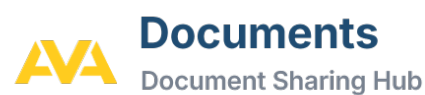


Australian/New Zealand Standard™

Energy audits

Part 3: Transport related activities



AS/NZS 3598.3:2014

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Australian/New Zealand Standard™

Energy audits

Part 3: Transport related activities

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EN-001, Energy Auditing, to supersede, in part, AS/NZS 3598:2000, *Energy audits*.

Energy audits are an integral part of the energy management process. They determine how efficiently energy is being consumed, identify energy and cost saving opportunities and can highlight potential process and productivity improvements. Implementing energy audit recommendations usually achieves significant cost savings.

This Standard will assist organizations to decide on the appropriate type of audit for their fleets, provide a guide when commissioning energy audits and present a uniform basis for preparing and comparing fleet energy audit proposals. It also aims to establish best practice for energy auditors, support the establishment of energy management systems and contribute to the quality of existing energy and other management systems.

This Standard covers the general requirements for energy audits in the transport sector. Requirements for other types of operation are provided in the following Standards:

- (a) AS/NZS 3598.1, *Energy audits*, Part 1: *Commercial buildings*.
- (b) AS/NZS 3598.2, *Energy audits*, Part 2: *Industrial and related activities*.

In the preparation of this Standard reference was made to the following:

- (i) ISO 50002, *Energy audits—Requirements with guidance for use*.
- (ii) ISO 50015, *Energy management systems—Measurement and verification of energy performance of organizations—General principles and guidance*.

Acknowledgement is made of the assistance received therefrom.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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FOREWORD

Energy audits are investigations of energy use for a defined audit object, such as a trucking fleet, railway network or an airline fleet. They enable the identification of energy use and costs, from which energy cost and consumption control measures can be implemented and reviewed. An energy audit is an important step for an organization, regardless of its size, type or area of operation. Organizations may commission energy audits to improve their energy performance, reduce energy consumption and achieve financial and environmental benefits.

An energy audit is best undertaken within the context of an energy management system that complies with an appropriate industry Standard, such as ISO 50001, *Energy management systems—Requirements with guidance for use*.

This Standard defines the attributes of an energy audit that is appropriate for a transport system, to enable the organization commissioning the audit, and the energy auditor selected to conduct the audit, to reach a common understanding of the audit's scope, process and deliverables. It states the minimum requirements for energy audits and corresponding obligations within the energy auditing process necessary for compliance with the Standard.

This Standard recognizes that there are differences in approach to energy auditing of transport fleets in terms of scope, boundary and objective, but seeks to harmonize common aspects of energy auditing in order to bring more clarity and transparency to the market for energy auditing services for transport systems.

This Standard does not address the requirements for auditing an organization's energy management system, which are covered by ISO 50003*, *Energy management systems—Requirements for bodies providing audit and certification of energy management systems*.

* To be published.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard **Energy audits**

Part 3: Transport related activities

1 SCOPE

This Standard sets out minimum requirements for commissioning and conducting three prescribed types of transport system energy audits that identify opportunities for cost effective investments to improve energy performance. It covers all forms of energy used in all transport fleets.

Requirements for each specified type of audit are designed to meet the organization's business needs and provide sufficient analytical rigour to provide a degree of confidence in the results that is appropriate to meet these transport business needs. The energy audit process is presented as a simple chronological sequence, but this does not preclude repeated iterations of certain steps.

This Standard outlines requirements for transport system energy audits.

This Standard applies both to organizations for which transport is the core activity, and to organizations for which transport is a support activity to other operations, such as mining or construction. Organizations may apply this Standard to on-site operations, such as off-road mine haulage, as well as transport operations using public transport infrastructure.

This Standard also applies to all modes of transport, as well as the different ranges (from local to long distance) and what is transported (i.e. freight and people). The Standard advises on the optimization of energy in single mode or multi-modal transport fleets.

Fixed on-site materials handling systems such as conveyors are not covered by this Standard. These are covered by AS/NZS 3598.2. Warehousing and distribution centre operations, including refrigeration systems, are covered in AS/NZS 3598.1.

Clauses 6 to 12 of this Standard establish the procedures for energy auditing in transportation systems, focusing on aspects that are common to every transport mode. In order to state the energy auditing features of particular transport modes, there is specific guidance for each of them at Appendix E, Paragraph E7.

2 OBJECTIVES

The objectives of this Standard are to—

- (a) provide a specification for organizations when commissioning energy audits for transport fleets to identify opportunities for cost effective investments to improve energy performance;
- (b) provide a framework for the evaluation of fleet data, energy management systems and operational procedures as a precursor to a detailed energy audit to quantify opportunities;
- (c) assist organizations to decide what type of audit is appropriate for their needs;
- (d) provide auditors with a uniform basis for preparing and comparing energy audit proposals for different fleets;
- (e) establish best practice for energy auditors to provide effective and professional service to transport fleet operators;

- (f) place the energy audit in the context of an energy management system by specifying pre- and post-audit activities for the organization, and suitable reporting requirements; and
- (g) complement existing energy, business and quality management systems, such as ISO 50001, AS/NZS ISO 14001 and AS/NZS ISO 9001.

3 APPLICATION

This Standard is intended for use by any organization that operates transport fleets of all types and anyone involved in the assessment of energy use and identification of opportunities to improve the management of energy in the fleet or within the organization. Organizations and auditors may use this Standard when defining the scope of an energy audit.

This Standard may be applied to transport fleets throughout Australia and New Zealand.

The Standard may serve as a reference document for anyone interested in effective energy management for transport fleets. This Standard has been developed to complement ISO 50001 and to be consistent with ISO 50002*.

4 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

NOTE: Documents for informative purposes are listed in the bibliography.

AS

4121 Code of ethics and procedures for the selection of consultants

AS/NZS

3598.1 Energy audits, Part 1: Commercial buildings

3598.2 Energy audits, Part 2: Industrial and related activities

AS/NZS ISO

9001 Quality management systems—Requirements

14001 Environmental management systems—Requirements with guidance for use

ISO

19011 Guidelines for auditing management systems

50001 Energy management systems—Requirements with guidance for use

50002 Energy audits—Requirements with guidance for use

50003* Energy management systems—Requirements for bodies providing audit and certification of energy management systems

50004* Energy management systems—Guidance for the implementation, maintenance and improvement of an energy management system

50006* Energy management systems—Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI)—General principles and guidance

50015 Energy management systems—Measurement and verification of organizations—General principles and guidance

International Maritime Organization (2012), *Guidelines For the Development of a Ship Energy Efficiency Management Plan (SEEMP)*, MEPC 63/23

UIC/UNIFE, TEC REC 100 001, *Specification and verification of energy consumption for railway rolling stock*, 2010 (download on: <http://www.tecrec-rail.org>)

* To be published.

5 DEFINITIONS

For the purpose of this Standard the definitions below apply:

5.1 Accuracy

The level of accuracy of energy savings and financial costs and benefits from energy performance improvement actions. Three levels are classified as follows:

- (a) *Broad estimates* Energy savings and capital costs estimated based on fleet-level energy data and information from similar projects previously implemented or based on simple engineering calculations/estimations to a lower degree of accuracy. These are generally based on rules of thumb without any preliminary design work. Suitable for smaller projects with short paybacks and low risks.
- (b) *Medium accuracy* Energy savings quantified using fleet and energy analysis as described for the Type 2 audit, including consideration of segment-specific data, duty cycles and other relevant context, with consideration of the detailed energy balance. Capital costs estimated based on a summation of major cost items based on the duty cycles and equipment or vehicles necessary to implement the energy savings measure.
- (c) *Higher accuracy* Energy savings quantified using fleet segment and energy analysis as described for the Type 3 audit, including consideration of segment-specific data, operations and other relevant context, with consideration of the detailed energy balance developed using the additional monitoring data. Capital costs estimated from contractor quotes and/or detailed cost estimates based on specific vehicle selections and schematic designs. Alternatively the level of accuracy required by the company's capex or opex process may be applied.

5.2 Audited object

Subject of the energy audit which may include transport systems, fleets, fleet segments and vehicles.

[Source: ISO 50002, with site(s), building(s), equipment, system(s), process(es), 'or services' omitted and 'fleet segments and vehicles' added.]

5.3 Benchmarking

The use of energy performance indicators (EnPIs) and other suitable data to compare the energy consumption and/or intensity of a vehicle or fleet under review with similar sized vehicles or fleets performing the same function and, thus, establishing whether energy consumption is in the typical range or comparatively efficient.

NOTES:

- 1 Better energy performance relative to other systems does not imply best practice.
- 2 Refer to Appendix E for additional guidance.

5.4 Boundary

Physical or site limits and/or organizational limits as defined by the organization.

NOTE: The boundary of energy audit could be different to the boundary of an energy management system.

Example: Long haul fleet, local delivery, bus fleet or passenger flight category.

[Source: ISO 50004*, example added]

* To be published.

5.5 Duty cycle

Operating cycle of a transport segment or vehicle, describing the different types of work performed, which will vary considerably depending on the following:

- (a) Trip distances, weights carried, average speeds, stopping frequency, route gradients, braking and cornering frequency, and drag coefficients.
- (b) The proportion of time that the vehicle operates in each mode (such as idling, cruising, braking, take-off or landing).

The cycle reflects the type of work the vehicle does and is independent of vehicle configuration. Operating cycles are typically one of the primary determinants of fuel consumption.

NOTES:

- 1 May also be applied to a fleet or to vehicle systems such as engines, turbines or air conditioning systems.
- 2 Different fleet segments may be described as having a particular duty cycle.
- 3 Refer to the Table E3 in Appendix E, for examples in a road transport context. Similar distinctions could be made for aircraft, trains and vessels.

5.6 Energy

Electricity, fuels, steam, heat, compressed air, and other like media.

NOTES:

- 1 For the purposes of this Standard, energy refers to the various forms of energy, including renewable, which can be extracted, purchased, stored, treated, used in equipment or in a process, or recovered.
- 2 Typical energy sources in transport include diesel fuel, aviation fuels, bunker fuel, petrol, biofuels and electricity.

[Source: ISO 50001, with changes to Note 1 and new Note 2.]

5.7 Energy audit

Systematic analysis of energy use and energy consumption of audited objects, in order to assess current energy use and identify, quantify and report on the opportunities for improved energy performance.

NOTE: The terms 'energy audit' and 'energy assessment' are often used interchangeably.

5.8 Energy auditor

Individual, group of people or body conducting an energy audit.

NOTE: A group or body can include subcontractors.

[Source: ISO 50004*]

5.9 Energy balance

A systematic accounting for energy flows and transformations in a system, covering all energy sources either instantaneously or over defined a period of time. This enables energy recovery options to be quantified.

NOTES:

- 1 Vehicle energy balances may account for the energy consumed by resistances (such as aerodynamic and rolling resistance), propulsion systems and ancillaries, generally on an instantaneous basis.
- 2 An energy balance may be represented by a Sankey diagram.

* To be published.

5.10 Energy baseline

Quantitative reference(s) providing a basis for comparison of energy performance.

NOTES:

- 1 An energy baseline reflects a specified period of time.
- 2 An energy baseline can be normalized using variables which affect energy use and/or consumption, e.g. tonnes shipped, equivalent flat haul, distance travelled, passenger kilometres, etc.
- 3 The energy baseline is also used for calculation of energy savings, as a reference before and after implementation of energy performance improvement actions.

[Source: ISO 50001, with changes to Note 2]

5.11 Energy consumption

Quantity of energy applied.

[Source: ISO 50001]

5.12 Energy efficiency

Ratio or other quantitative relationship between an output of performance, service, goods or energy, and an input of energy (e.g. conversion efficiency; energy required/energy used; output/input; theoretical energy used to operate/energy used to operate).

NOTES:

- 1 Both input and output need to be clearly specified in quantity and quality, and be measurable.
- 2 Vehicle fleet efficiency is typically denoted by energy intensity measures, such as litres of diesel per tonne kilometre.
- 3 For vehicles, conversion efficiency will typically only be relevant on an instantaneous basis.

[Source: ISO 50001, Notes 2 and 3 added]

5.13 Energy end use breakdown

An account of fuel or other energy inputs showing how much of an energy source is consumed by or allocated to each end use, such as vehicle class, duty (moving freight or passengers) or activity (moving, idling, rolling resistance, wind resistance), over a defined period of time.

NOTES:

- 1 An energy end-use breakdown is not an energy balance.
- 2 Each energy source is normally accounted for separately.
- 3 Fleet energy end use breakdowns might account for energy consumption by fleet segment or vehicle type.
- 4 Vehicle energy end use breakdowns may account for the energy consumed by resistances (such as aerodynamic and rolling resistance), propulsion systems and ancillaries, generally on a longer term basis using averaged data.

5.14 Energy intensity

Ratio of energy consumption to a measure of the activity carried out by an entity, e.g. production levels, total floor space, number of employees, financial turnover etc.

NOTES:

- 1 Energy consumption related to production levels is also referred to as 'specific consumption'.
- 2 Examples include litres per kilometre, litres per tonne kilometre, litres per passenger kilometre.

[Source: ISO 50004*, Note 2 added]

* To be published.

5.15 Energy management system (EnMS)

Set of interrelated or interacting elements to establish an energy policy and energy objectives, and processes and procedures to achieve those objectives.

[Source: ISO 50001]

5.16 Energy monitoring

The regular recording and review of energy consumption and cost, and the principal variables that could affect these, such as distance travelled, load and vehicle tare, vehicle operating procedures and velocity.

5.17 Energy performance

Measurable results related to energy efficiency, energy use and energy consumption.

NOTES:

- 1 In the context of energy management systems, results can be measured against the organization's energy policy, objectives, targets and other energy performance requirements.
- 2 Energy performance is one component of the performance of the energy management system.
- 3 For transport systems energy efficiency will typically be denoted by energy intensity measures, or conversion efficiency on an instantaneous basis.

[Source: ISO 50001, Note 3 added]

5.18 Energy performance indicator (EnPI)

Quantitative value or measure of energy performance, as defined by the organization.

NOTES:

- 1 This could be expressed as a simple metric, ratio or a more complex model.
- 2 Effective energy intensity measures should enable comparison between different divisions, fleet segments or vehicle types and performance trends over time.

[Source: ISO 50001, with changes to Note 2]

5.19 Energy savings

The direct energy and energy cost savings arising from energy performance improvement actions, including greenhouse gas emissions savings and costs where applicable.

5.20 Energy use

Manner or kind of application of energy (e.g. ventilation, lighting, heating, cooling, transportation, processes, production lines).

NOTE: Energy end-use application is an alternative term in some cases.

[Source: ISO 50001, Note added]

5.21 Fleet

Group of vehicles.

5.22 Non-energy savings

The financial value of indirect benefits such as maintenance savings, improved productivity or quality, etc. arising from energy performance improvement actions.

5.23 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.

NOTE: An organization can be a person or a group of people.

[Source: ISO 50002]

5.24 Relevant variable

Quantifiable parameter impacting energy consumption.

NOTE: Also known as adjustment factors (e.g. vehicle weight, tyre pressure, engine tuning, average velocity etc.).

[Source: ISO 50002]

5.25 Segment

Group of vehicles performing the same type of transport, i.e. subset of a fleet having a certain common feature.

NOTE: The criteria for segment definition depend on the kind of transport the audited organization performs and the kind of vehicles used. An example might be differentiating the vehicles performing local distribution as opposed to long distance shipment in two different segments.

5.26 Transport

Activity that implies the movement of people or goods from one place to another.

5.27 Transport service

Service provided to a beneficiary for the transport of a cargo or people from a departure point to a destination point.

5.28 Vehicle

Mobile object used to perform transport tasks.

Example: Truck, train, aircraft, ship or automobile.

5.29 Vehicle operator

Person that governs the vehicles with his/her own hands, (e.g. driver, captain, pilot).

NOTE: This includes remote operation or control of the vehicle.

6 SPECIFIC CONSIDERATIONS FOR TRANSPORT FLEETS

6.1 Factors affecting efficiency

Transport operations have characteristics that produce variability in energy performance and make fleet energy consumption difficult to model. There is often very high variation in routes, loading and traffic conditions. The influence of the vehicle operator on performance is very high relative to the influence of operators of industrial process equipment. Furthermore, transport operations may be constrained by regulations, such as noise or load limits on particular routes. In some cases, the possibility of selecting or changing the mode of transport is also a specific aspect of the transport activity.

While the day-to-day energy consumption of a business is driven largely by the efficiency of equipment and vehicle operator performance, at a strategic level there are also other factors that may increase or reduce energy consumption. These include the following:

- (a) Organizational targets for emissions reductions, etc.
- (b) How energy consumption measurement and monitoring systems data are used.
- (c) The choice of transport mode.
- (d) Vehicle utilization.
- (e) Vehicle loading and scheduling.
- (f) Customer needs, such as just-in-time delivery.
- (g) Contractual requirements.
- (h) Maintenance or repair requirements.

- (i) Variability in duty cycles.
- (j) Company policy on alternative fuels.
- (k) Regulatory and physical infrastructure.
- (l) Infrastructural and environmental conditions (topography, road surfaces, traffic, rail condition, etc.).

In many transport operations it is also difficult to quantify energy performance—or even select appropriate energy performance indicators—because conversion efficiency is not readily applicable to the overall transport task. This makes it difficult to quantify energy balances (and material/load balances) relative to industrial processes or buildings.

6.2 Data availability and quality

Transport is a complex dynamic industry with a significant number of variables. While it may be simple to estimate savings at a superficial level, an energy audit seeks to establish an ongoing energy management plan, and systematic approach to improving energy use. Therefore a structured technical approach to performing a fleet audit is considered essential.

A sound fleet audit ideally provides clarity, accuracy and logical analysis describing how a vehicle fleet operator or owner can save energy while maintaining or increasing productivity.

Evaluating data availability is an important step in determining the appropriate type of audit.

Most medium to large transport fleets operate different transport activities with different types of vehicles and duty cycles. An energy audit shall analyse energy performance by fleet segment wherever appropriate (and possible) so as to ensure that the analysis is applicable to the vehicle characteristics and duty cycle. Auditors should ensure that data is of sufficient quality to enable any recommendations made to be costed, measured and verified, with the specific purpose of giving the organization sufficient confidence to act on those recommendations.

6.3 Data availability review

Evaluating data availability is an important step in determining the appropriate type of audit. The process of review should include the following:

- (a) Prior to undertaking an energy audit the organization should evaluate energy measurement, data and monitoring systems for the fleet. The review—
 - (i) identifies cost effective improvements to measurement and metering systems so as to track energy performance over time; and
 - (ii) ensures sufficient valid data is available for accurate analysis and correct attribution of fuel consumption.
- (b) The review involves the following data collection tasks:
 - (i) Clear identification of the audited object and identification of boundaries applied.
 - (ii) Historic energy use including monthly energy consumption profiles for at least the last 12 months (recommended 24 months) to evaluate data quality.
 - (iii) Appropriate transport activity data to establish overall EnPIs.
 - (iv) Summary of energy consumption and costs.
 - (v) Table of gross price for each fuel (include lines/retailer split for large business).

- (c) Analysis to be performed as part of the review should include:
 - (i) Annual energy end-use breakdown by fleet segment including consumption of all end uses representing more than 20% of total energy cost or consumption.
NOTE: Remaining energy use need only be quantified as 'other'.
 - (ii) Establishment of EnPIs.
- (d) Analysis of the organization's existing systems to monitor and manage fuel consumption, including:
 - (i) Data quality and availability.
 - (ii) Details of any measures undertaken by the organization in the past to reduce fuel consumption.
 - (iii) Details of original equipment manufacturer (OEM) vehicle technology such as cruise control, as well as after-market equipment, associated systems, system interfaces and data sources.
NOTE: The ultimate system involves monitoring vehicle fuel use in as near real time as is viable, and correctly attributing the driver, location and task for each vehicle at the time of each fuel use record.
- (e) Analysis of the effectiveness of energy measurement, data and monitoring systems for the fleet.
- (f) The review report should outline the following:
 - (i) The scope for improvement to measurement and metering systems in order to enable effective energy performance monitoring.
 - (ii) Recommendations for the next steps in the monitoring and audit process, including estimated costs and benefits.
 - (iii) An indication of the broad accuracy of energy performance data, possibly via sensitivity analysis.
 - (iv) Where applicable, nomination of typical payback periods for the identified measurement and monitoring actions.

6.4 Operational procedures and measurement systems

To establish whether or not an energy saving intervention has worked, an energy audit should aim to correctly attribute any change to a particular variable (or variables) and to relate that change to baseline performance. Therefore the first type of audit focuses on measurement systems.

Measuring and metering technology is an enabler to inform vehicle operators and management. It is up to management to effect the required change and continue the energy saving process in the longer term.

7 WHEN TO UNDERTAKE AUDITS

An audit of an appropriate type should be undertaken every 3 to 5 years or whenever there are—

- (a) proposed and recent significant changes in fleet energy use, changes to fuel systems or processes;
- (b) depot/warehouse/hub site developments relocations or refurbishments that impact upon fleet logistics;
- (c) proposed and recent revisions of working fleet operating practices;
- (d) major changes in the customer base or in the types of loads being transported;

- (e) substantial changes in energy price or its availability;
- (f) significant changes in the energy performance indicator (EnPI) for the fleet or audited object;
- (g) significant changes in energy costs;
- (h) proposed and recent changes in technology, such as hybrid vehicles; or
- (i) regulatory or other requirements to do so.

8 ENERGY AUDIT REQUIREMENTS

8.1 General

A rigorous energy audit follows five fundamental requirements, as outlined in Clause 8.2. The application of these requirements helps to make the energy audit an effective and reliable tool in support of management decisions and controls, by providing information that enables an organization to act in order to improve its energy performance.

Adherence to these requirements is a prerequisite for providing an effective energy audit and for enabling energy auditor(s), working independently from one another, to reach consistent conclusions in similar circumstances.

Appendix B specifies requirements for performing an energy audit.

8.2 Requirements

An energy audit shall—

- (a) be consistent with the agreed scope, boundary and objective (see Paragraph B2);
- (b) involve measurement and observation that is appropriate to energy uses and consumption;
- (c) collect and utilize energy performance data that is representative and accurate;
- (d) employ a traceable process for collecting and analysing data; and
- (e) provide energy performance improvement opportunities based on financial analysis that is appropriate for the chosen type of audit.

9 ENERGY AUDITOR REQUIREMENTS

9.1 Competency

9.1.1 General

The energy auditor or auditing team shall have suitable knowledge for the type of work being undertaken and the agreed scope, boundary and objective.

NOTE: Any required accreditation or industry standards should be considered.

Transport fleet energy auditors shall demonstrate the following competencies, in accordance with the scope of the audit:

- (a) Knowledge of the different transport modes and duty cycles included in the audit scope.
- (b) Knowledge of transport segments.
- (c) Understanding of vehicle logistics.
- (d) Understanding of vehicle technologies and performance.
- (e) Knowledge of transport data systems and measurement systems.
- (f) Knowledge of the impact of vehicle operator behaviour.

- (g) Understanding of critical safety issues.
- (h) Knowledge of vehicle maintenance approaches and systems.

Any required auditor accreditation or industry standards applicable to the relevant jurisdiction should be considered, along with the type of audit and the audited object.

NOTE: See Appendix D for guidance on auditor competencies. Appendix D includes a list of additional recommended competencies.

9.1.2 Additional competencies for detailed audits

Audits of Type 2 and Type 3 require higher competency levels than Type 1 audits due to the increased level of detail and analysis involved. Audit types are specified in Clause 10.

Type 2 audits shall be undertaken by auditors with appropriate technical, managerial and professional experience and skills—and familiarity with the energy uses being audited—to analyse detailed energy and process data to identify and evaluate opportunities.

Type 3 audits shall be undertaken by auditors with appropriate technical, project management and professional experience and skills—and familiarity with the specific energy uses being audited—to analyse detailed energy and process data to identify and evaluate opportunities. As Type 3 audits involve measurement and acquisition of data the auditors should have knowledge of energy data acquisition and measurement.

9.2 Confidentiality

The energy auditor shall exercise discretion in the use and protection of data and other information acquired in the course of their duties. Energy audit information shall not be used inappropriately for personal gain by the energy auditor or the organization, or in a manner detrimental to the legitimate interest of the organization. This requirement includes the proper handling of sensitive or confidential information in consultation with the organization.

9.3 Objectivity

The energy auditor shall act independently and in an impartial manner. Conflicts of interest, personal, financial or other, shall be identified and disclosed to the organization in a timely manner.

NOTE: A conflict of interest occurs when an individual or organization is involved in multiple interests, one of which could possibly compromise the motivation for an act in another.

The energy auditor shall ensure that their claims for performance of products, provision of services and expertise are accurate, substantive and independently verifiable.

If the organization intends to carry out an energy audit using internal personnel, it may not be possible for energy auditor(s) to be fully independent of the audited object(s), but every effort should be made to remove bias and encourage objectivity.

10 AUDIT TYPES

10.1 General

Depending on the needs of the organization, one or more of the following audit types described in this Clause shall be selected to determine the scope and level of detail of the audit. Requirements for each audit type are specified in Clause 12.

NOTE: See Appendix E for guidance.

There are three types of audit described in Clauses 10.4 to 10.6, which are based on the level of detail and focus required. Clause 12 specifies the minimum requirements for each defined type of audit.

Type 1 represents the minimum level of detail required to comply with this Standard.

10.2 Selection of audit type

The appropriate focus and level of detail required for an audit depends on the audited object, the energy uses and energy consumption, and the resources available for the audit. As a preliminary audit activity, the organization and the energy auditor should establish the availability of data for the energy audit and determine whether or not the data is sufficient to enable this type of audit.

If additional measurement is required, the organization and the auditor should typically agree on the extent of required measurements before undertaking the audit. For audits of Type 2 or 3, it is advisable for the organization and the auditor to agree on a current energy price or prices.

Clauses 10.4 to 10.6 provide a summary of audit Types 1 to 3. Selection of the audit type shall be based on the detailed requirements for each audit type in Clause 12.

10.3 Auditor competencies for each audit type

Auditor competencies for the 3 types of audits are discussed in Clause 9.1.

10.4 Type 1

Type 1 defines the minimum level of detail for an audit required to comply with this Standard. Type 1 audits provide a quantitative overview of energy performance and identify no-cost and low-cost opportunities with paybacks periods of up to 2 years. The accuracy of costs and benefits would generally only be sufficient for low cost operational expenditures or as a method for prioritizing opportunities for more detailed assessment.

As such, a Type 1 audit is aimed at smaller fleets, for which a detailed audit is not normally cost-effective, or as a preliminary audit for larger transport operations. Larger organizations may use Type 1 audits to establish which fleets or fleet segments might require a more detailed audit, or to determine the potential to improve the efficiency of light vehicles in a broader portfolio of vehicle assets.

Type 1 audits provide indicative or typical savings calculated using rules of thumb or industry acceptable benchmarks, with indicative costs used to provide a simple payback. Costs and energy savings are therefore to a broad estimate level, see Clause 5.1(a).

10.5 Type 2

Type 2 defines a more detailed level of audit involving a comprehensive review and analysis of fleet segments, vehicles and operational characteristics of the whole fleet to enable quantified energy savings recommendations. Type 2 audits are required to include a financial analysis of recommended energy performance improvement actions based on agreed financial criteria to rank opportunities. The accuracy of costs and savings should generally be sufficient for operational expenditures or medium-scale capital investments, and should be commensurate with organization's approval processes for expenditures at those levels.

Type 2 audits may include in-service measurements but would not normally involve monitoring over time.

Some major projects or procurement opportunities may require additional data to quantify the energy performance improvements, costs and benefits, and may still require further investigation by the organization, possibly through a Type 3 audit.

Type 2 audits calculate energy savings by reconciling against each fleet segment, considering daily energy consumption profiles. Costs of implementation are based on a build-up of both capital and labour items including site, internal and project management costs. Type 2 audit requirements provide costs and benefits to a medium level of accuracy, see Clause 5.1(b).

10.6 Type 3

Audits of this type are typically focused on fleet divisions or specific fleet segments, such as for a long haul B-double fleet, rather than for all transport operations. Type 3 defines a more detailed and focused audit [see Clause 5.1(c)] than Type 2 to quantify the business case for energy saving measures. Type 3 audits involve additional measurements to monitor energy data over a period long enough to capture the various operating conditions and relevant variables which require their own set of measurements.

Audits of this type would normally involve representatives from the organization in the development of cost estimates, to provide the level of accuracy required by the company's existing capital expenditure process.

Type 3 audits calculate energy savings by reconciling against the detailed energy balance, considering energy consumption profiles and the additional measurements taken during the audit. Costs of implementation are based on a build-up of both capital and labour items including site internal and project management costs, to the level of accuracy required by the company's capital expenditure process. Type 3 audit requirements provide costs and benefits to a higher level of accuracy, developed with input from the organization.

NOTE: Type 3 audits could be undertaken for several fleets or fleet segments, either separately or in parallel, as part of the implementation of an energy management system. In these cases audits would typically be undertaken over a period of time sufficient to measure data, perform the analysis, including analysis of interactions between significant fleet segments and transport modes, and quantify the business case. This means that Type 3 audits covering major fleets or fleet segments in a broader transport operation would typically extend beyond the scope of a single contract and would require significant involvement from the organization.

11 ORGANIZATION'S ENGAGEMENT WITH THE AUDIT

11.1 General

The degree to which the organization engages with the audit process is critical to the success of the audit and the achievement of the objectives of the audit.

Energy audits and energy saving opportunities identified in audits are best implemented in the context of an Energy Management System (EnMS) such as one consistent with ISO 50001.

Whether or not an organization has an energy management system in place, organizations are more likely to achieve the intended outcomes of an audit when senior management supports audit objectives and provides sufficient resources for the audit process and for post-audit activities.

11.2 Pre-audit activities

11.2.1 General

Transport operations comprise complex, time-critical processes and being able to audit them without affecting fleet productivity is imperative.

The organization shall provide the auditor with appropriate access to relevant personnel, records, documentation and equipment as required for the type of audit.

The needs of both the operations department and the auditor shall be the subject of agreement between the two parties, to enable the auditors to complete their duties in a proper manner. This prior agreement should avoid the need for changes in audit scope during the audit process.

In order to ensure that there is sufficient data available for an energy audit it is recommended that organizations undertake a data availability review as outlined in Clause 4.3.

11.2.2 *Scope of the audit*

The scope of the audit shall align with the business objectives of the organization. In so far as the scope of the audit is encapsulated in the type of audit and in the boundaries of the object to be audited, the scope shall reflect the following:

- (a) Specific business and operational issues to be addressed by the audit.
- (b) Availability of the data and information required for the chosen type of audit.
- (c) Availability of organizational representatives to facilitate the chosen type of audit.
- (d) Complexity of the transport operations and the energy uses for the audited object.
- (e) Total energy expenditure.
- (f) Budget available for the audit process.

NOTE: Implementation of low cost, easily implemented projects may provide funding for the implementation of additional efficiency projects.

- (g) The potential benefits of undertaking an audit versus the time and cost involved in undertaking the audit.

NOTE: Implementation of low cost, easily implemented projects may provide funding for the implementation of additional efficiency projects.

11.2.3 *Selection of auditors*

Organizations shall select an auditor with demonstrated experience, relevant to the characteristics of the audited object and the type of audit to be undertaken, when carrying out any energy audit in accordance with this Standard. If an audit is being conducted externally, the process outlined in AS 4121 (or other appropriate procurement processes) should be used to select the energy auditor.

Benchmarking and monitoring fleet performance is an important part of a transport energy audit. The organization should ensure that the auditor has the knowledge and experience to effectively benchmark and monitor fleet performance over time.

The auditor shall nominate one or more capable individuals who will be responsible for conducting the audit. The work shall be performed by, or under the direct supervision of, the nominated individual or individuals. Where applicable, nominated individual(s) should be suitably qualified and recognized by appropriate industry associations or other organizations.

11.2.4 *Information to be provided*

As part of the energy audit planning process, the organization outlines the desired audit outcomes. In view of these outcomes, the auditor shall specify the minimum information needed to conduct an audit of the appropriate type in compliance with this Standard. The role of the organization is to supply the information agreed in the data collection plan to the auditor according to the timeframe agreed between the auditor and the organization.

NOTE: The data collection plan may be amended by agreement.

11.2.5 *Format*

The monitored data that is maintained by the organization should be presented in the form requested by the energy auditor or in another easily assimilated form (e.g. spreadsheets that reveal changes of energy consumption over time).

NOTE: As part of good energy management practice the data should be reviewed regularly and any change in the pattern of energy consumption over time should be investigated, possibly by an energy audit.

11.3 During the audit

11.3.1 General

The organization should arrange for appropriate fleet and/or site access, provision of additional information and meetings with key personnel and other staff as required by the auditor and agreed by the organization.

11.3.2 Internal communication

The organization shall issue a summary of the purpose and main needs of the audit and communicate this to the people with responsibility for the organization's facilities involved in transportation. Where possible, these personnel shall be present at the opening meeting.

As the audit progresses, the organization shall be informed of the results, deviations and any outstanding issues. Likewise, the auditor shall communicate with the organization on issues affecting the conduct of the audit.

The organization shall inform the auditor of any significant changes that would impact on the energy audit.

NOTE: Due to the dispersed nature of transport, a focus on communication is of paramount importance.

11.4 Post audit

The role of the organization does not end with the handover of the audit report.

In order to realize the business objectives of the audit the organization should carry out the following post-audit activities after the final report has been submitted:

- (a) If the business requirement of the audit was to assess the feasibility of a more detailed study, the organization should review the outcomes of the audit and make a decision on whether to undertake a more comprehensive or detailed audit.
- (b) Develop an action plan that outlines, by priority, the tasks and costs involved in implementing each measure, the allocation of these tasks, and the timetable for their implementation.
- (c) Present recommendations for implementation of energy performance improvement actions to the appropriate level of management for a decision.
- (d) Develop and submit capital documentation for those opportunities which are to proceed to implementation.
- (e) Ensure that decisions on implementation of recommendations under Items (c) and (d) are made and documented.
- (f) Implement the energy performance improvement actions approved under Items (c) and (d).
- (g) Regularly monitor the results of measures implemented and review the action plan as required.
- (h) If recommended in the audit report, consider whether any additional data collection or analysis is required to manage energy consumption or to quantify identified opportunities more accurately.
- (i) Assign a suitable management representative to oversee post-audit activities.
- (j) Communicate the outcomes of the audit, including energy performance improvements and non-energy benefits, to relevant staff in the organization.