Towards a revision of AS/NZS3598:2000 Energy Audits

BACKGROUND PAPER

National Framework for Energy Efficiency

EECA BUSINESS

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1 Introduction

1.1 Role of this background paper

This background paper aims to provide additional context to some of the issues raised in the discussion paper around the objectives, scope, methodology, structure and content of a new edition of AS/NZS3598.

The submissions and consultation sessions which form part of this consultation process will inform the preparation of an implementation paper that will prioritise actions to deliver a new edition of AS/NZS3598 and the necessary supporting materials to meet the objectives of AS/NZS3598.

Stakeholders are encouraged to consider issues raised in the discussion and background papers and contribute their feedback to assist in the specification of a new Standard.

1.2 Terms used in this background paper

- References to AS/NZS3598 or AS/NZS3598:2000 mean the current version of the AS/NZS3598:2000.
- The term The Standard refers to the proposed new version of AS/NZS3598:2000.
- The term (Energy) Audit means undertaking activities that comply with The Standard.
- The term Energy User refers to a facility, organisation or individual who is seeking to have an energy audit carried out.
- The term Provider refers to an individual or organisation that is delivering an energy audit to an Energy User. The Provider can be internal or external to the Energy User.
- EMS means Environmental Management System.
- EnMS means Energy Management System.
- Energy Performance means measurable results in energy efficiency, use and consumption. The term includes energy efficiency, intensity, conservation, and fuel choice

2 Situational Context

This section provides the context of the revision of The Standard. The section develops the case for a revision of AS/NZS3598 by first briefly outlining the role of energy audits. The section then explores several related questions:

- What are the barriers to implementation that an energy audit can address?
- How does the current standard align with the energy efficiency agenda in New Zealand and Australia?
- What are the strengths and weaknesses of the current standard?

2.1 The role of energy auditing

Energy audits are investigations of energy use in a defined area or site[1]. AS/NZS3598:2000 describes an energy audit in the scope section as identifying 'opportunities for cost effective investments to improve efficiency and effectiveness in the use of energy'.

Energy audits are not only essential for improving energy efficiency and performance, but represent a key step in the process of reducing greenhouse gas emissions from buildings, facilities, industrial processes and transport.

An energy audit starts with the establishment of an energy baseline, then identifies opportunities to improve that baseline, and finally evaluates and reports on those opportunities in terms of energy savings potential (or emissions savings potential if that is the organisation's goal) and cost effectiveness. In other words, energy audits are about defining current energy performance and then finding ways to improve that performance.

It is considered best practice for energy using organisations to use energy audits as a component of an energy management system. An EnMS provides an organisational platform (defined managerial responsibilities, an energy policy, goal definition, determination of an energy baseline, record keeping, etc) from which to tackle energy performance. An energy audit (or assessment - see section 7 on terminology) is the vital tool that gives the organisation the information on which to base decision making on improving energy performance.

It is possible to use energy audits without having a formal or even informal energy management system in place. However this increases the risk that the audit will not be truly useful to the organisation and that the audit recommendations will not be implemented. Government programs requiring or encouraging energy audits or assessments employ various mechanisms that strive to reduce this risk.

[1] Taken from AS/NZS3598:2000

2.2 Barriers to implementation of energy performance improvements

Insights from existing energy efficiency programs have highlighted barriers to energy performance improvement which could be addressed by the Standard.

Australian businesses that participate in the Energy Efficiency Opportunities (EEO) program have indicated a number of significant internal barriers to the identification and implementation of energy efficiency opportunities. These include:

- lack of senior management support,
- lack of suitable data,
- lack of budget/resources,
- the absence of accountability for energy management and,
- access to technical skills within the corporation.

Research[2] of EEO program participants identified that even after companies had undertaken a series of assessments, improvement in a range of areas was needed to improve the evaluation and implementation of opportunities. Areas identified which could be addressed through guidance from a Standard include:

- improving energy data collection and analysis;
- development of energy mass balances; and
- better business case development to gain management support for the implementation of actions identified through assessments,

The Expert Group has identified a variety of additional reasons for why an energy audit can 'fail'' to lead to sustained improvements in energy performance, and how a Standard could be used to address these issues.

- **A failure of site personnel to engage with the Provider and vice versa.** The Standard could refer to the roles required of specific managers, engineers and general staff in supporting the Audit, and provide guidance on how the Provider communicates with the Energy User. This could include guidelines or examples of documents that need to be provided to the Provider, and recommendations on how assessment results are communicated back to the Energy User.
- **A failure to assess the competency of the Provider to undertake an assessment of the site or technology.** Most Providers can point to a generic set of competencies. However, in many cases, Energy Users are seeking site specific knowledge beyond the recognised core competencies that is relevant to the proposed Energy Audit. As well as listing the critical and desired competencies for the Provider, The Standard could provide guidance to Energy Users on how best to assess the competencies of Providers. The

[2] Department of Resources Energy and Tourism (2010) Report for Long Term Strategy for the Development of Energy Efficiency Assessment Skills

Standard can also provide the basis for an appropriate accreditation scheme which could provide an additional level of assurance.

- **A failure to adequately evaluate the energy saving opportunities.** Problems can arise in three areas.
  - First, the calculation of the potential energy savings could be seen to be superficial or otherwise inadequate. Rigorous methodologies for evaluating savings due to process or operational changes exist in other fields. For instance improvements associated with refinements in the control of a manufacturing process can be robustly calculated. The methodologies call for an accurate baseline that is relevant to the opportunity and then the use of modelling or simulation tools to determine the impact of an improvement in the control of the process. The key point is that the calculation of potential improvements places an emphasis on rigorous methods, not “rules of thumb” or “guesstimates”. Energy efficiency opportunities can generate additional business benefits and costs over and above energy cost savings and these are not necessarily being included in evaluation of energy savings.
  - Secondly, the costs to achieve the savings are not calculated to an adequate degree of precision. Many Providers have limited experience in the actual design and implementation of projects and therefore fail to include crucial cost items. Or they just estimate implementation costs based on rules of thumb. There are a range of tools to assist in cost estimation. For instance, the AACE International Recommended Practice No. 18R-97 “Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries” provides clear guidance on the methods that must be employed to achieve a cost estimate to a given precision. “Attachment C: Extracts from Cost Estimation Guidebook” includes an excerpt from this document. The US Department of Energy produced the “Process Equipment Cost Estimation”, which has indicative costs of key items of process equipment and more importantly, design factors that can be applied to determine cost of all design and engineering activities once the costs of the major plant items are known. Further to applying rigorous methods, the Provider could be required to list all sources of data that contributed to the estimated cost.
  - Finally, the business case analysis may not be relevant to the business, their decision making process or key business drivers. Many audits report savings in terms of simple payback, yet very few businesses base investment decisions on payback. Providers often required guidance in relation to the accommodation of economic uncertainty in the assessment of energy efficiency opportunities. One example is energy price forecasting as this is often poorly done and can have a significant impact on the business case. This is a major challenge in particular in assessing opportunities in the transport sector, and assessors appear to be approaching this uncertainty in a variety of different ways.

2.3 Alignment of AS/NZS 3598 with New Zealand energy efficiency programs

AS/NZS 3598:2000 has played a central role in New Zealand's strategies to improve energy performance and develop a skilled energy audit industry.

The Energy Efficiency Conservation Authority (EECA) offers grants to part fund the cost of an energy audit. Energy audits must be done by an accredited energy auditor in accordance with AS/NZS 3598:2000. Preference is given to organisations that commit to implementing 50% of the audit recommendations that will deliver payback within 12 months.

The auditors must be accredited with the Energy Management Association of New Zealand (EMANZ). EMANZ runs training programs and an accreditation scheme for auditors, as well as providing standardised documents for audits. An industrial energy users liaison group provides input on implementation of the scheme.

A recent review of AS/NZS3598:2000 undertaken by EMANZ on behalf of EECA[3] concluded that only minor changes to AS/NZS3598:2000 were required for the New Zealand energy audit community.

The EMANZ study concluded that the current standard has adopted the best approach with respect to detailing performance (outcomes) with supplementary guidance. The study did identify however that the current standard did:

- lack information that details the relationship between audits and other components of energy management;
- need an additional level of audit below the current level 2 to address business's need for a basic scoping audit;
- require more emphasis on demand management and the development of benchmarking metrics;
- not adequately address transport fuel use; and
- not call for an energy balance or energy reconciliation.

[3] "Review of the Energy Audit Standard AS/NZS3598:2000", Energy Management Association of New Zealand, June 2010

2.4 Alignment of AS/NZ 3598 with Australian Government programs

Since the last update of AS/NZS3598 Australia has introduced a range of government programs and regulatory frameworks to facilitate greater energy efficiency uptake. More details of these programs are outlined at Appendix C.

The role of the current standard in these programs is outlined in the Table below.

Program	Role of AS/NZS3598
Commonwealth Energy Efficiency Opportunities program (EEO)	EEO requires large energy using companies to undertake rigorous energy assessments following a framework which combines management system and audit elements to identify, evaluate and make decisions on the implementation of opportunities EEO does not refer to AS/NZS3598.
Commercial Building Disclosure (CBD)	CBD is a national program designed to improve the energy efficiency of Australia's large office buildings. Under the program, most sellers or lessors of office space with a net lettable area of 2,000 square metres or more are required to obtain and disclose an up-to-date energy efficiency rating. CBD uses NABERS to determine the rating. Unlike AS/NZS3598, NABERS does not involve the identification of energy performance opportunities.
New South Wales Energy Saving Action Plans (ESAP)	Requires a technical assessment to the standard of a level 3 audit i.e. so that investment decisions can be made. The preparation of an ESAP also requires an Energy Management Review, which is outside the scope of AS/NZS3598.
Victorian Energy and Resource Efficiency Plans (EREP)	There is no existing audit standard that includes an integrated assessment of energy, water and waste. However, the requirements of a Resource Efficiency Site Assessment builds on the approach of the AS/NZS3598:2000 energy audit standards
Queensland Smart Energy Savings Program (SESP)	The audit will need to comply with a Level 2 Energy Audit under Australian Standard AS/NZS3598:2000, as a minimum requirement.

The National Strategy on Energy Efficiency has identified rationalisation of existing energy efficiency audit and assessment processes to deliver nationally consistent approaches to energy auditing (and skill requirements) as a key objective. The review of The Standard could assist in achieving this objective by ensuring the new Standard complements existing programs.

2.5 Alignment with sectoral audit processes

Further insight into the strengths and weaknesses of AS/NZS3598 emerges from a look at the use of the standard in the various sectors.

Commercial Buildings

AS/NZS3598 focuses on aspects which are particularly relevant to the auditing of energy use in commercial buildings. In this context AS/NZS3598 is particularly informative for the energy user, but less so for the service provider. For example, it offers useful direction to the building owner/manager on preparing for the energy audit, but it lacks detailed guidance for the auditor on appropriate methodologies or best practices to achieve quality outcomes. To address this issue the new Standard could draw on and/or reference a range of guidelines and standards (e.g. ASHRAE, CIBSE, AIRAH) relating to the technical aspects of auditing the energy use of building systems.

Commercial buildings are often owned and/or managed as part of a portfolio; in this situation there is often expertise to conduct energy audits in-house, at least to Level 1 or 2 standard. AS/NZS3598 assumes a conventional consultant-client model which is less applicable to organisations conducting energy audits internally. Moreover, there is no specification of auditor competencies, which diminishes its value to the energy user in terms of either external or internal auditor selection.

Research conducted for this project suggests the main users of AS/NZS3598 with respect to commercial building energy audits comprise high energy users required to conduct audits under legislation, organisations participating in voluntary incentive programs, Government facilities, and organisations with an existing “green” profile. While the audit levels set out in AS/NZS3598 are cited in regulatory and incentive program guidelines, in practice some confusion exists as to actual outcomes, which suggests a need for more specific linkage of methodologies with audit outcomes in the new Standard.

Industrial facilities

The issues with respect to industrial facilities are similar in many respects to those with commercial buildings. Some differences exist though and these are highlighted here. Industrial facilities use a much wider range of energy systems than most buildings and the lack of specific guidelines for these energy systems diminishes the value of the current standard. These systems include compressed air, industrial refrigeration, steam and hot water. In addition there are large energy using plant such as boilers and fired heaters, pumps and compressors, large motors and machinery. The auditing of these systems is very much the domain of specialists and the current standard offers little guidance to such specialists.

Appendix C of the current standard is more suited to buildings rather than industrial facilities, and can be confusing to an inexperienced auditor. For instance, building fabric is often mentioned. The actions in the standard favour the monitoring of electricity, yet energy use at many large industrial facilities is dominated by heating (both direct and indirect) using gas, steam and other energy

sources. The current standard also offers little advice for the monitoring of heaters, steam systems and heating medium systems.

The current standard is still used to define the requirements for audits of industrial facilities, and in many cases it is up to the skill of the auditor to decide the methodology and interpret the outputs.

Transport

The concept of energy auditing in the transport sector is relatively new when compared with energy auditing in sectors such as manufacturing and commercial buildings. The early experiences with energy auditing within the transport sector suggest that many of the concepts and practices applied for users of stationary energy do not translate easily to users of transport energy.

As a consequence, there is a need for comprehensive guidance in respect of the requirements of energy audits within the sector, the required skills of energy auditors, and the management of key issues that are peculiar to the transport sector. In particular, there will be a need to provide comprehensive guidance in respect of:

- the nature of data to be collected, including recommendations on the required granularity of such data;
- guidance on the metrics that should be used for constructing energy consumption baselines and assessing the merits of energy efficiency opportunities;
- guidance on the management of issues relating to the current high level of uncertainty surrounding the quantum of energy efficiency benefits (i.e. energy and economic basis) derived by improvement actions; and
- guidance on the procedures for the assessment of energy efficiency improvements in the transport sector given the high level of volatility and uncertainty surrounding short term movements in unit energy prices and the limited relevance of simple payback techniques for ranking improvement opportunities.

Mining

A mine will display features of a processing plant (e.g. a flotation concentrator, longwall miner) or a transport system (the surface mining fleet). Therefore energy audits of mines face the same issues with AS/NZS3598 as industrial facilities or transport operators.

2.6 Current strengths and weaknesses of AS/NZS3598:2000

In the review of AS/NZS3598, perceived strengths and weaknesses of the current standard should be considered. The following list has been compiled from the preceding analysis in this Section incorporating feedback from the Steering and Expert Groups.

Strengths	Weakness
AS/NZS3598 is technically strong. Where the current standard provides guidance, it is effective.	It favours the auditing of energy use in commercial buildings through the terms used and the examples chosen. For instance, the use of load profiles is always relevant to commercial buildings but not always relevant to an industrial site or transport operations.
The audit levels presented in the standard are well used and are regularly quoted in tender documents and the like. They provide some scope to tailor audits to the varying demands of energy users.	The standard does not outline the compelling reasons to undertake each aspect in an audit and also how the aspects relate to each other.
The standard is used in New Zealand to support industry development programs and an accreditation system.	It is a standard for energy auditing alone and only addresses broader questions of energy management systems in an appendix.
It defines the audit standards for a range of government programs.	In keeping with all outcomes focused standards, it does not give guidance for undertaking the aspects of an audit. So it lacks detailed guidance for auditors on methodologies, rigor and quality of outcomes.
Energy management systems are referenced but only in an appendix. (See Weaknesses)	It does not address the competences required by auditors.
Section 12 on the energy user's roles and responsibilities offers some useful advice.	While the three levels of audit offer some flexibility, the current standard lacks capacity to respond to varying scale, scope, complexity of situations and client types.
The list of outcomes for each audit level is comprehensive.	The audit better matches a consultant-client model rather than cases where the auditor is internal to the site.
Being an outcomes driven standard, it promotes continuous improvement in methodologies by requiring outputs but not prescribing methods.	It lacks the formal follow-up/ongoing engagement that is central to an energy management system.
	The accuracies for energy savings and capital costs prescribed for Level 1, 2 & 3 audits do not apply uniformly to different types of energy use e.g. it may be impractical to estimate the capital cost of a large complex project to +10% in a Level 3 audit because a detailed design would be required, whereas it may be quite possible to do so for a lighting project or installing a variable speed drive on a motor.

3 Objectives of new standard

The abstract for the AS/NZS3598:2000 describes it as

> *Setting out the requirements for commissioning and conducting energy audits, and identifying opportunities for cost effective investments, to improve efficiency and effectiveness in the use of energy. Primarily, it is intended for use by energy users but will be of assistance to energy auditors, and may serve as a useful reference document for anyone interested in the field of energy management best practice.*

It sets out minimum requirements for commissioning and conducting energy audits which identify opportunities for cost effective investments to improve efficiency and effectiveness in the use of energy. It is intended for use primarily by energy users when defining the scope of an audit and may be applied to the public, commercial and industrial sectors.

In this section, possible objectives of a revised AS/NZS3598 are proposed.

The overarching proposed objective of The Standard is ***to standardise best practice for energy audits and assessments in Australia and New Zealand across a range of circumstances, including varying type and scale of facilities and range of detail***.

A series of more specific objectives could also be considered. These are listed in the Table below. Not all of these objectives may be achievable.

Objective	Potential Role of Standard
Strengthen the capability and quality of energy auditing and assessment services.	A standard-based approach to the structure, content and methodology of energy assessments and audits could provide the basis to improve the quality of energy auditing services. However, this will need to be underpinned by a clear and rigorous framework for educating, training, certifying and evaluating energy assessors and auditors. A best practice, accreditation system based on the Standard could also provide assurance to both clients and assessors/auditors of the technical skills required.
Provide guidance for both Energy Users and Providers (both internal and external to the Energy User) regarding responsibilities and roles.	In outlining the characteristics of an Audit, The Standard could define what the Energy User must contribute to the Audit and what the Provider must contribute. By outlining the roles and responsibilities of the two parties it will reduce the likelihood of the Audit failing because of miscommunication between the parties.
Support the integration of energy management into core business to inform current and future business activities.	This objective emphasises the importance not only of energy assessment to identify opportunities for energy performance improvement, but also the role of The Standard in encouraging take up of an EnMS approach, and EnMS auditing.
Increase the number of projects identified and the rate of implementation of cost effective energy efficiency opportunities.	This objective could be realised by developing a standard that encourages the identification of opportunities and the framing of those opportunities in business cases that are readily understood and supported by decision makers.

Provide guidance to training organisations in relation to the tasks for which auditors/assessors and verifiers should have demonstrated competence.	The new standard could include a framework for defining key competencies for energy assessors and auditors and to help drive a training and accreditation system in Australia.
Be consistent with and complementary to relevant international standards and auditing guidelines, including the proposed ISO50001 and environmental auditing standards (for example ISO14000 series and ISO19011).	Harmonisation with international standards not only avoids duplicating effort, but acknowledges the transnational nature of both the client base for auditing and assessment services, and the service providers.
Be suitable for both voluntary use and to support regulatory and incentive programs, thereby minimising regulatory impacts to business.	To ensure compatibility with regulatory and incentive programs, The Standard would need to be structured to address the specific requirements of these programs. In turn, it is expected that future regulatory/incentive energy programs could explicitly reference The Standard, thus avoiding potential inconsistencies between jurisdictions and programs.

4 Scope of the new standard

This section of the paper explores the scope of The Standard, including questions such as:

- How should The Standard interface to any energy management system standard?
- Is there a case for including measurement and verification and support for energy performance contracts in The Standard?
- Should and how can energy efficient design be treated by The Standard?
- Should The Standard be expanded to include other resources such as water?

4.1 The interface of AS/NZ3598 to an energy management system standard

ISO50001 is the proposed international standard for EnMS which will be released in 2011. The purpose of ISO50001 is to enable organisations to establish the systems and processes necessary to improve energy performance. It is based on the common elements found in all of ISO's management system standards, ensuring a high level of compatibility with ISO9001 (quality management) and ISO14001 (environmental management).

The draft version of ISO50001 provides very little guidance on energy assessments or energy reviews. Guidance on energy audits through AS/NZS3598 may therefore assist in the energy planning and energy review stages of the ISO50001 management system.

The issue of responsibility is also important when considering the interface between an EnMS and an energy audit – and the impact that this has on the scope of an audit.

Under an ISO50001 EnMS, the energy using organization is required to take the results of the energy review process (which includes analysis of major energy using systems and an internally driven process to determine any operational improvement opportunities that may not be evident to external personnel) and **prioritise them.** This prioritisation process is driven by the business goals of the organisation. An external auditor may have recommended ten energy performance improvements. The energy user may decide that four are going to get done in the next two years and develop action plans to carry them out. They may also decide to undertake two other action plans to address operational opportunities that the organization identified – either themselves or in cooperation with the external auditor. This ISO concept of an energy review is largely the same as the energy assessment required by the EEO Program.

AS/NZS3598 effectively adopts a paradigm of an external energy auditor being commissioned by an energy user to conduct an audit. Effectively the audit is the responsibility of the external provider. The issue is further complicated by the fact that the effective auditing is often performed by **teams** of members with appropriate knowledge and skills. The team can be internal or external to the energy using business (or a combination).

This discussion raises several questions on scope

- Whose responsibility is the performance of an energy audit to The Standard? Is it the energy using company or the external provider? Alternatively, is an energy audit the responsibility of the

'chief auditor' whether this is the energy manager of an energy using organisation or the external provider?

- To what extent is the prioritisation process described above within the scope of an energy audit? Should the audit require recommendations in order of priority – but leave the final prioritisation and decision making out of scope?
- The Standard's scope must include the analysis of major energy using systems. Should it also include 'operational improvement opportunities' that often cut across systems?

4.2 Measurement and verification

One of the stated objectives of The Standard is to increase the number of energy saving opportunities that are successfully implemented.

Measurement and Verification (M&V) plays a key role in building the case for the implementation of opportunities by providing the platform to robustly verify the savings from previous projects.

M&V also plays a key role in realising energy saving opportunities through Energy Performance Contracts (EPCs). An EPC provides a means of sharing the risk associated with an energy saving opportunity and reducing the barriers to implementation. Central to EPCs is the measurement and verification of energy use and subsequent energy savings.

A number of best practice guidelines exist on M&V and EPCs. [4] The issue of M&V is also the subject of the International Performance Measurement and Verification Protocol (IPMVP)[5], which defines standard terms and suggests best practice for quantifying the results of energy efficiency investments and increased investment in energy efficiency, demand management and renewable energy projects.

Given the importance of M&V in facilitating greater uptake of energy efficiency opportunities, and the existence of best practice guidelines and protocols how should the issues of measurement and verification and Energy Performance Contracting be considered in the review of the Standard?

4.3 Energy efficient design

AS/NZS3598 and other assessment guidelines such as EEO program are by and large designed for the assessment of existing facilities, with their focus on energy baselines (i.e. logging current performance) and opportunities to improve on current performance.

A different focus is needed to assess the potential to improve on performance during the design phase. The cost effectiveness of improvements made during the design phase is usually far greater than after the facility has been built. It provides the designer the opportunity to consider whole of system design issues and evaluate best available technologies and practices.

[4] There are a range of best practice guides for EPCs, for example "A Best Practice Guide to Energy Performance Contracts"[4], produced by The Australasian Energy Performance Contracting Association for the Energy Efficiency Best Practice Program. A companion document "A Best Practice Guide to Measurement and Verification of Energy"[4] deals with the important issue of measurement and verification (M&V).

[5] http://www.evo-world.org/index.php?option=com_content&view=article&id=272&Itemid=504&lang=en (Accessed March 2011)

The usual approach to energy efficiency in design is through the use of design guidelines. These design guidelines tend to be specific to particular industries or technologies.

Other design processes could be considered however. The safe design of facilities, especially in manufacturing is managed by a sequence of hazard studies. For instance, Hazard Study 1 looks at potential risks and is undertaken before any design is laid down. Hazard Study 3 is a systematic review of the near final design, and changes made at this point will require significant design rework. It is usual for an energy efficiency study to also be carried out on the near-completed design. So a flaw in the design that leads to a hazard must be rectified but the same drivers do not apply in the case of a less energy efficient design. The best approach is to integrate energy efficiency considerations into all decisions through the hierarchy of design decision taking.

4.4 Water and waste

A potential additional aspect of the scope relates to the resources that are addressed by The Standard. Some government programs include water efficiency and/or waste minimisation within their scope. This recognises that savings of one resource type results in savings of others. So for instance, a reduction in the use of hot water reduces both water consumption and energy consumption. And often the savings of each alone cannot justify the investment but the combined savings can. The synergies, potential cost savings and environmental benefits captured through an integrated assessment may provide an incentive for action where energy savings alone do not.

Introducing multiple resource types into The Standard will however make it more complex for both the Energy User and the Provider.

5 Design of The Standard

Earlier sections of this Background Paper have highlighted the choices facing the authors of the new Standard in terms of the scope of The Standard. The design of The Standard is discussed in this next section. The aspects to be covered are:

- whether The Standard should be outcomes or process driven;
- whether The Standard should be generic or should it include or reference sector/technology specific requirements and guidelines; and
- the audit levels.

5.1 Outcomes or process driven

Outcomes driven standards define the outcomes that must be delivered for the audit or assessment to be compliant with The Standard. Outcomes driven standards allow users to develop their own techniques 'they do not provide any guidance for Providers and Energy Users. They must then seek guidance elsewhere, and there is no guarantee that the guidelines they use are appropriate, or even comply with The Standard. For example, The Standard may require the analysis and reporting of load profiles as an outcome but offer no suggestions as to the way that the load profile information is to be acquired or reviewed.

The EEO program is outcomes driven and the EEO Guidelines define what needs to be done, give examples of evidence to demonstrate compliance but they do not say how the various activities must be performed. AS/NZS3598 is currently outcomes driven. Standards Australia favours outcomes driven standards over process driven standards.

Process driven standards outline the procedures that must be followed to deliver the objective of The Standard. They have the benefit of ensuring the delivery of compliant outcomes (assuming that the process in The Standard is followed) and focusing on the improvement of a core set of auditing skills. This is particularly relevant if there are perceived skills gaps or shortages. However, process driven standards do not allow for the evolution of the methodology outside of the revision of The Standard and can constrain innovation in the field. Several of the Australian and New Zealand standards that relate to occupational health and safety are process driven. The standards that define the wiring codes are process driven, and the stifling of innovation is not an issue.

The design section of this paper assumes that The Standard could address both outcomes and process. Note that some of the models for The Standard that are presented below lend themselves to having an outcomes focus and could not readily be deployed as a process driven standard.

5.2 A generic standard or a suite of standards

A number of potential options could be considered when considering the structure and design of the Standard. Some of these were illustrated earlier in Appendix B of the Discussion Paper.

i) a generic or umbrella standard

The Standard could define a "**generic**" audit, one that is intended to suit all sectors and large, medium and small organisations. This is the approach used in the current version of AS/NZS3598. The benefit of this approach is simplicity in terms of preparation of The Standard. A feasible deployment of a generic audit standard would expand on the various steps, describing either the required outcomes from each step or the processes to be followed within each step. The challenge faced by the generic audit is ensuring that it is applicable to all sectors and technologies.

ii) a generic standard with a suite of sectoral or technology standards

An extension of the generic audit concept is to develop a "**suite**" **of standards** that would include

- a generic part that includes requirements of audits/assessments applicable to all of the target audience; and
- a series of parts specific to sectors and activities for instance, buildings, manufacturing, mining, transport, data analysis, preparation of business cases; or
- specific to particular processes, for instance: HVAC, steam systems, crushing and grinding.

The US Department of Energy's Superior Energy Performance program adopts this model. The 'generic' standard to be employed is ISO50001 and technology specific guidelines are the ASME guidelines for process heating, pumping, steam systems and compressed air systems.

The suite based approach introduces a range of benefits that are not without risks however. A standard built on this model would be more complex to develop and deploy. As well as requiring the generic framework, it needs a wide range of sector or technology specific guidelines. The development of these guidelines would be a major undertaking and would require a high level of involvement with stakeholders. Further, there will be challenges in keeping the specific guidelines aligned with the generic methodology.

iii) a generic standard with reference to a range of best practice guidelines or existing standards

An approach to addressing these complexities is that the **generic audit could reference sector or technology specific best practice guidelines** that are consistent with The Standard and which could be owned by the relevant sectoral industry associations. This removes the burden of developing the sector/technology specific guidelines. It does not guarantee however that the sector specific guidelines are compatible with the generic standard. Nor can it guarantee comprehensive coverage of the industrial, commercial and transport sectors, or coverage of the full range of technologies within that sector.

Several local and international organisations have developed standards or guidelines that focus on particular sectors of the economy. For instance, the UK Chartered Institute of Building Services Engineers has published Applications Manual AM5 'Energy Audits and Surveys´ which focuses on the assessment of commercial buildings. Similarly, the American Society of Heating, Refrigerating and Air-Conditioning Engineers publish 'Procedures for Commercial Building Energy Audits'. The

procedure provides customers and providers of energy audit services with a complete definition of good procedures for an energy survey and analysis. It also provides a format for defining buildings and their energy use that will allow data to be shared in meaningful ways.

Alternatively, The Standard could have a technology focus where details are provided on the auditing of particular items of plant. A collection of technology focused standards is published by the American Society of Mechanical Engineers (ASME). EA-1-2009 covers process heating systems that are defined as a group of heating equipment used for heating materials in the production of goods in an industrial plant. These systems use heat sources such as fuels, electricity, steam or other energy sources to supply the required heat. The Standard sets the requirements for conducting and reporting the results of a process heating energy assessment that considers the entire system, from energy inputs to the work performed as the result of these inputs. The Standard is designed to be applied primarily at industrial facilities, but many of the concepts can be used in other facilities such as those in the institutional and commercial sectors.

Other standards cover Energy Assessment for Pumping Systems (EA-2-2009), Energy Assessment for Steam Systems (EA-3-2009) and Energy Assessment for Compressed Air Systems (EA-4-2010) and have been developed along similar lines.

The Expert Group believes a technology focus provides an easier path to implementation because of the large number of readily available materials. Further, when constructed as guidelines, technology based standards provide a more effective means of supporting Providers than industry based standards. However, sector based standards offer more complete coverage of their sectors.

Several examples of guidelines are presented in Attachment B: Example Standard and Guidelines. Attention is particularly drawn to the European Commission Reference Document on Best Available Technologies for Energy Efficiency (February 2009)[6].

5.3 Audit levels

One of the defining characteristics of AS/NZS3598 was the audit level. It allowed AS/NZS3598 to apply to businesses of different energy performance goals and budgets.

The deliverables of each level of audit can be broadly grouped into main activity areas:

- determining the energy baseline;
- identifying energy saving opportunities;
- assessing those opportunities; and
- reporting results.

Broadly, AS/NZS3598 incorporates elements of each group into each audit level but at different levels of rigour. For example, in determining the energy base line, a Level 1 audit may involve just an examination of monthly bills whilst a Level 3 audit may include metering, daily load curves for the site and major plant items, and a model of energy use.

The Expert Group is recommending that audit levels are maintained in the review of the Standard but that possible changes, that better address identified business needs, are investigated.

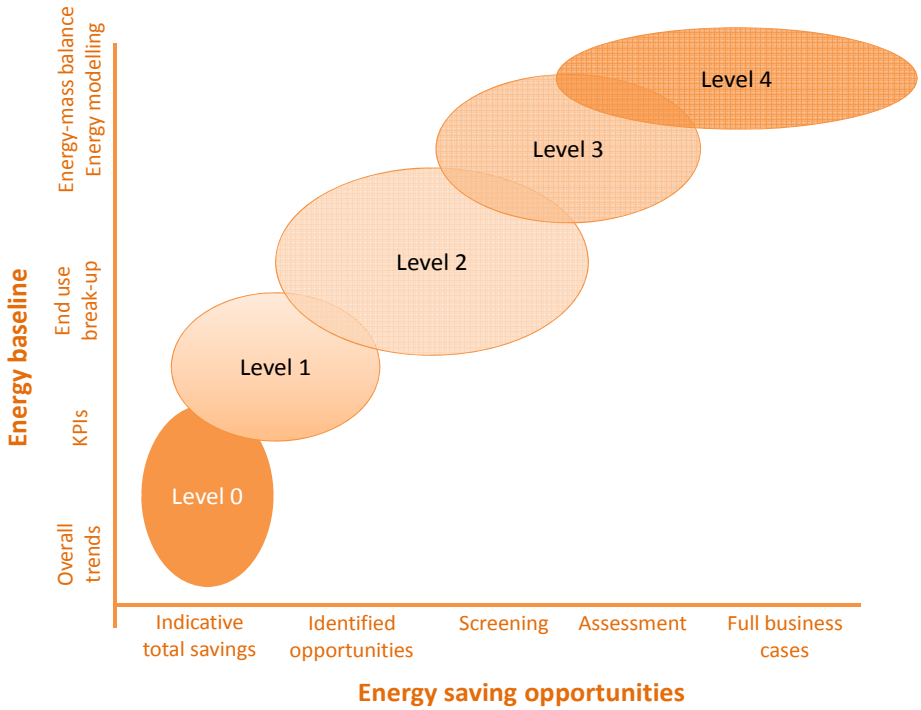
[6] This and several other Best Available Technology Guides are available from http://eippcb.jrc.es/reference/ (Accessed March 2011)

- A Level 0 audit is introduced as per the suggestion of the Energy Management Association of New Zealand. This would be a scoping study aimed at assessing the potential magnitude of savings without actually identifying any particular opportunities. The Level 0 audit could also include a simple KPI analysis, along the lines of a NABERS assessment. A further version of a Scoping Study could also be developed for use by Energy Users with multiple sites to identify the site or sites that should receive initial attention in any corporate wide energy study;
- The new Level 1 audit would contain all elements of the current Level 2 audit except for the detailed analysis of complex opportunities. This reflects an observation that many auditors have the competency to determine an energy baseline and identify a number of more generic opportunities such as energy efficiency lighting but not the more complex opportunities.
- A level 1a audit is introduced. The aim of this level of audit would be to provide a cost-effective alternative for small energy users which identifies and evaluates a list of cost effective opportunities.
- Levels 2 and 3 remain essentially as they are, with the addition of level 2a. This would be a design audit which ensures that energy efficiency is considered throughout the design process; and
- A Level 4 is added. The major difference between a Level 3 audit and a Level 4 audit would be the degree to which the auditors develop the business cases. A Level 4 audit would require the auditors to engage with senior financial managers in the Energy User's business to ensure that the business cases that are developed are compatible with the customer's systems, business drivers and language.

The table below provides some more detail on these levels, and how they could be used by businesses.

Level	Comment	Outcomes	Possible Accuracy %	Business need addressed	Example of use
0	Sometimes known as a scoping study, this would be a desktop study designed to understand energy use of a large multisite organisation and prioritise those sites for further investigation / auditing.	Simple KPI analysis Potential magnitude of savings Overall energy baseline	n/a	Understanding of an organisation's total energy use. Prioritised list of which sites to focus on.	Large multisite organisation to identify the site or sites that should receive initial attention in any corporate wide energy study.
1	Same as the current level I audit but no individual savings opportunities identified. Estimate of whole of site savings only. It may involve a site visit where benchmarks aren't available. The aim is to provide an estimate of savings available from undertaking a level 2 energy audit.	Energy end-use model Energy baseline Potential savings against known benchmarks. No energy savings opportunities identified.	n/a	Understanding of energy use Data for budgeting purposes Potential savings and benefits from undertaking a level 2 energy audit. Certainty as to whether to invest in a level 2 energy audit.	A site wants to improve its energy performance, and wants an understanding of current energy use and an estimate of savings potential.
1a	The current level 2 audit is not cost effective for small energy users. The aim of this level of audit would be to provide a cost-effective alternative for small energy users.	Understanding of total energy use. List of energy savings opportunities recommended for implementation.	+/-30%	Understanding of organisation's total energy use. Identify cost-effective energy savings opportunities.	Smaller organisations wishing to know what they can do to save money through energy efficiency for whom level 2 audits are not cost effective.
2	Much the same as the current standard.	Energy end-use model Detailed energy baseline Screened opportunities List of potential opportunities with rough costings	+/-30%	Identification, evaluation and implementation of low cost easy wins. Certainty as to whether to begin detailed assessment of opportunities	An energy user wants to identify opportunities with good potential. The Level 2 audit builds on the outcomes of the earlier Level 1 audit.
2a	Design audit: Review of the project brief, and the plans throughout the design process to ensure energy efficiency is optimised in the final plans and specifications.	Energy end use model. Plans and specifications incorporate cost-effective energy efficiency features.	+/-20%	Ensure all cost-effective energy efficient opportunities are incorporated into the new build / facility.	New building or production facility.
3	Much the same as the current standard.	Assessed opportunities Energy-mass balance	+/-20%	More detailed analysis of opportunities identified through a level 2 energy audit complete with more accurate costs and savings.	Organizations seeking more detail and verification of savings and costs of screened opportunities. Sometimes known as an “investment grade” audit. These could also be undertaken by an energy performance contractor.
4	Much the same as a level 3 energy audit but with far more developed business cases for the opportunities identified. The business cases identified would align with the client organisation’s terminology and decision making processes complete with client IRR’s or NPV etc.	Detailed business cases prepared in conjunction with the client to ensure the best possible likelihood of being approved for implementation.	+/-10%	An investment grade audit with detailed business cases to guide decisions on major energy savings measures.	A large site has identified a range of opportunities that exceed site management’s expenditure threshold and want detailed business cases for the Board.

The next figure shows a possible relationship between the various audit levels, and the increasing level of rigour required.



The other issue to consider with the current level system is its requirement of set accuracy rates. A level 3 audit requires costs and benefit estimates to be within 10% accuracy. However the obtainable accuracy for a given “level” varies for different technologies e.g. lighting, HVAC, refrigeration etc.

Feedback is requested on these issues.

6 Definition – Audit versus Assessment versus Review

Definitional clarity is a prerequisite for any discussion of The Standard. The terms “energy audit” and “energy assessment” have tended to be used loosely and interchangeably in Australia, New Zealand, the USA, UK and other English-speaking countries. “Energy review” is also used in some circles, including in the upcoming ISO50001 standard. However, where the term “audit” is defined at all, the definitions are typically strict and specific.

Energy auditing is still evolving as a discipline, and the term “energy audit” is frequently used incorrectly to describe procedures which are not in fact audits. The **key point of differentiation** between an audit and other types of investigation is that this evidence is compared against *an agreed set of audit criteria*. An “audit” as defined in the current Australian/New Zealand standard more closely reflects the definition of “assessment” given in ISO14015:

> “Whereas an auditor verifies existing information against established criteria, an assessor in addition gathers new information and is often required to evaluate information to determine business consequences”.

This aligns with a key objective of virtually every energy “audit”, which is to identify cost effective energy performance improvement opportunities.

In Australia the issue is further complicated as the term energy *assessment* has been associated with the Energy Efficiency Opportunities (EEO) program, specific building energy rating systems (e.g. NABERS, NatHERS), targeted state government programs (e.g. NSW Energy Efficiency for Small Business Program) and even assessments of energy production capacity (e.g. wind, solar).

The above evidence supports a view that the term “energy assessment” or “energy review” be used to describe the “audit” activities outlined in the current version of AS/NZS3598, and the term “audit” be restricted to audits of organisations’ *energy management systems* (EnMS), and audits against statutory or other compliance criteria which may apply to an organisation. This must be weighed against the widespread use of the term “energy audit” to describe these activities.

7 Support for accreditation and training

The shortage of suitably trained Providers has been flagged as one of the barriers to the take up of audit outcomes. The present state of energy assessment and auditing training in Australia lacks clear objectives and delivery models, and one of the proposed objectives of The Standard is to address this issue and provide guidance to training organisations.

Development of an accreditation system based on demonstrated competencies could also provide Energy Users with a level of assurance when selecting a Provider. This would address the criticism from Energy Users that they find it difficult to find auditors that have the relevant technical understanding or level of skills to assess their particular site or facility.

Currently, energy auditor training is offered by a range of industry associations, registered training providers and individual energy/environmental services providers (not necessarily training providers). In most cases there is little consistency between curricula, minimal acknowledgment of the existing standard, and with few exceptions, scant opportunity for peer review let alone formal accreditation of courses.

Certification of auditors is similarly dispersed across a number of industry associations. New Zealand runs a successful accreditation scheme based around the EECA Energy Audit Grants scheme. EMANZ is the accrediting body. In Australia, certification is provided by the Australian Institute of Refrigeration, Air-conditioning and Heating. There is also a requirement for formal accreditation to be a NABERS assessor. The only other national scheme appears to be the registration process for the very specific category of “Greenhouse and Energy Auditors” under the *National Greenhouse and Energy Reporting (Auditor Registration) Instrument 2009.*

The main points to consider in the development of The Standard with respect to training, certification and accreditation may be summarised as follows:

- The Standard could draw on the structure and range of variables set out in ISO19011 to establish criteria for competence of Providers. Competence is based on the demonstration of particular technical attributes, and ability to apply the knowledge and skills (generic and specific) gained through education, work experience, auditor training and audit experience.
- If The Standard is designed to inform Audits requiring different levels of detail and analysis it could be appropriate to consider setting different levels of Provider competence, i.e. not all Providers may need to be able to conduct Audits equivalent to the current Level 3 Audit.
- Clearly most Providers will have specialist expertise in just one or a small number of industries. Options to address this issue to support best practice in energy assessment and auditing could include assigning Providers to specific industry codes as part of the certification process.
- Assessor/auditor training will require the development of appropriate curricula, consistent with the competence criteria set out in the new standard. This will be a substantial project in its own right, involving extensive stakeholder consultation. It could draw on the experience of existing energy education and training related programs, for example the training of Greenhouse and Energy Auditors and the NSW DECCW Energy Efficiency Training Program.

In addition to accreditation of an auditor certification body or bodies, it will also be necessary to establish a program for accreditation of the training providers responsible for the delivery of an agreed assessor/auditor training program(s). The training provider accreditation body may or may not be the same entity as the auditor certification body.

8 Implementation & Priorities

This final section of the Background Paper explores the questions around how the review of The Standard should be implemented. Issues around implementation are uncertain as the process will depend upon the outcomes of the consultation phase. For instance, a complete rewrite of AS/NZS3598 will clearly operate to a different timetable than a minor revision.

This background paper has proposed a variety of options for The Standard. All involve a generic core standard. In some cases either sector specific or technology specific guidelines are included. It is likely that a suite of standards and supporting materials will be time consuming and expensive to implement. For example, a specific 'part' for on-road freight transport would be quite different to a specific part for commercial buildings or process heating systems. It is unlikely that all parts could be developed at once. Therefore it is necessary to identify the areas of greatest need and opportunity, and suggest a possible program or schedule of work.

Basing the approach on generic problems or a core methodology and then indicating what specific examples belong to each example class may overcome a substantial part of this issue. Producing guidelines outside of The Standard could also reduce cost and time for implementation but carries with it the risk of lack of rigour.

Finally there is the question of promotion of The Standard once it has been developed. AS/NZS3598 is currently not a mandatory standard and so Energy Users and Providers must be given reasons to use it. Financial incentives, such as the EECA Energy Audit Grants scheme is one option. Rolling out an accreditation scheme in Australia that is similar to the scheme used in New Zealand is another option. This is all likely to take considerable time, and require funding to support the development and rollout of any specific schemes.

Attachment A: Australian and New Zealand Government Programs

Energy Efficiency and Conservation Authority Energy Audit Grants

The EECA Grants are to part fund the cost of an energy audit. Energy audits must be done in accordance with AES/NZS3598:2000, and by an accredited energy auditor. The maximum amount of the grant is 33% of the cost of the audit, and the cap is 3% of your energy cost, to a maximum of $20,000 per site. Preference will be given to organisations that commit to implementing 50% of the audit recommendations that will deliver payback within 12 months. The auditors must be accredited with the Energy Management Association of New Zealand.

Commonwealth Energy Efficiency Opportunities program (EEO)

(http://www.ret.gov.au/energy/efficiency/eeo/about/Pages/default.aspx)

The Energy Efficiency Opportunities program encourages large energy-using businesses to improve their energy efficiency by requiring businesses to identify, evaluate and report publicly on cost effective energy savings opportunities. Participation is mandatory for corporations which use more than 0.5 petajoules (PJ) of energy per year.

The program applies to approximately 280 corporations from the mining, resource processing, manufacturing, transport and commercial sectors. These corporations represent approximately 60% of business energy end use and 45% of Australia's total energy end use.

The central component of Energy Efficiency Opportunities involves assessing a participant's energy use to identify cost effective opportunities for improving energy efficiency with up to four year paybacks. To ensure assessments are rigorous and comprehensive, participants must meet the minimum standard detailed in the Assessment Framework.

The key elements of the Assessment Framework cover:

- Leadership support for the assessment and the improvement of energy use;
- The involvement of a range of skilled and experienced people, and people with a direct and indirect influence on energy use during the assessment process;
- Information and data that is appropriately, comprehensively and accurately measured and analysed;
- A process to identify, investigate and evaluate energy efficiency opportunities with paybacks of four years or less;
- Business decision making for opportunities that are to be implemented or investigated further;
- Communicating the outcomes of the assessment and the investment decisions made regarding the opportunities identified and proposed business response, to the public, senior management, the board and personnel involved.

The program is supported by a range of documentation including the Energy Efficiency Opportunities Assessment Handbook and the Energy Efficiency Opportunities Industry Guidelines. An extract from the Guidelines is shown here.

Key Element 3

Information, data and analysis

INTENT

- Sufficient data, in suitable forms, is used to quantify and understand energy use, identify and quantify energy saving opportunities, and to track performance and outcomes (where actions are implemented).
- Energy data is analysed from different perspectives to understand relationships between activity and consumption, and to identify energy efficiency opportunities.

No.	Key Requirements	Evidence / Supporting documentation
3.1	Business contextual information that influences energy use is identified and documented, including: a. The key business priorities and plans (e.g. relocation, expansion) and how these influence or impact on energy use and the energy assessment; and b. The key site processes and activities that use energy.	Evidence showing that key background information has been collected and analysed for its impact on energy use, for example: • A background paper, series of reports or presentations summarising this analysis for consideration during the assessment.

A critical difference between EEO and typical energy assessment frameworks is the integration of leadership, people, planning / decision making and communications as well as technical elements. In this sense, the key requirements of the Assessment Framework are closer to what would be expected for an energy management system than a conventional assessment protocol, and the Framework itself could be seen as a de facto standard.

Both the structure and the content of the EEO Assessment Framework will need to be taken into account in the framing of the new version of AS/NZS3598.

Commercial Building Disclosure (CBD)

(http://www.cbd.gov.au/)

This program requires most sellers or leasers of office space of 2,000 square metres or more to obtain and disclose an up-to-date energy efficiency rating. From 1 November 2011 a full Building Energy Efficiency Certificate will need to be disclosed. These must be publicly accessible on the online Building Energy Efficiency Register, and include:

- A NABERS Energy star rating for the building;
- An assessment of tenancy lighting in the area of the building that is being sold or leased; and
- General energy efficiency guidance.

The NABERS Energy star rating must also be included in any advertisement for the sale, lease or sublease of the office space.

New South Wales Energy Saving Action Plans (ESAP)

(http://www.environment.nsw.gov.au/sustainbus/energysaving.htm)

The NSW Government introduced legislation in May 2005 requiring high energy users and local councils in NSW to prepare Energy Savings Action Plans. ESAPs provide a comprehensive analysis

of an organisation's energy use and management strategies, and involve determining current energy use, undertaking a management review, undertaking a detailed technical review and assessing and identifying savings measures.

The guidelines for preparing ESAPs nominate five tasks:

- Determining how much energy is used;
- Planning at management level;
- Determining how energy is used and efficiency opportunities;
- Putting the energy savings action plan together; and
- Implementing and reviewing energy savings action plans.

Step 3 – the technical review – is defined as:

> "a stand-alone investigation of energy use and opportunities for improvement that is of sufficient detail to enable implementation decisions to be made – generally a Level 3 Energy Audit under Australian Standard 3598:2000".

Participants in the ESAP program are supported by material available from the NSW Government. An example is the "Guidelines for Energy Saving Action Plans". The guidelines require the technical review to be similar to a Level 3 energy audit as per AS/NZS3598. An extract from the Guidelines follows

Detailed Technical Review Guidelines

For sites requiring detailed technical reviews, the following guidelines indicate the level of information and detail that may be required to support implementation decisions:

- preparation of an energy balance – essentially a model based on measured energy use to compare with actual consumption. (Reconciliation of model results and actual consumption can be used to identify and quantify waste)
- a detailed investigation of each energy using device, equipment item and process across the site and preparation of an inventory, including as appropriate:
  - energy consumption patterns and levels
  - description of energy use, operating, maintenance and cleaning procedures and
  - control systems, normal working hours, start up and shutdown procedures
- in addition, for major energy uses / processes / equipment items:
  - usage trends and patterns utilising the monitoring required in this section
  - energy consumption indicators (KPIs) including a comparison of current consumption against predicted energy use and
  - identification of appropriate energy use targets
- in production and manufacturing organisations, a consideration of scheduling and lengths of production runs
- quantification of out-of-hours consumption and identification of measures to reduce out-of-hours consumption and
- investigation of opportunities to reduce peak electrical demand (on weekday afternoons in December to February and early evenings on weekdays in June to August).

Victorian Energy and Resource Efficiency Plans (EREP)

(http://www.epa.vic.gov.au/bus/erep/default.asp)

The EREP program applies to large energy and water using sites – those using more than 100 TJ of energy and/or 120 ML of water per annum. The steps involved in preparing an EREP are:

- Calculating baseline energy, water and waste data;
- Identifying major energy-using, water-using and waste-generating activities;
- Identifying actions to reduce energy and water usage and reduce waste;
- Calculating financial and resource costs and savings expected from each action;
- Calculating payback periods for each action;
- Nominating timeframes and responsibilities for implementing actions;
- Monitoring, reviewing and reporting on the site's progress.

The EREP Toolkit Module 3 outlines a Resource Efficiency Site Assessment (RESA) procedure to assist designated organisations to meet program requirements. The document notes that:

> "There is no existing audit standard that includes an integrated assessment of energy, water and waste7. However, the requirements of a RESA build on the approach of the AS/NZS 3598:2000 energy audit standards".

Examination of the criteria set out in the Toolkit suggests (in relation to energy) the level of data collection and analysis necessary to inform an EREP could be obtained through an AS/NZS3598 Level 2 audit, although there is no explicit requirement for this in the EREP documentation. An extract from Module 3 of the Toolkit follows:

3.3 Step 3: Collect background information

3.3.1 Benefits

Collecting general information regarding your organisation, your premises and its operations will provide a context for your RESA and may highlight factors unique to your operations that can impact on your resource efficiency.

Collecting information before you start the assessment could prove to be beneficial in:

- defining what resource efficiency means with respect to your operations
- understanding how resource efficiency and your site operations are inter-related
- understanding the similarities between your site and other sites within your organisation
- developing an understanding of resource efficiency amongst staff members, tenants, contractors etc.
- gaining input and 'buy-in' from key personnel at the premises (for example, staff, tenants or contractors)
- identifying gaps in the premises' data and knowledge relating to resource efficiency
- reducing the amount of time it takes to complete the RESA.

Queensland Smart Energy Savings Program (SESP)

(http://www.dme.qld.gov.au/Energy/smart_energy_savings_program_.cfm)

The Queensland Government's Smart Energy Savings Program (SESP) requires participating businesses to undertake an energy audit, develop an Energy Savings Plan and publish their actions

[7] Although it could be argued that ISO114015:2003 *Environmental management – Environmental assessment of sites and organisations (EASO)* provides a suitable framework for integrated assessments.

for each relevant site, on a five-yearly cycle. The SESP initially applies to businesses with sites which consumed between 100 and 500 terajoules (TJ) in the 2009-10 financial year. The threshold will be reduced over time to capture smaller energy users.

To complete the Smart Energy Savings Program process, participating businesses are required to:

- Verify their energy use;
- Register to participate in the program;
- Audit energy use and identify energy savings measures;
- Produce an Energy Savings Plan of measures to implement;
- Publish a public commitment on the actions to be taken;
- Annually update the public commitment;
- In the third year, review progress and report;
- In the fifth year, collect baseline data for the next cycle.

The audit must comply with a Level 2 Energy Audit under Australian Standard AS/NZS3598:2000, as a minimum requirement. An extract from the SESP Guide follows:

7.2 Step 2: Set baseline

A baseline is to be set in year one of the cycle, based on the findings of the energy audit, and will form the basis against which the success of energy savings measures will be assessed. A baseline must be set for each registered site.

As part of the baseline, an energy efficiency indicator for the site's main business activity may be calculated. The energy efficiency indicator is a measure of energy saving performance that is independent of fluctuations in output or activity and scale changes such as adding or decommissioning a process or activity (i.e. energy per unit of output). A generic energy efficiency indicator is calculated as:

$$\text{Energy efficiency indicator} = \frac{\text{Energy use (TJ)}}{\text{Quantity of main business activity}}$$

Attachment B: Example Standard and Guidelines

AS/NZS3598 Contents Page

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Table 6: Different types of data analysis (continued)

Purpose	Where it may be useful	Key questions to ask
Benchmarking		
Establish and use suitable energy indicators to compare performance to: • other sites, processes, equipment, shifts, operators, etc.; • 'ideal' performance.	Wherever valid comparisons can be made – often more useful at an equipment, process or system level than at a site level. Benchmarking can also provide feedback for operators, designers, maintenance staff, etc.	Where there are differences, can I identify why they exist? How have the better performers done it? How can I apply this to my situation now, soon, or in the longer term?
X-Y plots of energy use versus production (this is really a single variable version of regression analysis)		
To clarify the nature of energy use relative to production rates	Any item of equipment, process or site where a measurable volume or quantity of product is processed and energy is used	How big is the 'fixed energy overhead'? What factors might be contributing to this? How far from the ideal is the gradient (i.e. marginal energy use per unit of output)? What factors might be contributing to this difference?
Energy-mass balance		
To understand where and how energy is used and lost throughout a system To assist in development	Any process where energy is used to carry out a task Development of the energy-mass balance is usually iterative, as often	Where is energy used and wasted? What material flows and transformations occur at each point in the process? How much energy is theoretically needed to carry out each stage – and how much is

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Attachment C: Extracts from Cost Estimation Guidebook

AACE Cost Estimate Classification System

CLASS 4 ESTIMATE	
Description: Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Typically, engineering is from 1% to 15% complete, and would comprise at a minimum the following: plant capacity, block schematics, indicated layout, process flow diagrams (PFDs) for main process systems, and preliminary engineered process and utility equipment lists. **Level of Project Definition Required:** 1% to 15% of full project definition. **End Usage:** Class 4 estimates are prepared for a number of purposes, such as but not limited to, detailed strategic planning, business development, project screening at more developed stages, alternative scheme analysis, confirmation of economic and/or technical feasibility, and preliminary budget approval or approval to proceed to next stage.	**Estimating Methods Used:** Class 4 estimates virtually always use stochastic estimating methods such as equipment factors, Lang factors, Hand factors, Chilton factors, Peters-Timmerhaus factors, Guthrie factors, the Miller method, gross unit costs/ratios, and other parametric and modeling techniques. **Expected Accuracy Range:** Typical accuracy ranges for Class 4 estimates are -15% to -30% on the low side, and +20% to +50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. **Effort to Prepare (for US$20MM project):** Typically, as little as 20 hours or less to perhaps more than 300 hours, depending on the project and the estimating methodology used. **ANSI Standard Reference Z94.2-1989 Name:** Budget estimate (typically -15% to + 30%). **Alternate Estimate Names, Terms, Expressions, Synonyms:** Screening, top-down, feasibility, authorization, factored, pre-design, pre-study.

Figure 2b. – Class 4 Estimate

CLASS 3 ESTIMATE	
Description: Class 3 estimates are generally prepared to form the basis for budget authorization, appropriation, and/or funding. As such, they typically form the initial control estimate against which all actual costs and resources will be monitored. Typically, engineering is from 10% to 40% complete, and would comprise at a minimum the following: process flow diagrams, utility flow diagrams, preliminary piping and instrument diagrams, plot plan, developed layout drawings, and essentially complete engineered process and utility equipment lists. **Level of Project Definition Required:** 10% to 40% of full project definition. **End Usage:** Class 3 estimates are typically prepared to support full project funding requests, and become the first of the project phase "control estimates" against which all actual costs and resources will be monitored for variations to the budget. They are used as the project budget until replaced by more detailed estimates. In many owner organizations, a Class 3 estimate may be the last estimate required and could well form the only basis for cost/schedule control.	**Estimating Methods Used:** Class 3 estimates usually involve more deterministic estimating methods than stochastic methods. They usually involve a high degree of unit cost line items, although these may be at an assembly level of detail rather than individual components. Factoring and other stochastic methods may be used to estimate less-significant areas of the project. **Expected Accuracy Range:** Typical accuracy ranges for Class 3 estimates are -10% to -20% on the low side, and +10% to +30% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. **Effort to Prepare (for US$20MM project):** Typically, as little as 150 hours or less to perhaps more than 1,500 hours, depending on the project and the estimating methodology used. **ANSI Standard Reference Z94.2-1989 Name:** Budget estimate (typically -15% to + 30%). **Alternate Estimate Names, Terms, Expressions, Synonyms:** Budget, scope, sanction, semi-detailed, authorization, preliminary control, concept study, development, basic