PAS 51215:2014

Energy efficiency assessment – Competence of a lead energy assessor – Specification

Department of Energy & Climate Change

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ISBN 978 0 580 84377 8

ICS 27.010

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Publication history

First published June 2014

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Foreword

This PAS was sponsored by the Department of Energy & Climate Change (DECC). Its development was facilitated by BSI Standards Limited and it was published under licence from the British Standards Institution. It came into effect on 26 June 2014.

Acknowledgement is given to Kit Oung as the technical author of this PAS.

BSI also wishes to acknowledge the following organizations that were involved in the development of this PAS as members of the steering group:

- Association of British Certification Bodies (ABCB);
- Carbon Trust;
- Chartered Institution of Building Services Engineers (CIBSE);
- Co-opted;
- Department of Energy & Climate Change (DECC);
- EEF, the manufacturers organisation;
- Energy Institute;
- Energy Managers' Association (EMA);
- Energy Services and Technology Association (ESTA);
- Environment Agency;
- Freight Transport Association (FTA);
- Institute of Environmental Management and Assessment (IEMA);
- SKM Enviros (part of Jacobs Engineering Group);
- The Building Futures Group;
- Verco.

Comments from a wider range of interested parties were invited and received by BSI. The expert contributions made by the organizations and individuals consulted in the development of this PAS are gratefully acknowledged.

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The PAS process enables a specification to be rapidly developed in order to fulfil an immediate need in industry. A PAS can be considered for further development as a British Standard, or constitute part of the UK input into the development of a European or International Standard.

Relationship with other publications

There are a number of standards in existence and in development in the field of energy audits and energy assessments. PAS 51215 fits into this body of work with its focus on the competencies required of a lead energy assessor, rather than on the energy assessments or energy audits themselves.

The BS EN 16247 series is a European standardization series, which covers different aspects of energy audits. It is intended that PAS 51215 will complement and coexist with this suite of standards.

BS EN ISO 50001 specifies requirements on energy management systems and also gives guidance for their use. ISO 50002[1)], the second in this suite of international standards covers general requirements common to all energy audits. It is also intended that PAS 51215 will complement and coexist with these standards.

[1)] In preparation.

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Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in coloured italic type. They do not constitute normative elements, and as such are not requirements.

The introduction and informative annexes (Annex A, Annex B and Annex C) also do not constitute a normative element of the PAS and as such are not requirements.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Statement by DECC

The Energy Savings Opportunity Scheme (ESOS) is the UK's approach to implementing Article 8 of the EU Energy Efficiency Directive (2012/27/EU) [1], which requires all Member States to introduce a programme requiring large enterprises to conduct regular energy efficiency assessments by appropriately qualified and/or accredited individuals. Those individuals can be either in-house experts or external resources such as consultants and energy service providers. The Government aims for PAS 51215 to be applied to "lead energy assessors" conducting ESOS compliant energy efficiency assessments. The Department of Energy & Climate Change (DECC) sponsored BSI Standards Limited to develop PAS 51215 to set out a clear level of competence for "lead energy assessors" who will be responsible for ensuring that quality energy efficiency assessments are carried out in accordance with the statutory requirements set out in secondary legislation by the Government.

DECC does not intend for ESOS and PAS 51215 to replace other schemes, such as those supporting the Energy Performance of Buildings Directive (EPBD) [2] or the Green Deal[2)].

***NOTE** Further details on ESOS can be found here: https://www.gov.uk/government/consultations/energy-savings-opportunity-scheme.*

[2)] See the Government website for further information: https://www.gov.uk/green-deal-energy-saving-measures/overview.

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0 Introduction

0.1 Motivation behind the creation of PAS 51215

Article 8(4) of the European Union Energy Efficiency Directive (2012/27/EU) [1] requires all Member States to introduce a programme requiring large enterprises to conduct regular energy audits by appropriately qualified and/or accredited individuals.

Such individuals may be either in-house experts or external resources such as consultants and energy service providers. The UK Government's approach to implementing Article 8(4) of this Directive has been to set up the Energy Savings Opportunity Scheme (ESOS) which covers energy assessments.

These energy assessments could cover buildings or groups of buildings, industrial operations or installations, including transportation.

Within ESOS, those individuals deemed capable of conducting an energy efficiency assessment, leading an assessment team, and/or reviewing and approving the outcome of an organization-wide energy efficiency assessment, or series of energy efficiency assessments, are referred to as lead energy assessors.

NOTE 1 *Further information about the EU Energy Efficiency Directive (2012/27/EU) can be found at http://ec.europa.eu/energy/efficiency/eed/eed_en.htm.*

NOTE 2 *A "large enterprise" is also referred to as a "large business" or "large organization". A large enterprise is generally considered to be that which falls outside of the definition in European legislation for a Small or Medium Enterprise (SME), thus a large enterprise is a business having either over 250 employees, or both a turnover of above €50 million (approx. £42.5 million) and assets over €43 million (approx. £36.5 million). Further information regarding the definition of a large enterprise with relation to ESOS can be found on DECC's webpage, see [3] in the bibliography.*

In order to help large enterprises to comply with the Directive and the requirements of ESOS, the Department of Energy & Climate Change (DECC) has sponsored the BSI Standards Limited to develop a PAS.

PAS 51215 (the number for which is derived from the initial EU deadline for undertaking all energy audits, 5 December 2015), was developed through a consensus-driven, formal development process, with involvement from key stakeholders and a public consultation.

DECC's aim for PAS 51215 is to establish clear competencies for lead energy assessors. As with other specifications published by BSI, the requirements of the PAS are expressed in sentences using the word "shall". Information, guidance and recommendations are not requirements within the PAS. These are given in notes and commentary text, in the introduction and informative annexes (Annex A, Annex B and Annex C).

It is important to note that while the motivation behind the creation of PAS 51215 was to facilitate compliance with the Directive, and to create a specification that is applicable to lead energy assessors conducting ESOS compliant energy efficiency assessments, it is not exclusively tied to either the Directive or ESOS itself.

NOTE 3 *Further details on ESOS can be found at https://www.gov.uk/government/consultations/energy-savings-opportunity-scheme.*

0.2 Why conduct an energy efficiency assessment?

An energy efficiency assessment is one of the methods an organization can use to improve its energy performance, including its energy use, energy consumption and energy efficiency. An organization might wish to use an energy efficiency assessment for the following reasons, though it is important to note that this is not an exhaustive list.

a) To identify and evaluate opportunities for improvement arising from good housekeeping, procedural changes, behaviour changes, and requirements for additional monitoring techniques.

b) To evaluate the energy performance of a component (e.g. air compressor, boiler, steam trap, pump, fan, a component within a manufacturing plant, building or vehicle fleet) and to identify opportunities for improvement.

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c) To evaluate the energy performance of a system and to identify opportunities for improvement, e.g. through assessments on the generation plant, its distribution and end-use for a range of utilities, through assessment on a series of components making up a unit operation, or through assessments on all unit operations that makes up the whole building, manufacturing plant or vehicles and/or fleet.

d) To evaluate the technical feasibility and economic viability of specific opportunities for the reduction of energy consumption within the organization.

e) To identify and evaluate opportunities for the reduction of energy consumption arising from an organization's supply chain.

f) To verify the technical and financial suitability of a proposal prepared by an equipment manufacturer or service provider.

g) To assess and verify that all significant opportunities for improvement in energy efficiency have been identified and assessed.

0.3 Barriers to reducing energy use and energy consumption, and solutions

DECC's *Energy Efficiency Strategy 2012* [4] describes two of the most important barriers to reducing energy use and energy consumption, and to improving energy efficiency: lack of access to trusted information regarding energy efficiency, and underestimating the value that energy efficiency can bring to an organization.

Energy efficiency assessments conducted or overseen by a lead energy assessor can help overcome these barriers through providing access to trusted information and helping organizations understand the value of energy efficiency.

A harmonized approach to energy efficiency assessments can increase the visibility, transparency and comparability of an energy efficiency assessment and the quantified improvement opportunities, thus reducing uncertainties in organizational expectations, increasing confidence in the output from an energy efficiency assessment and reducing the risk to investment by organizations.

0.4 The lead energy assessor role and its responsibilities

The role of a lead energy assessor entails having the relevant competencies to carry out, lead and/or review and approve the outcome of an energy efficiency assessment.

This PAS defines the competence of a lead energy assessor through a combination of the following: professional conduct (**4.2**), core competencies (**4.3**), technical and non-technical knowledge and skills (**4.4**) and the management (including the knowledge and skills) of an assessment team (**4.5**).

The lead energy assessor might be appointed from a source external to the organization, or might be appointed from within the organization itself.

Planning is an important part of an energy efficiency assessment, and one that is integral to the role of a lead energy assessor. This could involve specifying and agreeing the scope, evaluation criteria and timeframes with the organization for which the energy efficiency assessment is being undertaken.

In addition, a lead energy assessor's responsibilities typically include:

a) assessing the scope of the energy efficiency assessment to:
   1) define the knowledge and skills needed;
   2) identify the need for additional assessment resource;
   3) discuss and agree with the organization the requirements for an assessment team;
   4) check that an assessment team is competent to carry out the relevant elements of the energy efficiency assessment assigned to them;
   5) develop and manage the programme of work;
   6) review and approve the outcome of energy efficiency assessment findings by the assessment team;

b) discussing and agreeing with the organization a chosen method for the energy efficiency assessment;

c) leading the activities and processes of an energy efficiency assessment;

d) signing off the energy efficiency assessment report, in order to confirm that the energy efficiency assessment:
   1) has been carried out in an independent manner by competent personnel;

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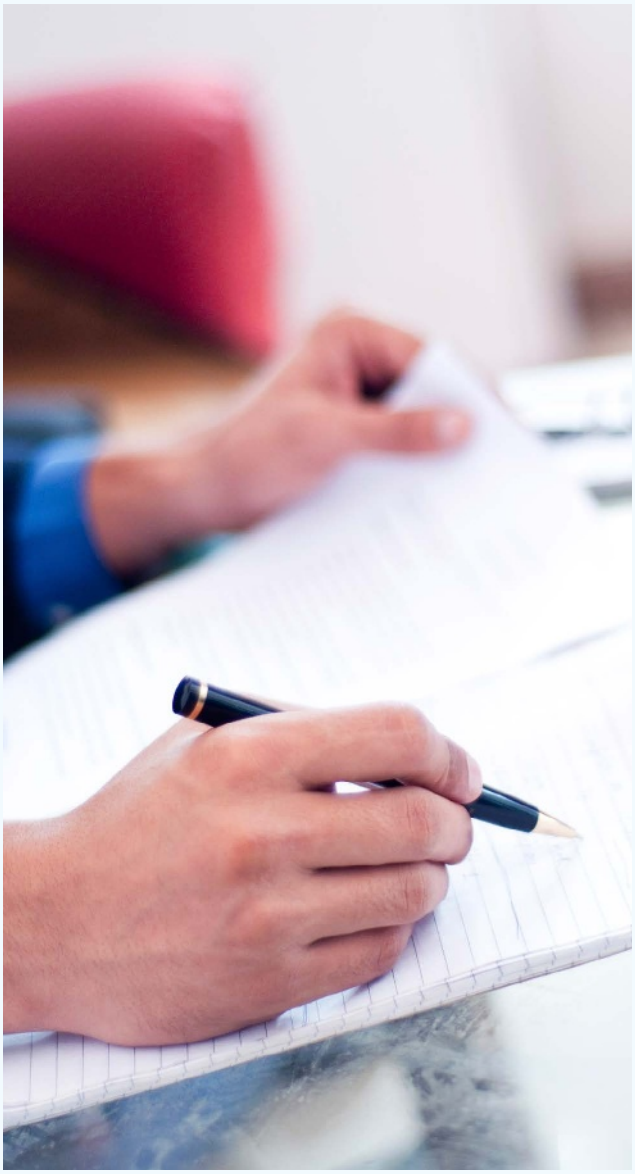
2) has been carried out using the method agreed (for example, this might be BS EN 16247-1, ISO 50002[3] or another methodology such as one developed within an organization);
3) covers the planned scope of the energy efficiency assessment;
4) is based on appropriately detailed calculations of the opportunities for improvement;
5) includes an energy efficiency assessment report that provides clear and concise information on the opportunities for improvement; and
6) meets any other criteria agreed with the organization;

e) being accountable for the findings, recommendations and content of the energy efficiency assessment report.



0.5 "Assessment" versus "audit" [4]

The differences between an audit and an assessment are subtle. It is a subject that causes much discussion within the energy efficiency industry, and is one on which most people will have a strong opinion.

Fundamentally, an assessment deals primarily with examining adherence to a set of concepts and principles, and evaluating the outcome through both quantitative and qualitative data. The focus tends to be on the output, rather than the route taken to get there.

On the other hand, the focus of an audit is primarily on procedures and processes that are to be followed, and is conducted through checking the adherence of people, equipment and activities to these procedures and processes. It is generally conducted through a series of controlled checks and balances. The dissection, analysis and evaluation of results is, in most cases, the secondary focus of an audit.

PAS 51215 deals with the competence of a lead energy assessor conducting energy efficiency assessments by approaching it through the method of an assessment; while the concepts and principles of lead energy assessor competences are prescribed in this specification, the processes and procedures themselves are not. That said, it is clear that a competent lead energy assessor needs to have a sufficient understanding of the processes and procedures for effective energy audits, particularly when overseeing an assessment team. It is for this reason that the informative annexes contain examples of ways in which the competences might be demonstrated.

[3] In preparation.

[4] Further discussion on the differences between assessment and audit can be found on the European Foundation for Quality Management website: http://www.efqm.org/blog/whats-the-difference-between-assessment-and-audit. [Available at the time of publication.]

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1 Scope

This PAS specifies requirements for the competencies necessary for a person to be deemed capable of conducting an energy efficiency assessment, leading an assessment team, and/or reviewing and approving the outcome of an organization-wide energy efficiency assessment, or series of energy efficiency assessments.

It is applicable to a lead energy assessor who might be working alone or leading an assessment team to complete an energy efficiency assessment. The energy efficiency assessments covered include those to be carried out on a building or group of buildings, industrial operations or installations and transport, which form a key part of an organization's energy consumption.

Annex A gives examples of ways in which core competencies might be demonstrated, Annex B gives considerations for determining the necessary knowledge and skills of an assessment team and Annex C gives examples of energy use. All annexes are for information and guidance and do not form part of the requirements for the PAS.

This PAS does not cover the processes involved in carrying out an energy efficiency assessment or for identifying the scope of an individual energy efficiency assessment.

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2 Normative references

There are no normative references.

3 Terms and definitions

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

3.1 assessment team

person, or team of people, having specific knowledge or expertise that is associated with an energy efficiency assessment

NOTE *The knowledge or expertise of an assessment team can relate to the technical issues related to buildings, processes, transport or other activities and non-technical issues such as behavioural and organizational barriers.*

3.2 competence

ability to carry out an energy efficiency assessment using knowledge, skills and experience

NOTE 1 *Adapted from CEN Guide 14, section B4 [5].*

NOTE 2 *While experience (see **3.8**) is obtained through the practical application of knowledge and skills, knowledge and skills can also be obtained through the non-practical application of carrying out energy efficiency assessments.*

3.3 energy efficiency

ratio or other quantitative relationship between an output of performance, service, goods or energy, and the respective input of energy

NOTE *Examples of energy efficiency include: conversion efficiency, energy required/energy used, output/input, theoretical energy used to operate/energy used to operate, actual energy consumption/benchmark energy consumption.*

[BS EN ISO 50001:2011, **3.8**, modified]

3.4 energy efficiency assessment

systematic analysis and evaluation of energy use, energy consumption and energy efficiency in order to identify, quantify and report on the opportunities for improved energy performance and potential energy savings

NOTE 1 *An energy efficiency assessment can be carried out using in-house expertise, using internal resource supervised by a third-party, or using third-party resource on behalf of the organization.*

NOTE 2 *An energy efficiency assessment does not preclude management practices outside of energy efficiency assessments.*

3.5 energy performance

measurable results related to energy efficiency (see **3.3**), energy use (see **3.7**) and energy consumption

[BS EN ISO 50001:2011, **3.12**, excluding notes which are specific to energy management]

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3.6 energy performance indicator

quantitative value or measure of energy performance

***NOTE** This could be expressed as a simple metric, ratio or a more complex model.*

[BS EN ISO 50001:2011, **3.13**, modified]

3.7 energy use

manner or kind of application of energy

***NOTE 1** Examples include ventilation, lighting, heating, cooling, transportation, processes, production lines.*

***NOTE 2** Energy can be in the form of electricity, fuel, steam, heat, compressed air or other similar media.*

[BS EN ISO 50001:2011, **3.18**]

3.8 experience

combination of knowledge (see **3.9**) and skill (**3.13**) obtained through a period of practical application of carrying out energy efficiency assessments

***NOTE** Adapted from CEN Guide 14, section B6 [5].*

3.9 knowledge

assimilation of facts, theories and practices with regard to carrying out an energy efficiency assessment

***NOTE** Adapted from CEN Guide 14, section B5 [5].*

3.10 lead energy assessor

person who is competent to lead and/or review and approve the outcome of an energy efficiency assessment

***NOTE** A lead energy assessor might also take part in an energy efficiency assessment.*

3.11 organization

company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration and that has the authority to control its energy use and consumption

[BS EN ISO 50001:2011, **3.22**]

3.12 scope

extent and/or boundary of activities, facilities and equipment that is the subject of an energy efficiency assessment

***NOTE** The scope of an energy efficiency assessment can include buildings, processes and transport.*

[BS EN ISO 50001:2011, **3.26**, modified]

3.13 skill

ability to apply knowledge in order to carry out an energy efficiency assessment

***NOTE** Adapted from CEN Guide 14, section B7 [5].*

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4 Competencies to lead an energy efficiency assessment

4.1 General

The lead energy assessor shall demonstrate competence to carry out an energy efficiency assessment, and/or lead an assessment team, and/or review and approve an energy efficiency assessment by providing evidence for the following areas:

a) professional conduct, in accordance with **4.2**;

b) core competencies required for an energy efficiency assessment, in accordance with **4.3**;

c) current and relevant technical and non-technical knowledge and skills, appropriate to the scope of an energy efficiency assessment, in accordance with **4.4**;

d) assessment team management, in accordance with **4.5**.

4.2 Professional conduct

Lead energy assessors shall provide evidence that they are able to conduct energy efficiency assessments in a professional and objective manner.

NOTE *Examples of desired personal behaviours can be found in BS EN ISO/IEC 17021:2011, Annex D. It is recommended that the lead energy assessor is assessed for, or asked to provide evidence of, these personal behaviours as an indication that they can comply with **4.2**. Evidence might also include references from previous clients or confirmations that the lead energy assessor has signed codes of conduct.*

4.3 Core competencies required for an energy efficiency assessment

Lead energy assessors shall provide evidence that they have experience of the core competencies involved in an energy efficiency assessment, which are summarized in the following list:

a) understanding the operational context of an organization being assessed;

b) familiarity with, and ability to apply, the requirements of energy efficiency assessment methods;

c) scoping an energy efficiency assessment, as applicable to the organization being assessed;

d) understanding, in detail, of energy use and energy systems applicable to the organization being assessed;

NOTE *Common examples of energy use are listed in Annex C.*

e) managing energy efficiency assessment teams and budgets;

f) understanding the techniques of measuring, sampling, sub-metering, and establishing an energy balance;

g) data interpretation, including analysis and scrutiny of energy use, energy consumption, and energy performance data;

h) identification, quantification, ranking and prioritization of opportunities for improvement;

i) managing working relationships;

j) preparing and presenting a technical and non-technical report for an energy efficiency assessment.

NOTE *See Annex A for examples of demonstrating core competencies required for an energy efficiency assessment. It is important to note that unlike the core competencies given in the main clauses of the PAS, the examples given in Annex A are only indications of ways in which the competencies might be demonstrated.*

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4.4 Technical and non-technical knowledge and skills

The lead energy assessor shall provide evidence that they have technical and non-technical knowledge and skills that correspond to those required to cover the scope of an energy efficiency assessment [see **4.3**c)].

Where a lead energy assessor is carrying out the whole energy efficiency assessment themselves, they shall provide evidence that they have all of the technical and non-technical knowledge and skills relevant to the organization being assessed and the energy efficiency assessment requirements.

Where a lead energy assessor does not have all of the required technical and non-technical knowledge and skills, or where they wish to delegate or outsource specific parts of an energy efficiency assessment, additional team members with the relevant technical and non-technical knowledge and skills shall be used. Where additional team members are required, the lead energy assessor shall comply with **4.5**.

NOTE *See Table B.1 and Table B.2 for examples of technical and non-technical knowledge and skills.*

4.5 Assessment team: management, knowledge and skills

Where the lead energy assessor does not have the necessary technical and non-technical knowledge and skills for specific energy uses or aspects of an energy efficiency assessment, or where they wish to delegate or outsource specific parts of an energy efficiency assessment to an assessment team, they shall provide evidence of their experience or knowledge of:

a) sourcing members of an assessment team with the relevant knowledge and skills;

b) assessing members of an assessment team as having the relevant knowledge and skills for the role assigned;

c) managing the assessment team during the course of the energy efficiency assessment;

d) reviewing the assessment team's work outputs for accuracy and completeness.

NOTE *It is not necessary for the lead energy assessor to be competent in all areas; however, they should have sufficient knowledge, skills and experience to effectively manage the work carried out by members of the assessment team. While technical expertise may take the form of an assessment team carrying out elements of an energy efficiency assessment, the overall competence of the team, as led by a lead energy assessor, should be sufficient to encompass the full scope of the energy efficiency assessment. Examples of knowledge and skills indicators of an assessment team are given in Annex B. Annex B is not a list of requirements.*

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5 Maintenance of lead energy assessor competence

5.1 General

The lead energy assessor shall provide evidence that their knowledge and skills are current at the time of undertaking an energy efficiency assessment.

NOTE *Continued professional development helps a lead energy assessor to maintain their knowledge and skills and to obtain an awareness of new developments. Additional private study, work experience, training, coaching, and attendance at conferences, meetings and seminars that is often included in continued professional development can also be used as evidence of current skills and knowledge.*

Continual professional development activities should include:

a) obtaining or refreshing knowledge of good practice within energy efficiency assessments;

b) obtaining or refreshing knowledge of legal, and other, requirements relevant to the organization being assessed.

5.2 Records

The lead energy assessor shall provide records of their relevant knowledge, skills, training and experience.

NOTE 1 *Such records may also include any other information deemed relevant, such as affiliations and professional status.*

NOTE 2 *Records should be kept up-to-date and the most recent records should be presented.*

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Annex A (informative)
Examples of demonstrating core competencies

Table A.1 gives examples of ways in which the core competencies required for an energy efficiency assessment might be demonstrated. It is important to note that while it is a requirement for a lead energy assessor to demonstrate all of the core competencies (see **4.3**), the following table only gives an indication of ways in which these might be shown.

Table A.1 – Core competencies required for an energy efficiency assessment

Number	Core competencies	Examples of competence
A1	Understanding operational context of the organization being assessed	• Reviewing potential issues and drivers that could affect the implementation of identified opportunities for improvement by the organization in the short-term or long-term, e.g. expansion plans, asset replacement plans, end of building lease, strategic and/or tactical measures taken by the organization. • Identifying legal requirements, guidelines, codes of practice and standards applicable to the scope of energy efficiency assessment(s) being undertaken and specific to the organization involved. Investigating how these affect the energy use, energy consumption and energy efficiency of the organization. • Reviewing opportunities for improvement identified during the course of an energy efficiency assessment in the light of all applicable legal requirements, guidelines, codes of practice and standards identified, to check that such opportunities for improvement do not prevent the organization's compliance.
A2	Familiarity with, and ability to apply, the requirements of energy efficiency assessment methods	• Applying energy efficiency assessment principles, processes and techniques chosen and agreed with the organization (for example, these might include BS EN 16247-1 or ISO 50002[5)]) so that the energy efficiency assessments are planned, conducted and reported in a consistent and systematic manner.
A3	Scoping an energy efficiency assessment, as applicable to the organization being assessed	• Defining the scope of the energy efficiency assessment to be undertaken, including an overview of the energy use in a building, a group of buildings, industrial operations or installations and transport, and communicating and agreeing the scope with the organization. ***NOTE*** *A lead energy assessor is generally expected to:* *a) understand how the scope of energy efficiency assessments can be developed;* *b) be able to justify, discuss and agree on the scope for energy efficiency assessments;* *c) understand the interactions and trade-offs between major energy users within an organization;* *d) be able to assess the implications/consequences of a change made on a type of energy use within the scope of energy efficiency assessments and their impact on other parts of the organization;* *e) be able to take a holistic (whole organization) approach to energy performance improvement.*

[5)] In preparation.

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Table A.1 – Core competencies required for an energy efficiency assessment *(continued)*

Number	Core competencies	Examples of competence
A4	Understanding, in detail, energy use and energy systems applicable to the organization being assessed	• Understanding the operating principles and common opportunities for improvements for those energy systems relevant to the scope of the energy efficiency assessment. • Applying the operating principles to analyse the applicable energy use and energy consumption relevant to the scope of an energy efficiency assessment. • Identifying, discussing and agreeing with the organization, the competencies required for the energy efficiency assessment. • Assessing and documenting the relevant competencies of the assessment team to meet the requirements of the energy efficiency assessment.
A5	Managing energy efficiency assessment teams and budgets	• Maintaining an overview of energy efficiency assessment activities, schedules and budgets. • Identifying the resources required for the planned energy efficiency assessment, including likely contingencies. • Organizing information and knowledge in a way that supports effective planning and flexibility in energy efficiency assessment plans that is consistent with the required outcomes. • Applying systems thinking to optimize the whole; balancing new ideas with tried and tested solutions; balancing risk with the desire to produce improvements. ***NOTE*** *Systems thinking is a method of analysis that focuses on the interrelation between all of the parts within a system, how they work over their lifetime and how they function as part of a larger system. Sometimes it is better to sacrifice optimizing a component within a system if, overall, a greater energy saving or benefit can be achieved.* • Taking corrective action to deal with deviations from planned resource use. • Developing and delegating roles and responsibilities to an assessment team. • Changing existing plans and schedules of energy efficiency assessment to take into account any sudden and unexpected organizational events.
A6	Understanding the techniques of measuring, sampling, sub-metering and establishing an energy balance	• Optimizing the use of energy data, and other relevant data the organization collects, including installed instruments, portable measuring devices and third-party data to obtain energy data for analysis. • Interpreting, identifying, and where necessary, challenging energy data, and other relevant data; identifying meter accuracy and repeatability issues that have an impact on the output of the energy efficiency assessment. • Defining the sample size, sampling period and sampling frequency for energy data, and other relevant data, required during an energy efficiency assessment so that the results are representative of the building, processes or transport operations. • Defining trials and/or laboratory analysis that might be required during an energy efficiency assessment. • Defining the applicability and limitations of the collected energy data, and other relevant data, during an energy efficiency assessment. • Interpreting energy data and relating it to observed operating conditions from the energy efficiency assessment. • Constructing appropriate energy balances for different energy types at appropriate levels, such as for whole organization, individual site or individual unit operation. ***NOTE*** *A lead energy assessor is generally expected to understand the principles of representative data collection and be able to use a combination of methods to collect energy data, and other relevant data and/or information.*

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Table A.1 – Core competencies required for an energy efficiency assessment *(continued)*

Number	Core competencies	Examples of competence
A7	Data interpretation, including analysis and scrutiny of energy use, energy consumption, and energy performance data	• Analysing energy use, energy consumption and energy efficiency. • Identifying trends, anomalies, and investigating the reasons for anomalies, where practicable. • Where appropriate and relevant, complementing the analysis with energy benchmark data. • Identifying and quantifying variables influencing energy consumption and energy efficiency. • Identifying and calculating energy performance indicators for the organization and/or the scope of the energy efficiency assessment. This could include data from external as well as internal sources, for example, the interpretation and scrutiny of energy billings and anomalies in such data sources. ***NOTE 1*** *A lead energy assessor is generally expected to:* *a) use trends to help analyse energy use, energy consumption and energy efficiency, identify anomalies and identify the root cause of those anomalies; and* *b) map energy use and energy consumption in consistent units of measurement.* ***NOTE 2*** *Energy performance indicators can be used by the organization to make decisions about their energy use, consumption and efficiency.* ***NOTE 3*** *The concept of energy balance may also be used to map energy use and energy consumption.*
A8	Identification, quantification, ranking and prioritization of opportunities for improvement	• Using collected energy data, and other relevant data, to understand energy use in order to identify opportunities for improvement. • Using the relevant technical and non-technical knowledge and skills to check any assumptions made, explain the energy data, and check the applicability of identified opportunities for improvement. ***NOTE*** *An indicative application of technical and non-technical skills and knowledge that might be required is described in Annex B. Annex B is not a list of requirements.* • Developing a concept and cost for the potential implementation of opportunities. ***NOTE 1*** *It is generally expected that other data that influences energy consumption such as production data or weather data, is used to support the analysis of energy use, consumption and efficiency.* ***NOTE 2*** *Opportunities for improvement might fall into the following categories:* *a) improving energy management practices;* *b) improving operational practices;* *c) improving maintenance practices;* *d) utilizing energy efficient behaviour change programmes;* *e) modifying, retrofitting and/or replacing products with energy efficient products.* ***NOTE 3*** *A lead energy assessor would generally be expected to:* *a) use logical and transparent calculation methods to derive energy performance and energy reductions from opportunities for improvement;* *b) be able to conceptualize how the identified opportunities for improvement can be constructed and/or implemented;* *c) be able to use the conceptualized design to develop the cost of implementation;* *d) be able to apply a range of financial appraisal methods such as simple pay back, net present value, rate of return and life cycle cost analysis;* *e) be able to propose the concept of how the improvement could be measured and verified after it has been implemented.*

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Table A.1 – Core competencies required for an energy efficiency assessment *(continued)*

Number	Core competencies	Examples of competence
A8	Identification, quantification, ranking and prioritization of opportunities for improvement	***NOTE 4*** *Where a range of opportunities are recommended for implementation, it is important to avoid the double counting of improvements.* ***NOTE 5*** *New and/or near market technological development might impact the energy efficiency opportunities. It is recommended that a lead energy assessor stays abreast of these developments.*
A9	Managing working relationships	• Working with the client/organization/other internal personnel to: a) identify the different groups in an organization that can have an effect on energy consumption; b) identify the diversity of expertise, knowledge, skills and attitudes required to achieve an improvement in energy performance; c) establish two-way communication with all of the identified groups of people in order to collect and verify information and energy efficiency ideas, and to engage the different groups to implement energy efficient behaviours. ***NOTE*** *A lead energy assessor is generally expected to:* *a) establish working relationships with the employees of the organization and the assessment team;* *b) consult the organization in relation to key decisions and activities and take account of their views, including their priorities, expectations and attitudes to potential risks;* *c) create an environment of trust, gain commitments and accountability from the organization and the assessment team;* *d) understand difficult situations and work demands from the organization and provide, where necessary, options to move things forward;* *e) identify and resolve conflicts of interest and disagreements with the organization in ways that minimize damage to work and activities, as well as to the individuals and organizations involved.*
A10	Preparation and presentation of a technical and non-technical report for an energy efficiency assessment	• Producing a technical and non-technical energy efficiency assessment report. • Producing a business case for improving energy performance. • Making presentations of energy efficiency assessment findings to both technical and non-technical staff in the organization being assessed. ***NOTE*** *A lead energy assessor would be expected to:* *a) be able to write in a concise and informative manner without the use of complex technical language;* *b) be able to present ideas for improvement without the use of technical jargon to a business and management-minded audience;* *c) be able to generate a business case for improving energy performance.*

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Annex B (informative) Considerations for determining the necessary knowledge and skills of an assessment team

The lead energy assessor should define, assess and document the technical and non-technical knowledge and skills required for an energy efficiency assessment. It is important for the lead energy assessor and/or their assessment team to have a range of technical and non-technical knowledge and skills appropriate to the agreed scope of the energy efficiency assessment. A range of technical and non-technical knowledge and skills for an assessment team are listed in Table B.1 and Table B.2.

It is important for the assessment team to have a range of technical and non-technical knowledge and skills which are complementary to, and that supplement, the lead energy assessor's needs. The assessment team can play a vital part in making sense of the observed energy usage and data (and any other relevant data collected), in specifying the appropriate skill set for the scope of the energy efficiency assessment, in identifying and quantifying the cost of implementing opportunities for improvement, and in presenting opportunities for improvement in a manner that is understood by the organization.

Once the lead energy assessor has agreed with the organization which method is to be used to carry out the energy efficiency assessment, and which activities and processes are to be included, it is important to define the scope in writing. The knowledge and skills required of the lead energy assessor, or of others within the assessment team, should also be defined in writing. At this point, any existing supporting information, including previously undertaken assessments or audits, should be identified. All activities and processes agreed with the organization should be carried out in a clear and transparent process (see Table B.1 and Table B.2).

In order to determine what the requirements are for an assessment team, the lead energy assessor should follow the investigative process outlined in a) to d).

a) Are there existing assessment reports or audit reports that fall within the scope of the energy efficiency assessment that can be used within it?
   1) If YES, include these as part of the overall report for the energy efficiency assessment.
   2) If NO, identify the resources required to cover the full scope of the energy efficiency assessment.

b) Does the lead energy assessor have all the necessary time, resources, knowledge and skills for the identified scope of the energy efficiency assessment with respect to the organization's processes and activities?
   1) If YES, no further assessment team members are required.
   2) If NO,
      i) clearly identify where the gaps are; and
      ii) select assessment team members with the relevant knowledge and skills; or
      iii) assess the knowledge and skills of any assessment team member proposed by the organization or other party.

      ***NOTE** When considering the necessary knowledge and skills, it is important to take into account factors such as: the type of technology required for the processes; the type of energy efficiency assessment required (infrastructure, transport, etc.); the scale and complexity of the operations; the business sector specific technologies or services; relevant legislation and codes of practice, plus any relevant existing standards.*

c) Does the potential assessment team member have the knowledge and skills for the relevant processes and activities needed within the scope of the energy efficiency assessment to supplement those of the lead energy assessor for some or all of the gaps identified?
   1) If YES, the knowledge and skills are adequate to supplement the lead energy assessors and no further assessment team members are required.
   2) If NO, repeat b) to fill all the relevant gaps as further assessment team members are required.

   ***NOTE** For all assessment team members identified, it is important that the lead energy assessor obtains adequate proof of competence.*

d) Finalize and confirm the members of the assessment team and obtain any relevant complementary existing supporting information; confirm this with the organization and any other relevant parties (e.g. an external auditing organization).

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Examples of technical knowledge and skills that might be relevant to energy efficiency assessments are given in Table B.1. It is important to note that it might not be necessary to be able to demonstrate all of the examples of knowledge and skills given in Table B.1.

The technical knowledge and skills descriptors are as follows:

- understanding, and application, of:
  - material and energy balance;
  - fluid flow;
  - heat transfer;
  - transport systems;
  - electrical systems;
- measuring, sampling, sub-metering and interpreting results;
- understanding the role of operating procedures and their impact on energy performance;
- conceptual design, technical and economic evaluation;
- project planning and deployment;
- understanding the importance of maintenance.

Examples of non-technical knowledge and skills that might be relevant to energy efficiency assessments are given in Table B.2.

The non-technical knowledge and skills descriptors are as follows:

- communicating the outcome of an energy efficiency assessment;
- training;
- stakeholder engagement;
- managing change;
- economic valuation of opportunities for improvement;
- generating a business case for implementing identified opportunities for improvement.

Table B.1 – Technical knowledge and skills

Number	Descriptor	Examples of knowledge and skills
B1-1	Understanding, and application, of material and energy balance	Knowledge of: • Material and energy balance as a quantitative basis for energy consumption and as an energy performance indicator within the scope. Ability to: • Use energy and other data to demonstrate a balance between material and energy efficiency and losses that fall within the scope of an energy efficiency assessment through energy inputs and energy outputs. ***NOTE 1*** *Depending on the scope, some energy uses might also be known collectively as utilities, facilities, building services, etc.* ***NOTE 2*** *The material and energy balance calculation could be completed based on first principles, with the aid of tables and charts, or computer simulation. Some examples of tables and charts are steam tables, and psychrometric charts.* • Use material and energy balance along with the related calculations of fluid flow, heat transfer, mass transfer and electricity consumption to quantify the identified opportunities for improvement. • Relate to, and communicate with, the organization using operating parameters that are familiar to the organization. ***NOTE*** *When assumptions are made during calculations, it is important to check that the assumptions are valid. Such assumptions should also be documented.* • Use material and energy balance to quantify the minimum, normal and maximum operating conditions to indicate and/or specify the measurement range for any additional metering and measurement devices. • Develop and calculate the energy performance indicators within the scope.

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Table B.1 – Technical knowledge and skills *(continued)*

Number	Descriptor	Examples of knowledge and skills
B1-2	Understanding, and application, of fluid flow	Knowledge of: • Fluid (air, gaseous and liquid) flow calculations, including pressure drop (hydraulic) calculations in the operations of energy use, and their applicability to particular situations affecting buildings, processes or transport. • Different types of pump, compressor and fan technologies (in particular the flow-pressure-power characteristics) and efficiencies. Ability to: • Calculate fluid flows and pressure drops in various configurations of equipment, machines, pipes, ducts, fittings, nozzles, and orifices. ***NOTE** The fluid flow calculation could be done based on first principles, with the aid of tables and charts, or recognized computer simulation. Some examples of tables and charts are pressure drop tables, pump curves and fan curves.* • Distinguish the difference between compressible and incompressible fluids, and use the corresponding fluid properties. • Use fluid flow calculations to assess and quantify opportunities for improvement in relation to fluid flow and/or pressure reduction and recognize their implications on energy use, in particular: a) recognizing applications requiring constant torque and/or variable torque and utilizing the correct method of calculation; b) calculating the conditions leading to pump and fan cavitations and using this information to determine the suitable flow and/or pressure reduction opportunities; c) where necessary, selecting and sizing control valves, taking into consideration the pressure drop and critical pressures of the fluid. • Select pumps, compressors and fans that are suitably sized to carry out their intended duties. • Specify the installation requirements for variable speed-driven pumps, compressors and fans.

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Table B.1 – Technical knowledge and skills *(continued)*

Number	Descriptor	Examples of knowledge and skills
B1-3	Understanding, and application, of heat transfer	Knowledge of: • The interrelationship between various mechanisms of heat transfer. • Heat transfer and thermodynamic calculations. • The different types of heat exchangers and their specifications. • The conditions in which heat exchangers need to be selected and knowledge of the operating conditions that could affect their effectiveness and performance (both highly important). ***NOTE*** *Depending on the application and organization, there are many naming conventions for heat exchangers. Some examples of their naming conventions are: shell and tube heat exchangers, plate heat exchangers, spiral heat exchangers, heat transfer coils, compact heat exchangers, boilers, condensers, evaporators, re-boilers, economizers, heat recovery units, biomass boilers and low pressure boilers.* • Insulation of pipes, fittings and surface calculations. Ability to: • Apply heat transfer, heat gains, heat loss and thermodynamic calculations when analysing energy use, energy consumption and energy efficiency. • Use energy data, and other relevant data, to calculate heating and/or cooling duties of heat exchangers, including boiling, evaporation, and condensation. • Identify heat exchanger performance issues, including corrosion, scaling, fouling, and microorganism deposits. Recommend options to clean the heat exchanger and options to minimize and/or eliminate corrosion, scaling, fouling, and microorganism deposits. • Identify and use heat transfer calculations to assess and quantify opportunities for improvement in relation to heat transfer areas, effectiveness and/or heat exchanger configuration and the implications on energy use. • Calculate heat loss and heat gains from surfaces (pipes, ducts, fittings, etc.) and calculate the minimum requirement for thermal insulation.

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Table B.1 – Technical knowledge and skills *(continued)*

Number	Descriptor	Examples of knowledge and skills
B1-4	Understanding, and application, of transport systems	Knowledge of: • Different modes and purposes of transport and their application. • Key parameters that determine the energy efficiencies of transport vehicles and transport networks. • Identification of legal requirements of operating transport fleets (e.g. freight, passenger obligations). • Fuel efficiency actions applicable to different modes of transport. • Interdependencies between fleet operations and energy performance indicators. Ability to: • Calculate fuel consumption from vehicles. • Assess fuel efficiency of transport operations. • Identify and quantify operational actions to improve fuel efficiency, in particular: a) monitoring fuel consumption; b) monitoring driver fuel performance; c) fuel efficiency driver training; d) routing and scheduling; e) tyre management; f) aerodynamic improvements; and g) reducing empty running. • Identify suitable energy performance indicators for the various modes of transport.
B1-5	Understanding, and application, of electrical systems	Knowledge of: • Power consumption calculations from voltage and amps readings. • Impact of load factors and power factors on electricity pricing and penalties. • Principles of voltage regulation or optimization and knowledge of their suitable applications. Ability to: • Calculate the power consumption from voltage and amp readings. • Identify electrical ratings for a common electricity user within the scope of energy efficiency assessments. • Identify and/or calculate electricity loads, load factors and diversity factors for electrically operated energy use. • Identify, assess and quantify opportunities for improvement arising from power factor, power quality and voltage reduction. • Judge the suitability of variable speed drive against resizing electric motors, while taking into consideration the change in power factor across a range of expected motor loads, efficiencies and motor losses. • Assess the viability of a recommendation for repairing and rewinding an existing motor against replacing it with new high efficiency motors. • Calculate heat generation from large uninterruptable power suppliers (UPSs) and large electrical installations.

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Table B.1 – Technical knowledge and skills *(continued)*

Number	Descriptor	Examples of knowledge and skills
B1-6	Measuring, sampling, sub-metering and interpreting results	Knowledge of: • Representative sampling of energy data, and other data, taking account of changes in operating conditions and energy performance in buildings, processes and transport. • Available measuring techniques for flow, pressure, temperature, pH, composition, electricity and other parameters, including how they can relate to energy consumption. • The installation requirements of different fixed and portable measuring devices, their advantages and disadvantages, and associated implications for accuracy and the repeatability of measurements. • The dangers of using average readings and how to determine the need to use average values, a range of values and representative sampling in calculations. • The range of errors and uncertainty in measurements and the risks and benefits to using average readings. Ability to: • Optimize the use of energy data, and other data the organization collects, installed instruments and portable measuring devices to obtain energy data for analysis. • Interpret, identify, and where necessary, troubleshoot energy data, and other relevant data, to identify meter accuracy and repeatability issues that have an impact on the output of the energy efficiency assessment. • Define the sample size, sampling period and sampling frequency for energy data, and other data required during an energy efficiency assessment, so that the results are representative of the building, process or transport operations. • Define the types of designs of experiments, trials and/or laboratory analysis that might be required during an energy efficiency assessment. • Define the applicability and limitations of the collected energy data (and any other applicable data) during an energy efficiency assessment. • Interpret energy data and relate the data to operating conditions observed from the energy efficiency assessment.

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Table B.1 – Technical knowledge and skills *(continued)*

Number	Descriptor	Examples of knowledge and skills
B1-7	Understanding the role of operating procedures and their impact on energy performance	Knowledge of: • Operating procedures and schedules and their impact on energy use and consumption variances. ***NOTE*** *Most energy use does not operate continuously and consistently on a 24-hour basis, but might differ at different periods of time, such as at start-up, standby/idle time, operations, maintenance, and when shut down.* • Impact on energy use, consumption and efficiency of daily and seasonal variations, internal and external climate and environmental conditions. Ability to: • Understand the current procedural and human-machine interface requirements during start-up, standby/idle time, operations, maintenance and shut down within the scope from the perspectives of energy consumption and energy performance. ***NOTE*** *Some examples of human-machine interfaces are distributed control systems, building management systems, utility monitoring systems and process control systems.* • Compare procedural requirements with actual operational methods. • Understand automated control systems such as human-machine interfaces, distributed control systems, building management systems, utility monitoring systems and process control systems. • Analyse and interpret energy data, and other relevant data, collected over different operating modes. • Identify, assess and quantify opportunities for improvement involving different modes of energy use operations. • Review and propose modifications to operating and maintenance procedures to reflect requirements for improved energy performance. These might include procedural changes, scheduling changes and behavioural changes.

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Table B.1 – Technical knowledge and skills *(continued)*

Number	Descriptor	Examples of knowledge and skills
B1-8	Conceptual design, technical and economic evaluation	Knowledge of: • Utilizing concept designs and technical and economic evaluations as a basis to develop implementation cost. • Ranking and prioritizing opportunities for improvement. • Necessary steps to implement opportunities for improvement. • Cost implications for different levels of cost and energy performance improvement estimates/calculations on the economic viability of opportunities. • Methods to assess financial viability of projects. Ability to: • Specify opportunities for improvement into implementable projects within the scope. This might include: a) producing the basis of designs, design duty information and/or detailed specifications for plant or building modifications, retrofits and new builds; b) developing the steps necessary to construct, install, test and commission proposed opportunities for improvement and using them as a basis to develop project costs; c) establishing and quantifying costs and benefits arising from implementing the opportunities for improvement within the scope of the energy efficiency assessment and the organization as a whole; and d) specifying any additional energy data, and other relevant data, from energy users and/or trials that might be required to fully assess the identified opportunities for improvement. • Assess the technical feasibilities and economic viabilities of proposed opportunities for improvement. ***NOTE 1*** *The assessment team should take into consideration the organization's preferred method of financial analysis and planned lifetime of the opportunity for improvement.* ***NOTE 2*** *The assessment team is generally expected to articulate the different levels of calculations/estimates and the steps necessary to improve and/or finalize the opportunities for improvement and their costs.*

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Table B.1 – Technical knowledge and skills *(continued)*

Number	Descriptor	Examples of knowledge and skills
B1-9	Project planning and deployment	Knowledge of: • The different stages of project implementation and the different parties involved in delivering a project. • The principles of project management, including project controls, project planning, budget controls, and management of work flow to successfully complete a project. ***NOTE*** *An assessment team that is competent in project planning and implementation is able to develop an implementation plan that is thorough yet realistic. A thorough, realistic implementation plan increases the accuracy of estimated project costs.* Ability to: • Identify the key stakeholders for opportunities for improvement and identify the type of information they need. • Develop objectives of the project and develop an implementation plan. • Implement processes to manage potential risks arising from the project and account for contingencies. • Analyse received information to identify facts, patterns and trends that might impact on key decisions. • Identify and evaluate a range of options. • Track, take corrective and preventive action to remedy inadequate, unreliable, contradictory or ambiguous information uncovered during a project. • Monitor and control the project. • Evaluate the success of the project.
B1-10	Understanding the importance of maintenance	Knowledge of: • Initial inspection techniques to identify asset integrity and reliability issues using the basic senses (e.g. sight, hearing, smell and touch). • Impact of machinery reliability in relation to energy consumption and energy efficiency, in particular, unplanned down time, idle time, and energy losses. ***NOTE 1*** *An assessment team that is competent in this area is able to identify opportunities for improvement that might arise from maintenance issues or asset integrity issues.* ***NOTE 2*** *Some examples of maintenance issues are poor alignment, poor quality components and parts or poor execution of maintenance activities.* Ability to: • Measure, maintain and improve the reliability of energy use through engineering, technical and procedural methods. • Identify maintenance issues using basic skills (noisy drives, unusual vibration, etc.). • Inform and discuss problems with the organization's maintenance personnel. • Evaluate and maintain asset integrity by checking that it is fit for purpose, managing asset lifecycle and establishing a programme for safe operations or maintenance. • Use a combination of technical and non-technical knowledge and skills to design out routine failures and/or causes of failures.

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Table B.2 – Non-technical knowledge and skills

Number	Descriptor	Examples of knowledge and skills
B2-1	Communicating the outcome of an energy efficiency assessment	Knowledge of: • Main configurations of energy use and how to decipher the layout of diagrams and control loops. • Graphic and data representation techniques. ***NOTE*** *Examples include box diagrams, flow diagrams, line schematics, process diagrams and piping and instrumentation diagrams (P&ID).* Ability to: • Develop reports using terminologies that are understandable by technical and non-technical stakeholders. • Deliver presentations to a wide variety of audiences. • Identify, engage with, and respond to, a range of stakeholders ***NOTE*** *Examples of audiences and stakeholders may range from the board of directors, site directors/managers, sales and marketing department, operations department, engineering department, finance department, environment/ sustainability department, technicians, operators, and administrative employees.* • Interpret and understand any existing diagrams for energy use within the scope. • Where relevant to the scope, prepare diagrams for the proposed opportunities for improvement. ***NOTE*** *Such diagrams may include relationships with other parts of the buildings, processes, transport networks or the organization.* • Define the scope of energy efficiency assessments based on flow and instrumentation diagrams. • Use existing diagrams to identify and request appropriate energy data, and other data that the organization collects, pertaining to the scope. • Draw a visual representation of the identified opportunity for improvement. • Understand and prepare diagrams to convey opportunities for improvement.
B2-2	Training	Knowledge of: • The importance of training in instilling energy efficient behaviours, applying corrective and preventive actions, applying changes in procedures and in communicating changes arising from implementing opportunities for improvement. Ability to: • Identify potential learning opportunities as appropriate to the scope of an energy efficiency assessment.

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Table B.2 – Non-technical knowledge and skills *(continued)*

Number	Descriptor	Examples of knowledge and skills
B2-3	Stakeholder engagement	Knowledge of: • Managing people (this is one of the most important skills in managing energy use, consumption and efficiency). Skills involved in managing people might include: a) facilitating; b) developing teams; c) engaging in energy efficient behaviours in a workplace; d) demonstrating good practice from pilot trials and/or case studies from other organizations. ***NOTE*** *It might be beneficial for the assessment team to inspire and empower employees to innovate. This can also encourage new ideas for energy performance improvement.* Ability to: • Communicate with the relevant stakeholders during an energy efficiency assessment to identify opportunities for improvement, including opportunities arising from ways of working, scheduling, and existing issues (e.g. maintenance, simple improvements). • Communicate with the relevant stakeholders during an energy efficiency assessment to: a) identify their motivations for (or against) implementing specific opportunities for improvement; and b) uncover any inter-departmental conflicts that could have an impact on energy performance and behavioural issues. • Communicate recommendations for disarming the motivational and behavioural barriers to improvement. • Communicate the outcomes of an energy efficiency assessment to senior management and/or the relevant stakeholders within the organization. ***NOTE*** *An assessment team that is competent in this area needs to:* *a) communicate in a clear manner that is tailored to the relevant audience (i.e. the organization's employees);* *b) have a willingness to listen;* *c) disseminate relevant energy performance information at the right level in a timely manner that facilitates the resolution of problems.*

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Table B.2 – Non-technical knowledge and skills *(continued)*

Number	Descriptor	Examples of knowledge and skills
B2-4	Managing change	Knowledge of: • Managing change in organizations. ***NOTE*** *An assessment team that is competent in planning and implementing change with regard to the energy use of an organization is essential for delivering targeted behavioural change. This might entail the following:* *a) communicating a vision of the future, reasons for change and any associated benefits, roles and responsibilities of those involved in implementing changes;* *b) obtaining the necessary influence and resources; and* *c) assessing and designing change programmes that are effective and that meet the requirements of the organization.* Ability to: • Identify potential barriers to implementing change and opportunities to overcome these. • Carry out staff engagement energy surveys, interpret the results and propose an energy behaviour change programme.
B2-5	Economic valuation of opportunities for improvement	Knowledge of: • Time value of money (i.e. the present value of a coin is more than the value of that same coin in the future). • How an organization raises capital and finance, including balance sheet financing, and cash flow financing. • Models for evaluating financial feasibility of opportunities (e.g. simple pay back, discounted cash flow, lifecycle cost analysis). • Impact of corporation tax, tax reliefs and depreciation on opportunities for improvement. Ability to: • Incorporate various finance and accounting concepts to develop project finance analysis. • Put a value to non-energy improvements associated with an opportunity for improvement (e.g. reduction in water, waste and maintenance, improving quality, yield and conditions for work). • Articulate non-monetary benefits from the proposed opportunities for improvements. • Identify areas of cost uncertainties and take these into account via cost escalations and contingencies in the financial evaluation. • Compare the opportunity cost for identified opportunities for improvement and develop the portfolio for implementation, taking into account short- and long-term capital requirements. • Relate valuations for opportunities for improvement to the organization's business model and strategic plans.
B2-6	Generating a business case for implementing identified opportunities for improvement	Ability to: • Develop business case/proposals for implementing the recommended opportunities for improvement, building on the data and insights gained from the energy efficiency assessment, and technical and non-technical knowledge and skills. • Develop a draft action plan/implementation plan for discussion. • Present the outcome of the energy efficiency assessment, business case or proposal to senior management in a manner that could facilitate decision making.

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Annex C (informative) Examples of energy use

There are many energy uses in buildings, industrial processes and in transport systems.

Some examples of energy use associated with buildings are:

- space heating;
- refrigeration for space cooling;
- hot water;
- fans for ventilation;
- pumps;
- controls;
- humidification and de-humidification;
- lighting (internal);
- lighting (external);
- small power equipment;
- ICT equipment (servers, etc.);
- vertical transport;
- cooking (including bakery ovens);
- catering – distributed (vending machines, etc.);
- refrigeration for cold storage (e.g. food);
- entertainment equipment;
- laundry;
- medical equipment;
- laboratory equipment;
- swimming pool.

Some examples of energy use associated to industrial processes are:

- humidification and dehumidification processes;
- boiling, evaporation and condensation processes;
- chilled water/chilled glycol systems;
- compressed air systems;
- furnaces;
- blast chilling and freezing processes;
- conveyor and material handling systems;
- cooling systems (dry, wet, and evaporative);
- distillation, absorption, adsorption and separation processes;
- hot water systems;
- drying processes;
- fan systems;
- furnace and combustion systems;
- heat exchange networks;
- heating systems (low pressure, medium pressure and high pressure);
- industrial gases;
- insulation;
- mixing systems;
- motors and drive systems;
- power generation and distribution;
- pumps and hydraulic systems;
- refrigeration systems;
- steam and condensate systems;
- vacuum systems;
- water and waste water treatment;
- human interface and control systems for energy use.

Transport energy uses are typically split between transport modes. Three examples are:

- freight vehicles;
- passenger transport; and
- grey fleet.

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ISBN 978-0-580-84377-8