting, heating, cooling, transportation, data storage.

Note 1 to entry: Energy use is sometimes referred to as "energy end-use."

[SOURCE: ISO 50001:2018, 3.5.4, modified — In the example, "production process" has been deleted.]

3.8
relevant variable
quantifiable factor that impacts energy performance and routinely changes

EXAMPLE Weather conditions, operating conditions (indoor temperature, light level), working hours, number of occupants, etc.

[SOURCE: ISO 50015:2014, 3.18 modified — In the example, "number of occupants, etc." has replaced "production output".]

3.9
significant energy use
SEU
energy use (3.7) accounting for substantial energy consumption and/or offering considerable potential for energy performance improvement

Note 1 to entry: Significance criteria are determined by the organization.

[SOURCE: ISO 50001:2018, 3.5.6, modified — Note 2 to entry has been deleted.]

3.10
static factor
identified factor that impacts energy performance and does not routinely change

EXAMPLE Facility size, design of installed equipment, gross floor area vacancy, weekly operating hours, seasonal extended hours of operation.

[SOURCE: ISO 50001:2018, 3.4.8, modified — Note 1 to entry has been deleted, and in the example, "gross floor area vacancy, weekly operating hours, seasonal extended hours of operation" has replaced "number of weekly shifts; range of products".]

4 The process of obtaining and managing data

4.1 General

This clause presents a management process that the EnMT can use to determine the sources of data needed to implement an EnMS, and the subsequent collection of those data. This process assumes that the EnMT is in place and has identified the essential quantitative parameters to be used for energy management. While there are a number of approaches to energy management, the basic management approaches are very similar, and generally make use of similar data elements. To provide a specific example of the data under discussion, the typical data elements used in an ISO 50001 implementation are listed in Annex A.

In this document, the term "data" refers to any data, including energy data, necessary to accomplish successful implementation of an EnMS. Collection of those data may require the EnMT to work with individuals or organizations that already obtain or control that data. These data may be within the same organization (e.g. building operators or their staff) or organizations outside the organization (e.g. weather service data).

The data that the EnMT determines to be necessary to implement the EnMS should be listed in a DMP. The DMP includes basic descriptors of the data, the source and contact information, and the manner and timing with which the data will be provided or can be accessed.

NOTE For implementation of ISO 50001, the guidance in ISO 50004 on collecting data can be used.

The automated collection of data can often lead to potential resource savings. Particularly when data collection is automated, a common understanding of the needs and constraints is important for efficient data communication. This includes data semantics, formats and attributes for managing data that describes building energy performance.

4.2 Process for defining data needs for energy management

4.2.1 General

Different approaches to energy management use a similar sequence of activities. Typically, these follow a continual improvement approach, such as PDCA. For the implementation of ISO 50001, the typical data needs are given in Annex A. The data needs are best met by following structured processes for identifying data and its availability, as shown in Figure 2.

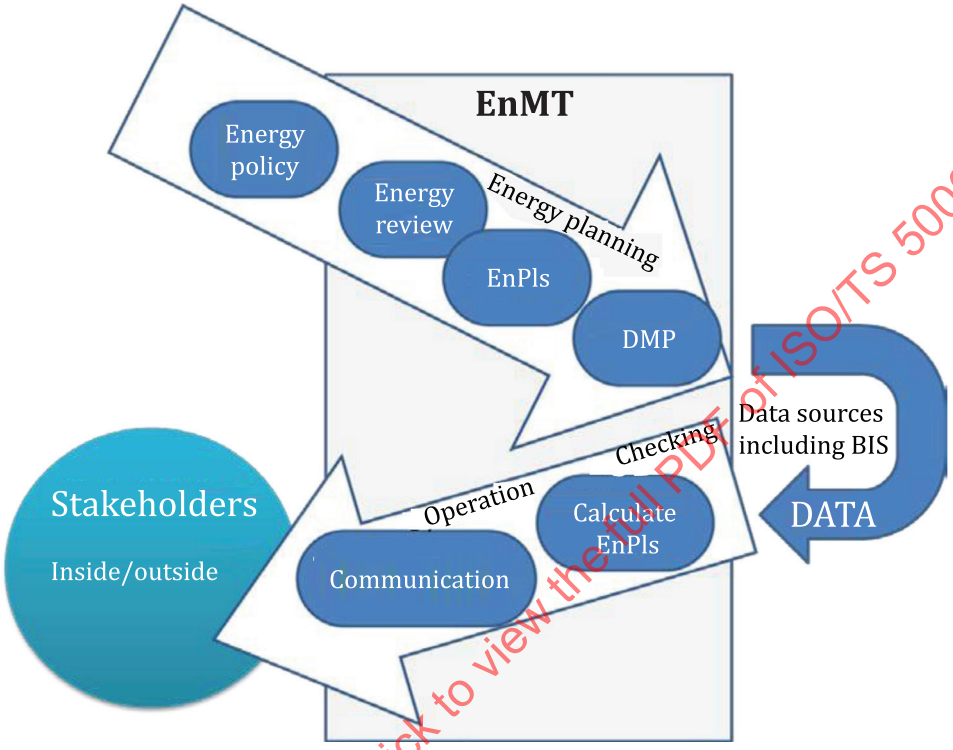

Figure 2 — Representation of typical energy management process

Figure 2 shows a single cycle of an ongoing EnMS. An energy policy will have been established. The energy review periodically identifies energy flows and other relevant variables before the EnMT selects EnPIs appropriate for each stakeholder. EnPIs can be used to set energy targets consistent with the energy policy. The EnMT specifies the data needed for calculating the EnPIs, arranges for the availability of the data and collects those data from its sources, including a BIS. The EnMT calculates the EnPIs and communicates the results to stakeholders inside and outside the organization.

The data collection can be manual, automatic or a combination of both, depending on the configuration and structure of the existing data sources, e.g. weather data or occupancy data from sensors, a security system, a point of sale activity within the building.

4.2.2 Determination of a data management plan

The EnMT determines the data requirements for EnMS activities. These requirements can be included in the DMP using the following steps:

a) identify data and their attributes;

b) identify the entities that can provide and exchange data (e.g. EnMT, external sources);

c) identify the types of data defined, stored and used by each entity that can provide data;

d) identify who will gather, maintain and store data;

e) determine the availability of data based on structure, configuration and limitations (e.g. equipment, cost, time, resources).

Data requirements can include building energy data and data about relevant variables, such as occupancy or internal temperatures. Data requirements also can include static factors, such as the building area or operating hours.

The EnMT should also allow for the fact that data, particularly BIS data, may be available with attributes specific to its source. For BIS data, this can be related to building operation and management. Data will usually have to be transformed into data formats and attributes compatible with EnMS activities before they can be used.

The EnMT should determine whether the BIS is able to make available the necessary energy data, or other data, in a format that can be directly used. If so, these data can be converted by the automation system into formats which are compatible with EnMS activities.

When the BIS or automation system is not able to produce data that the EnMT can directly use, those data might need to be processed (e.g. the EnMT needs daily average temperature, rather than hourly readings from the BIS). Some of the common situations that the EnMT can encounter are discussed in Clause 5.

4.3 Characteristics of data to be recorded in a data management plan

The DMP records the data characteristics, sources and agreements for data needed by the EnMT. Its development can take into account the existing BIS configuration and its capabilities to provide and process data. It is advised to consider the context information provided by the attributes associated with the data provided by the BIS. The DMP also specifies the characteristics of each data element.

For each element of data, the following should be recorded:

a) the name and description of what is to be provided to the EnMT;

b) the reason these particular data (e.g. temperature) are to be provided to the EnMT (e.g. which EnPI or other use requires these data);

c) the person responsible for recording or measuring the data;

d) the person responsible for its calibration and maintenance;

e) how it is recorded or measured;

f) how often it is recorded;

g) how the time of measurement will be recorded;

h) the values or range of values expected;

i) what constitutes a significant deviation from the anticipated values;

j) what actions are taken for values that show a significant deviation from the anticipated values;

k) the format of the recorded data;

l) how the data will be processed before they are provided to the EnMT;

m) the person responsible for that processing;

n) the agreement on how the data are to be provided to the EnMT;

o) for each of the data provided to the EnMT, who on the EnMT will receive it;

p) if the data are to be provided electronically, the technical specification of the data that will be provided to the EnMT;

q) how special situations will be resolved (see Clause 6);

r) how the EnMT will be informed of changes to any of the above.

The EnMT can use any convenient form to record this information. A sample table is given in Annex C.

5 Potential issues pertaining to data for managing energy

5.1 General

The process of obtaining and managing data for energy management (see Clause 4) begins to describe some of the issues that can arise, but it is not exhaustive. As the EnMT encounters these situations, they should be noted and the resolution be recorded in the DMP. Some aspects of these potential issues are more important when obtaining data through an automated process.

5.2 Data timing

The EnMT can find that available data and measurements do not match the time frame of the energy consumption, EnPIs or other measurements used in the EnMS. Available data could be at higher or lower frequency, or there could be a mismatch with the frequency used in the EnMS. As a result, the EnMT should be prepared to recalculate the data so that its frequency matches the requirements of the EnMS.

For example, in a case where the EnMT is calculating an EnPI of the energy monthly consumption of a building, the building's metered energy data:

— could be at a greater frequency than the monthly performance metric (e.g. 15 min data); a possible solution would be to aggregate data for the required period;

— could be not for calendar months, but on a monthly schedule starting mid-month; a possible solution would be to create daily usage through pro-rating consumption by days and using these daily values to construct consumption over the desired period.

The EnMT should document any adjustments made to data received.

5.3 Data composition

The EnMT could find that types of data needed as inputs for EnPIs or other measurements are not readily available, but usable data (energy consumption or otherwise) are available.

EXAMPLE 1 The EnMT plans to change a lighting system from fluorescent to light-emitting diode (LED) lamps. There had been no metering on the lighting circuits. However, it is possible to use occupancy data (which can come from reference manuals) and the wattage of the lights being replaced to estimate energy used by lighting before the EPIA.

EXAMPLE 2 The EnMT plans to use the electrical circuit metering in a building to monitor energy consumption, but it could determine that the electrical circuits in a building are in a configuration that does not align with the energy consumption of the occupied space. For example, an office in a building could be served by more than one electrical circuit, with each supplying multiple energy uses. As a result, the effects of energy performance improvement activities do not show in the energy consumption of the circuits in the building. The EnMT would document such situations and the actions taken to obtain input data for the EnPIs.

5.4 Independent building occupants

Building energy use can be complex, with multiple occupants or tenants independently choosing their energy consumption. This situation can require the EnMT to make specific arrangements to acquire the data needed to manage energy. These arrangements can be technical (e.g. installation of energy sub-meters or special sensors) or non-technical (e.g. agreements for access to read meters or sensors). Such situations are often found in rented multi-use buildings or business parks.

Figure 3 shows energy use in a multi-use, rented commercial building, and the main sources of data that need to be captured to measure the impact of two EPIAs.

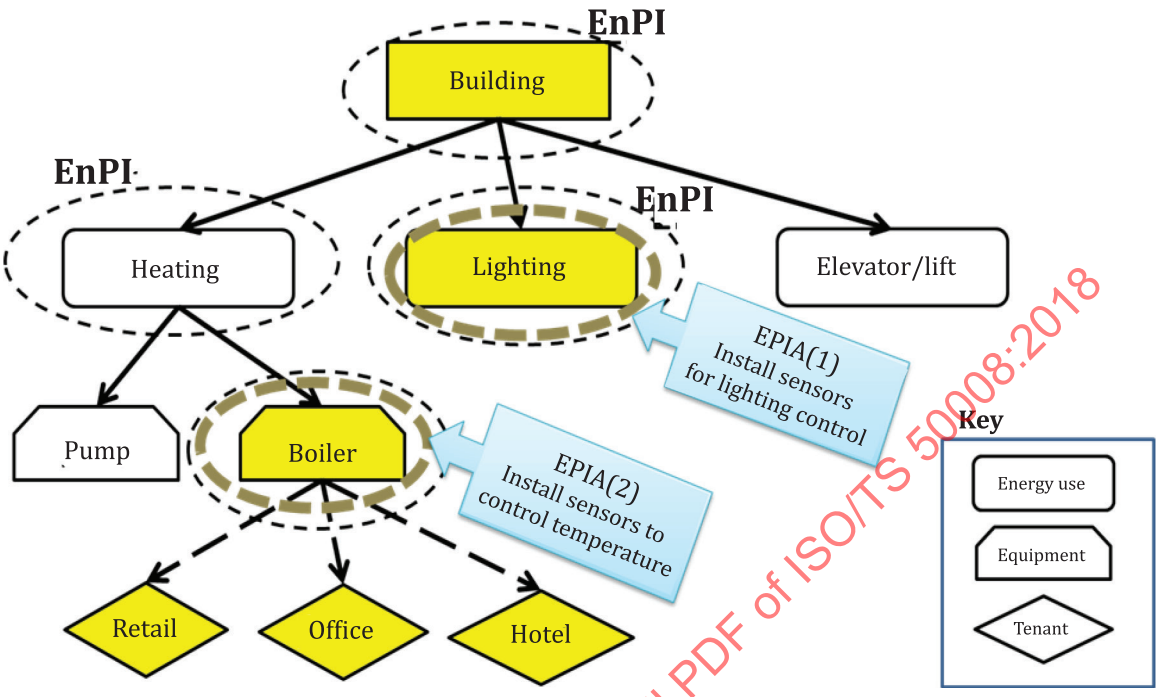

Figure 3 — Energy use in a multi-use rented building

In Figure 3, the main sources of data are highlighted in yellow. EPIA(1) affects only common area lighting. EPIA(2) affects all areas of the building, including space used by tenants. The EnMT can manage energy consumption of the building from a whole-building perspective, but the tenants could be able to control the temperature and heating periods for their own spaces. To manage the energy use in the building effectively and assess the effect of EPIA(2) on the boiler, the EnMT might need to obtain the cooperation of the tenants to determine their use of heat. This could be through sensors measuring temperature in tenant spaces, surveys of temperature and timing of usage, as appropriate.

5.5 Changes in automatically provided data

The EnMT can depend on automatically provided data under the control of others inside or outside of the organization. For reasons of their own, such as equipment upgrades, data providers can change the format or attributes of data provided to the EnMT. The necessity to alert the EnMT of such changes can be included in the EnMT's DMP. Whether alerted or not, the EnMT and the originators of the data should make new arrangements for the continued supply of data to the EnMT. These should be recorded in the DMP.

5.6 Standardization to facilitate automatically provided data

The use of standardized data formats, systems or specifications can help the EnMT manage data in the most efficient manner. The EnMT should be aware these can be specific to some of the data sources, such as equipment and building control systems. These standardized formats and specifications can be at levels that describe the building, a building's components and building-related equipment. To the extent that the EnMT can make use of standardized formats or specifications, its ability to manipulate data will be improved, and the longer-term cost of the EnMS is likely to be reduced. Access to higher quality data can support ongoing improved energy performance.

Equipment in a building can make use any of several communication protocols to generate and communicate data. Energy data, relevant variables and other needed data may be available by using such protocols. See Annex B.

6 Documented information

6.1 Guidance on documented information

Documented information is important for maintaining the effectiveness, quality and transparency of a building EnMS. This is particularly true as members of the EnMT, those they work with and other stakeholders change over time. Accordingly, the process of developing the structure of the data to support energy management should be documented so that each step is clear and that users of the documentation are able to do so in a manner that produces accurate and usable data for those managing energy. While 4.3 provides specific guidance regarding documentation for each item of data, in general, documented information should also include the following:

— the specific energy management activity, plan or description that is the basis for the development of the DMP (e.g. ISO 50001);

— the EnPIs and any other metrics in the EnMS, including data needed, how they are to be processed and the calculations underlying the EnPIs;

— information on the roles and functions of the EnMT, including how those enable effective EnMS operation.

The documented information should be under a change management process so that each version of the data specification and each set of changes are documented. This is particularly important if the EnMT obtains data from a variety of sources.

6.2 Confidentiality

The data and metrics used for an EnMS should be kept confidential. Other requirements related to confidentiality should be considered as appropriate.

Annex A
(informative)

Representative data needs of energy management systems

A.1 General

This annex lists typical informational needs of an EnMS, drawn from ISO 50001. Other energy performance improvement processes can have similar needs. Generally, the EnMT could need data for the following activities.

A.2 Energy planning

The types of data needed for the execution of energy planning include, but are not limited to, the following:

— current energy sources;

— past and present energy uses and consumption;

— a list of the facilities, equipment, systems, processes and personnel working for, or on behalf of, the organization that significantly affects energy use and consumption;

— relevant variables affecting SEUs;

— current energy performance of facilities, equipment, systems and processes needed to identify SEUs;

— daily operation (comparison with EnPIs, target and energy baselines, and corrective action at the time of deviation);

— changes in static factors; also, maintenance and updating of EnPIs and energy baselines.

NOTE Data for an energy planning can also be provided by energy audits. ISO 50002 provides information on energy audits.

A.3 Energy audit

Data obtainable from an energy audit that is useful for the EnMS can include the following:

— a list of relevant measurement points and their associated measurement procedures and equipment;

— identification of feasible additional measurement points;

— accuracy and repeatability required for the measurements or their associated measurement uncertainty;

— measurement duration and frequency of each measurement;

— relevant variables provided by the organization (e.g. operating parameters, production data);

— responsibilities for carrying out the measurements, including personnel working for or on behalf of the organization;

— calibration and traceability of the measurement equipment.

The DMP can be an important approach for communicating the availability of data from the BIS and for specifying the energy data needed for EnMS activities. The DMP can also include consideration of the constraints imposed by the means by which the BIS acquires data.

NOTE ISO 50002 provides information on energy audits.

A.4 Energy performance measurement

Activities requiring data or information occurring during the evaluation of the energy performance (evaluation of EnPIs) include the following:

— defining the boundary (or boundaries) within which energy performance will be managed;

— defining and quantifying energy flows;

— defining and quantifying relevant variables;

— defining and quantifying static factors;

— determining the specific energy performance characteristics (e.g. EnPIs) to be quantified;

— determining whether normalization is needed and, if needed, the data required for normalization;

— identifying the users of EnPIs.

NOTE ISO 50006 provides additional guidance on energy performance measurement.

A.5 Measurement and verification of energy performance

The documented information for the measurement and verification (M&V) process should include how the data for M&V should be identified and managed during the M&V activities. Data management documented information includes, but is not limited to, documented information on the means to store, backup, maintain and secure the data. The M&V process should also include information on measurement planning, such as the location, frequency and installation of meters or sensors.

NOTE ISO 50015 provides additional guidance on M&V.

