EREP Toolkit

Module 3 of 5:
A resource efficiency site assessment procedure

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CONTENTS

DEFINITIONS AND TERMS

TERM	DEFINITION
The Act	Environment Protection Act 1970.
Activity	Any task, process or service undertaken at the site.
Baseline data	The average resource use for each resource stream (water, waste, energy) in the established reference period (i.e. before undertaking EREP actions), excluding abnormal seasonal variations
Benchmarking	Comparing your own performance against relevant markers (e.g., other sites in your business or your industry sector, or known best practice markers) for the purpose of establishing your relative positioning.
Energy	Energy or energy sources specified in Schedule 1 of the Regulations used at a premises in accordance with the criteria described in regulation 6 of the Regulations and includes: (a) electricity (not generated at the site) whether from renewable or other sources; (b) steam (not generated at the site) used to provide energy; (c) compressed air (not generated at the site) used to provide energy; (d) combustible fuels; (e) reductants.
EPA	Environment Protection Authority Victoria.
EREP	An Environment and Resource Efficiency Plan.
EREP participants	Sites required to participate in the EREP program.
EREP program	The statutory program under which a business may be required to prepare an EREP, as set out in the Act and Regulations.
GHG	Greenhouse gas
Main meters	Meters that record the energy or water used at a premises that is supplied by an external third party.
Premises	The site which is being assessed for resource efficiency. The legislated scope of an EREP assessment is the operations within the site boundary. A wider assessment scope may be used voluntarily.
The Regulations	Environment Protection (Environment and Resource Efficiency Plans) Regulations 2007.
RESA	Resource Efficiency Site Assessment.
Reporting period	A financial year or another 12 month period approved by the Authority.
Resource efficiency hierarchy	Avoid, reduce, reuse, recycle, recover, switch, treat, contain, offset, dispose.
Resource efficiency indicator	The ratio of a site's resource use to the quantity of production or service activity occurring at the site (eg. the amount of resource consumed or waste generated per unit of production).
Resource use threshold	A threshold level of energy or water use which, if exceeded at a site, means that the site must participate in the EREP Program.
Site	A site has the same meaning as a premises.
Sub-meter	A meter installed within the site to record the energy or water supplied to an individual activity or item of equipment.
Trigger year	The 2006–07 financial year or any subsequent financial year in which the resource use thresholds are exceeded.
Utility	The supply of electricity, gas and water from a company that provides a public service.
Waste	Waste includes: • general waste (putrescible, solid inert, or prescribed industrial waste) • liquid waste (trade waste, domestic sewage, licensed wastewater discharge, or prescribed industrial waste), whether disposed of (on site or off site), reused or recycled.
Water	Water includes mains water, groundwater, surface water, recycled (or reused) water, desalinated water, rainwater, harvested stormwater and grey water, but does not include seawater.
waterMAP	A water Management Action Plan, prepared under a program defined by the Department of Sustainability and Environment, Victoria.

UNITS

kilolitre (kL)	one thousand litres.
Megalitre (ML)	one million (10^6) litres.
Gigalitre (GL)	one thousand million (10^9) litres.
kilowatt hour (kWh)	the energy use equivalent to using 1 kilowatt of electric power for 1 hour.
Megawatt hour (MWh)	one thousand kWh.
Gigawatt hour (GWh)	one million kWh.
Megajoule (MJ)	one million (10^6) joules.
Gigajoule (GJ)	one thousand million (10^9) joules.
Terajoule (TJ)	one million million (10^{12}) joules, and equivalent to 0.278 GWh.

1. INTRODUCTION

An organisation's energy and water consumption, use of materials and waste generation impact on the environment and the organisation's ability to operate sustainably. A resource efficiency assessment can help businesses identify opportunities for resource efficiency improvements, enabling sites to adopt a sustainable approach to resource use and waste generation.

This module outlines a resource efficiency site assessment procedure. It is part of an EREP Toolkit consisting of five modules designed to help organisations to manage resource efficiency in their businesses. Figure 1.1 shows where Module 3 fits within the EREP Toolkit and provides an overview of the material it contains.

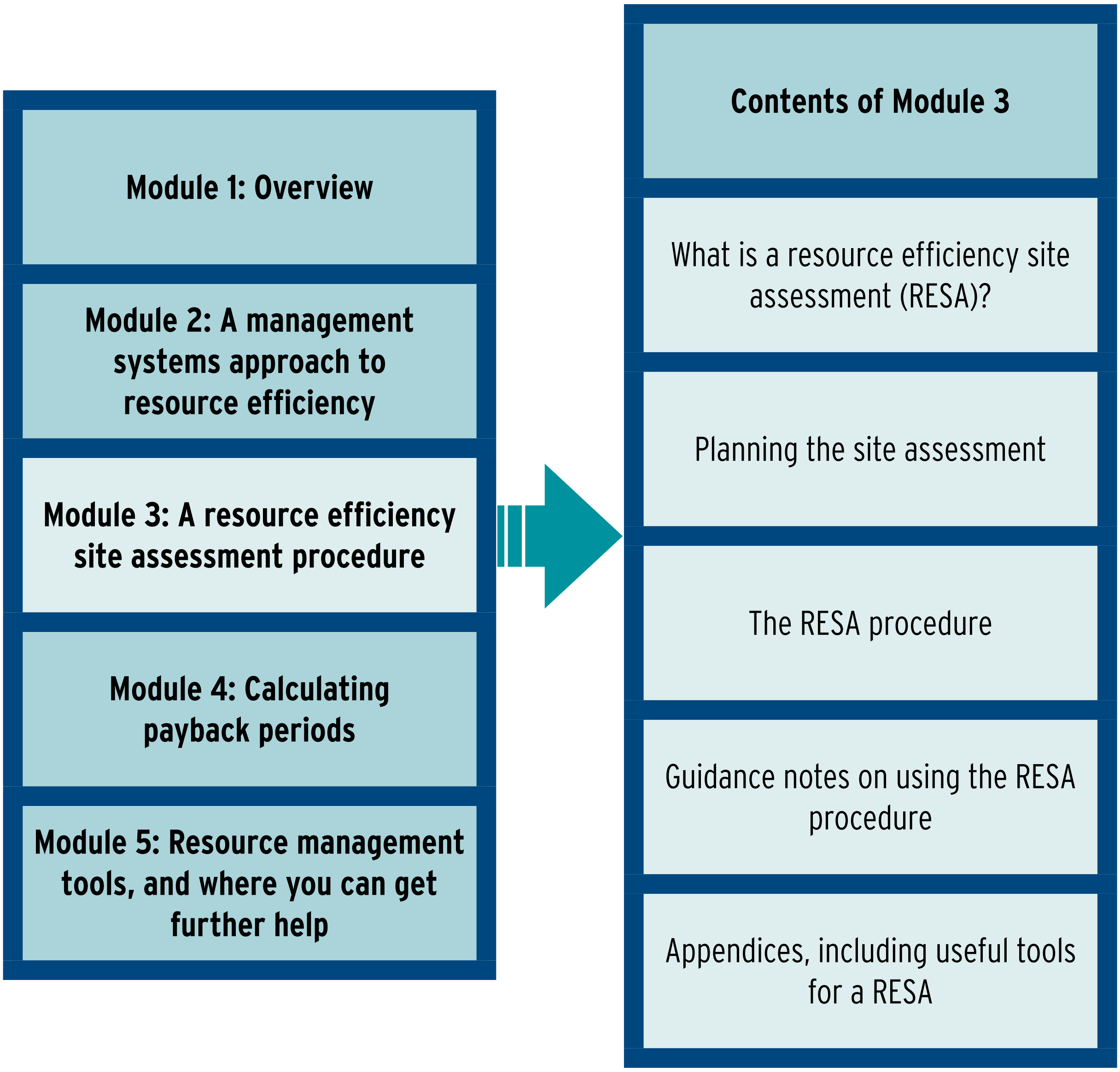


FIGURE 1.1: KEY ELEMENTS OF THE EREP TOOLKIT

The purpose of this module is to assist you to:

- identify the activities that consume the majority of resources and generate the majority of waste at your premises
- estimate the quantity of resources used and waste generated for each of these activities
- identify opportunities and actions to reduce resource use and/or waste generation

- assess each action for the potential savings in resource use and waste generation, total cost savings, capital cost to implement and simple payback period
- prioritise a list of actions.

1.1 How to use this module

This module includes five sections, two guidance notes and associated appendices. Hyperlinks within the document can be used to help you navigate to related sections of the module or to open external internet references.

Section 1 provides an introduction to the module.

Section 2 describes what a resource efficiency site assessment (RESA) is and provides some basic information about what an assessment may involve.

Sections 3 and 4 provide details on the two stages of a resource efficiency site assessment (planning and assessment), the steps involved in each stage and how these steps relate to each other.

Section 5 provides links to relevant resources and references.

Guidance Notes 1 and 2 provide more detailed practical support on various aspects of the planning and assessment stages outlined in Sections 3 and 4. Information includes who should be involved, using external consultants, and how to identify and assess activities and potential improvement actions.

Appendices provide examples and additional resource materials to assist in completing an assessment.

Key information in the guidance notes and appendices includes:

- working with consultants, and a 'scope of work' that can be used to help you engage a consultant
- information that will need to be available to inform a RESA
- a suggested format for a RESA report, including an action plan.
- a multi-criteria assessment approach for assessing and prioritising the potential actions that have been identified.

Where appropriate, this document refers to other modules in the EREP Toolkit and the EREP Guidelines. It also includes specific 'Notes for EREP participants' that show how aspects of the resource efficiency site assessment link to the EREP program.

This document should be used as a guideline for undertaking a resource efficiency site assessment. It is recognised that an organisation's structure, operations and approach to resource efficiency management may impact on the exact process used to undertake a site assessment and develop an action plan.

Note for EREP participants

An organisation may be required to undertake a detailed resource efficiency assessment as part of the EREP program (refer to the EREP Guidelines and Module 1 of the EREP Toolkit for more details). You should ideally use your organisation's existing approach to resource efficiency management and assessment, where this is suitable. Alternatively, the resource efficiency site assessment procedure outlined within this module can be used, as required, and will provide confidence that your assessment meets the EREP program requirements.

The action plan template shown in part 7.1 of Appendix C is the format that must be used for EREP submissions.

2. RESOURCE EFFICIENCY SITE ASSESSMENT

2.1 What is a resource efficiency site assessment?

A resource efficiency site assessment (RESA) aims to:

1. quantify overall site resource consumption and waste generation
2. identify the activities that use the majority of resources and generate the majority of waste
3. quantify resource consumption and waste generation for each significant activity
4. identify opportunities for resource efficiency improvement
5. assess the business-wide resource efficiency impacts, the implementation cost, and the annual cost savings that would be achieved from implementing each opportunity
6. prioritise the list of actions to be implemented so that an action plan can be developed.

The RESA procedure outlined in this module can be applied by any business to assess its resource use and identify opportunities to improve the efficiency of that use. The opportunities can then be assessed to determine their financial viability, and prioritised for the purpose of implementation.

Unlike single-dimensioned assessments (e.g., energy or water assessment), a RESA evaluates all inputs and all outputs of an activity together. This will provide a better understanding of the relationships between various inputs and outputs, and will better inform decisions on how to optimise operations and minimise overall environmental impact.

Note for EREP participants

We recognise that some sites may have already undertaken a range of single resource efficiency assessments relating to one or more of the water, waste and energy streams. These assessments are valuable inputs into the development of your EREP. However, it is possible that some of the assessments or actions identified require closer analysis in order to understand the impact on broader resource efficiency, as well as to identify a wider range of opportunities. In these instances, the RESA procedure is a suitable tool that can be adapted and applied.

Table 2.1 includes some of the common types of materials, energy, water and waste that an organisation might encounter in its operations.

TABLE 2.1: SCOPE FOR ASSESSMENT OF RESOURCE USE AND WASTE GENERATION

Materials	Energy	Water	Waste
• Raw materials / feedstocks • Chemical additives • Product packaging	• Electricity • Steam • Combustible fuels • Compressed air	• Mains water • Ground water • Surface water • Recycled water • Stormwater • Grey water	• Solid waste • Trade waste • Putrescible waste • Prescribed industrial waste • Fill material

CASE STUDY: THE BENEFITS OF AN INTEGRATED ASSESSMENT APPROACH (BlueScope Steel, Hastings)

A process integration study of BlueScope Steel's Western Port operations in Hastings, Victoria, was undertaken to identify opportunities and solutions to the company's environmental challenges. The facility was identified in EPA Victoria's Top 30 project as one of the 30 largest generators of prescribed industrial waste in Victoria.

It was recognised during initial site assessments that opportunities for water, energy and waste improvements were often interdependent and that issues surrounding prescribed industrial waste generation could be better addressed by improving the integration of the processes.

By analysing and optimising the flow of materials, water and energy around the site, potential opportunities were identified to:

- reduce prescribed industrial waste formation
- improve reuse and recycling of existing process flows
- increase water and energy efficiency.

Outcomes of the study

An integrated analysis and innovative approach to devising solutions resulted in 22 recommendations for process improvements that would not have been identified if the waste stream was considered in isolation. Each was assigned an order of priority and cost estimate. Some of these recommendations required more detailed study for optimisation. The table below summarises the main outcomes of the study.

For more information refer to the following web pages:

http://epanote2.epa.vic.gov.au/EPA/Publications.nsf/2f1c2625731746aa4a256ce90001cbb5/10bebc4ff15a76daca2572f9000c12da/$FILE/1132.pdf

http://epanote2.epa.vic.gov.au/EPA/Publications.nsf/2f1c2625731746aa4a256ce90001cbb5/07c91233f77bd16dca2572f1000a11db/$FILE/1157.pdf

Key outcomes	
Environmental improvement plan (2003–2006)	
Reduction in prescribed industrial waste	65% (2.6 kg per tonne of steel produced)
Reduction in energy cost and GHG emissions	• Cost savings of approx. $800,000 per annum • GHG reduction:42,000 tonnes of CO2-e
Return on investment (2003-2006)	Recovery of implementation costs: 1.2 years
Key initiatives implemented	• Installed a Filter Cake Drying Plant • Partnered with waste service provider • Glove and rag recycling • Establishment of Environmental Committee • Implementation of ISO 14001
Environmental improvement plan (2006–2011)	
Anticipated outcomes	• Cost savings of approx. $600,000 per annum • GHG reduction: 20,000 tonnes of CO2-e (in 2011)

2.2 Why undertake a RESA?

An organisation may undertake a RESA for a number of reasons, including to:

- more accurately assign the cost of resources and wastes to products/services
- identify opportunities for savings in resource consumption and waste generation
- optimise a process/operation
- better inform its business decisions.

A RESA may be undertaken for the whole premises or for a specific process, operation or activity.

2.3 What are the steps involved in a RESA?

A RESA has two main stages: the planning stage and the assessment stage. There are a number of steps involved in each stage, which can be further broken down into tasks. The key stages and steps are outlined in Figure 2.1.

Further information

Detail on the planning steps is outlined in Section 3 of this module, while the assessment steps are detailed in Section 4 of this module. Guidance on how to undertake each step, and some points for further consideration, are included in Guidance Notes 1 and 2 of this module.

2.4 How long will it take to complete a RESA?

The time to complete a RESA will depend on a number of factors including:

- whether any work regarding resource efficiency has previously been undertaken at the premises or within the organisation (e.g., at other similar operations)
- the availability of information
- the availability of staff and funding
- the complexity of operations
- the experience and knowledge of staff at the premises or within the organisation (e.g., at other similar operations)
- the desired level of accuracy.

If an organisation is starting from scratch it may take up to six months to complete a RESA. However, if an organisation has been working to improve resource efficiency over several years, the RESA may only require that the existing assessments and action plans are updated and integrated into one, which may only take a few weeks or a month.

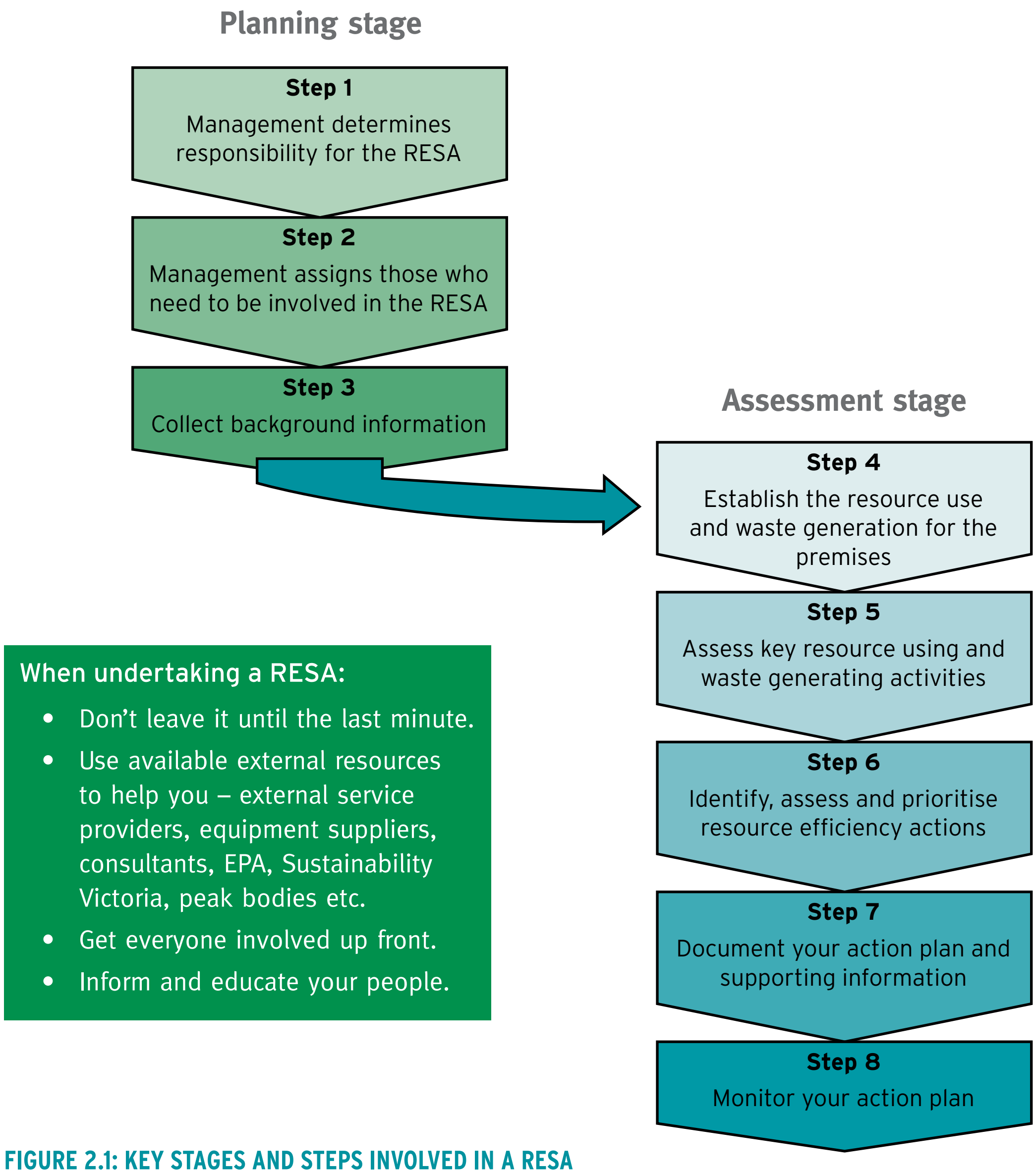


FIGURE 2.1: KEY STAGES AND STEPS INVOLVED IN A RESA

2.5 What are the outcomes of a RESA?

A RESA will help an organisation to develop an action plan that will deliver savings in resource consumption, waste generation and the associated costs. In addition, those involved in the RESA process will gain a greater understanding of how the organisation's operations, resource use and waste generation are related, which can provide significant benefit to the organisation. The RESA can also enable better communication with employees and other stakeholders on resource efficiency.

Undertaking a RESA is just one step that an organisation can take to improve its management of resources and wastes. The benefits that can be achieved will be maximised when this assessment is undertaken as part of a resource management program. Further details on resource management can be found in Module 2 of the EREP Toolkit.

CASE STUDY: WHAT ARE THE OUTCOMES OF A RESA? (Unilever, Tatura)
Unilever's Tatura facility found that a comprehensive assessment method which looks at all aspects of an organisation and uses innovative approaches like Total Productive Manufacturing to highlight areas for resource efficiency improvements can have real savings for organisations. Taking a structured and systematic approach to problem identification, investigation and solution finding can have enormous savings for the environmental, social and economic aspects of the organisation. For more information refer to the following web page: http://epanote2.epa.vic.gov.au/EPA/Publications.nsf/2f1c2625731746aa4a256ce90001cbb5/3c04e984cd426203ca2572f9000d0aad/$FILE/1129.pdf

2.6 What level of detail is required for a RESA?

A RESA requires you to 'map' and calculate the resource use and waste generation for your premises, or for a specific area or operation within your premises. Various steps in the assessment procedure outlined in Figure 2.1 require quantities to be determined. In many cases you will need to use estimation techniques, which will have an error associated with them. However the more detail that can be applied to an assessment the lower the overall error will become. In general, the level of detail required for a RESA is directly related to the level of accuracy necessary for each step or task.

As you progress through the assessment the level of accuracy required will vary. For example, the output of Step 4 will form the basis for the entire assessment so it is desirable to have a high degree of accuracy and, therefore, a detailed assessment (e.g., meter readings) is preferred.

In Steps 5 and 6 you may find that an iterative approach is most effective. You may start by making rough estimates to determine where or for what activities the most significant resource use occurs, or which potential actions are likely to generate the greatest savings. As you progress through the procedure you may need to revise these estimates, using more detailed analysis and information. This will increase the accuracy of estimates to a point where it is sufficient to support a business case for an action. This will be particularly important if significant capital investment is required.

See Guidance Note 2 for further advice on the level of accuracy required at each stage of the assessment

2.7 How often do I need to undertake a RESA?

We recommend that once you complete your assessment you regularly maintain and update the data and information used as its basis. It is particularly important to update data when:

- establishing improved monitoring systems
- resource and/or waste disposal costs change
- a major change in operations occurs.

We also recommend that a complete review of the RESA is undertaken and reported to management every year. This should involve working through each task in the RESA – not just those where estimates have been made – otherwise you may not fully take into account changes in your operations or changes in technology.

For example, you should:

- review operations to determine whether any changes have occurred within the key resource-consuming and/or waste-generating activities
- update data with new information:
  - main meter and sub-meter data
  - technical data
  - changes in activity frequency, hours of operation, work practices etc.
  - additional manual monitoring data (e.g., log sheets, maintenance records, stocktake data)
- revise opportunity assessments with updated data
- evaluate new technologies/opportunities
- prioritise actions and revise the action plan.

3. PLANNING THE ASSESSMENT

Before starting the RESA it is important to undertake some preparatory work to ensure that the assessment is completed within management's required quality, budget and time constraints. The three steps involved in the planning stage are outlined in Figure 3.1.

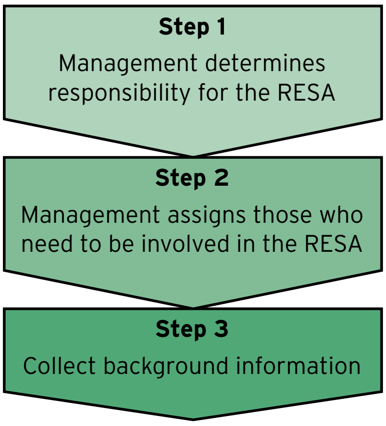


FIGURE 3.1: STEPS IN THE PLANNING STAGE OF A RESA

3.1 Step 1: Determine who will be responsible for the RESA

You will need to assign responsibility for completing the RESA. This person(s) may not necessarily undertake the assessment personally but is responsible for managing the RESA process. Similarly, this person(s) will not necessarily be responsible for implementing the RESA actions but will be responsible for monitoring progress against the action plan.

When determining who should be responsible, you should consider who has the skills and the authority to manage the process. This person will ideally have some understanding of resource use and waste generation at the premises as well as the ability to engage team members and relevant managers in the process. If the RESA needs to be completed within a set timeframe, the person should also have the ability to manage their own time as well as influence the time of the other team members completing the assessment.

3.2 Step 2: Determine who will be involved in the RESA

First consider what information is needed to complete a RESA and the skills that will therefore be required. A RESA requires a thorough assessment of resource use and waste reduction opportunities and should be prepared by a team with the necessary qualifications and expertise.

See Guidance Note 1

Section 1.1 of Guidance Note 1 provides further support on:

- potential internal assessment team members, and where they can provide assistance
- potential external assessment participants
- how to get your people involved in the RESA.

CASE STUDY: INVOLVING THE RIGHT PEOPLE (BlueScope Steel, Hastings)

In 2003 BlueScope Steel's Western Port facility assessed energy use for each of its processes. Instead of just contracting out the assessment and action plan development, the Western Port team decided on a smarter approach. It put together a small assessment team made up of:

- the Principal Environmental Engineer
- a combustion engineer with a passion for systems improvement
- an energy efficiency consultant to work intensively on the audit and the action plan.

At half a dozen brainstorming workshops with employees from different areas of the plant, the Energy Team posed just one question: 'If this afternoon you were told that energy would be indefinitely restricted by 10 per cent, starting tomorrow, how would you run your process?'

Over 100 energy saving ideas were generated for the Energy Team to assess. After estimating the costs, timelines and potential to reduce greenhouse gas emissions, 16 actions were included in BlueScope Steel Western Port's 2003–2006 Energy Improvement Plan, with some other worthy ideas included for further investigation. These actions resulted in savings of 42,000 tonnes of GHG emissions per year, delivering not only environmental benefits but impressive financial benefits as well.

With 11 more energy saving actions in its 2006–2011 Environmental Improvement Plan, the site is anticipating that GHG emissions will be reduced by a further 20,000 tonnes per year at the completion of the EIP.

For more information refer to the following web page:

http://epanote2.epa.vic.gov.au/EPA/Publications.nsf/2f1c2625731746aa4a256ce90001cbb5/07c91233f77bd16dca2572f1000a11db/$FILE/1157.pdf

3.2.1 Employees

In order to obtain maximum value from your RESA, a range of people from across your organisation should be involved in each step of the assessment. These people may include site-based managers and staff, as well as staff with organisation-wide responsibilities (such as the national environment manager and purchasing officer – raw materials).

3.2.2 Relevant third parties

Depending on your operation, you may have third parties who use resources or generate waste at your premises (for example tenants, contractors and joint venture employees). If this is the case, you will need to consider how you will involve these third parties in your assessment.

Raw material suppliers, energy and water retailers, waste contractors, service providers and equipment suppliers can provide useful information throughout the assessment, including identifying opportunities to reduce resource consumption and waste generation.

CASE STUDY: WORKING WITH TENANTS TO REDUCE WASTE (Westfield)

Westfield developed a trial sustainable business management program within the International Food Court of Sydney Central Plaza. The program works closely with retailers to reduce the environmental impact of food court retailers and at the same time increase the potential for greater profitability. The program creates knowledge and awareness about sustainability through retailer training and workshops and ongoing support from Westfield centre management. Progress is measured through a series of audits focusing on water and energy usage, transport, waste management and business management including staff satisfaction and productivity.

The program has been very well received by retailers and is already expected to cut energy and water usage by 10 per cent. It is planned that the program will be rolled out to other Westfield centres.

CASE STUDY: WORKING WITH SUPPLIERS TO REDUCE WASTE

Hawker de Havilland receives up to 14 large boxes from America every month, each 1 m^3 in volume. They contained aircraft balance weights, which used to be held in trays made from silica-impregnated expanded plastic. This was not recyclable and went to landfill.

The company asked the supplier to replace this packaging with a cardboard tray based on a 'McDonald's style' drinks holder. The supplier came up with a new packaging design that not only protects the product but has resulted in the following savings:

- reduced waste fees – 300 m^3 of plastics not sent to landfill per year
- reduced packaging fees and airfreight costs, and greater potential for cardboard recycling.

3.2.3 External consultants

You may find that people within your organisation do not have all of the necessary skills to undertake an assessment or those who have the skills are not available. In this case, the outcome of your assessment is likely to be enhanced by the appointment of an appropriately qualified consultant to work with you to complete some or all of the assessment steps.

However, to gain the most benefit from your RESA, it is important to remember that you (not the consultant) are ultimately responsible for undertaking the RESA and implementing any actions. You must retain 'ownership' of the RESA process.

See Guidance Note 1

Section 1.1 of Guidance Note 1 provides further support on:

- what role a consultant should play in a RESA
- developing a 'scope of work'
- working with consultants

Appendix B includes an example of a 'scope of work' for an external contractor.

Appendix C includes a format that should be used to prepare a RESA report.

3.2.4 Determine roles

Having identified who will be involved in the RESA you need to clearly define each person's role in completing the required tasks, so that everyone involved in the assessment understands what is required of them and how much time they will need to make available.

This task is especially important if you engage a consultant. The consultant will help YOU complete the RESA. They will need you to provide access to the relevant people to obtain the information they require. You will still need to involve a cross-section of employees in the assessment process in order to maximise the benefit to the organisation.

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.

3.3.2 Existing information

You may have existing environmental management plans that include some of the information required for the assessment.

You should also identify whether any previous work has been undertaken at your premises (or similar sites within the organisation) in the area of resource efficiency and/or organisation sustainability as this may:

- provide data that can be used in the identification of the key activities that use resources and/or generate waste
- identify actions that have not been implemented and can be considered for inclusion in your assessment
- stimulate ideas for reducing resource consumption and waste generation that can be developed into actions.

In addition, you may find that your organisation and/or premises is participating in other voluntary and/or mandatory resource efficiency programs, which may provide valuable information for your assessment.

See Guidance Note 1

Section 1.2 of Guidance Note 1 provides further advice on:

- how previous work may relate to the RESA
- how related programs may provide useful information for the RESA.

Appendix A includes a list of information that may be required to complete an assessment.

4. UNDERTAKING THE ASSESSMENT

Steps 1 to 3 of the resource efficiency site assessment (RESA) were discussed in Section 3 under the general heading of planning. The subsequent steps 4 to 8 cover the assessment stage of the RESA. The individual tasks required to complete these four steps are shown in Figure 4.1 below.

The following sections provide some details of what may be involved in each task.

See Guidance Note 2 for further support and worked examples on how to undertake each task.

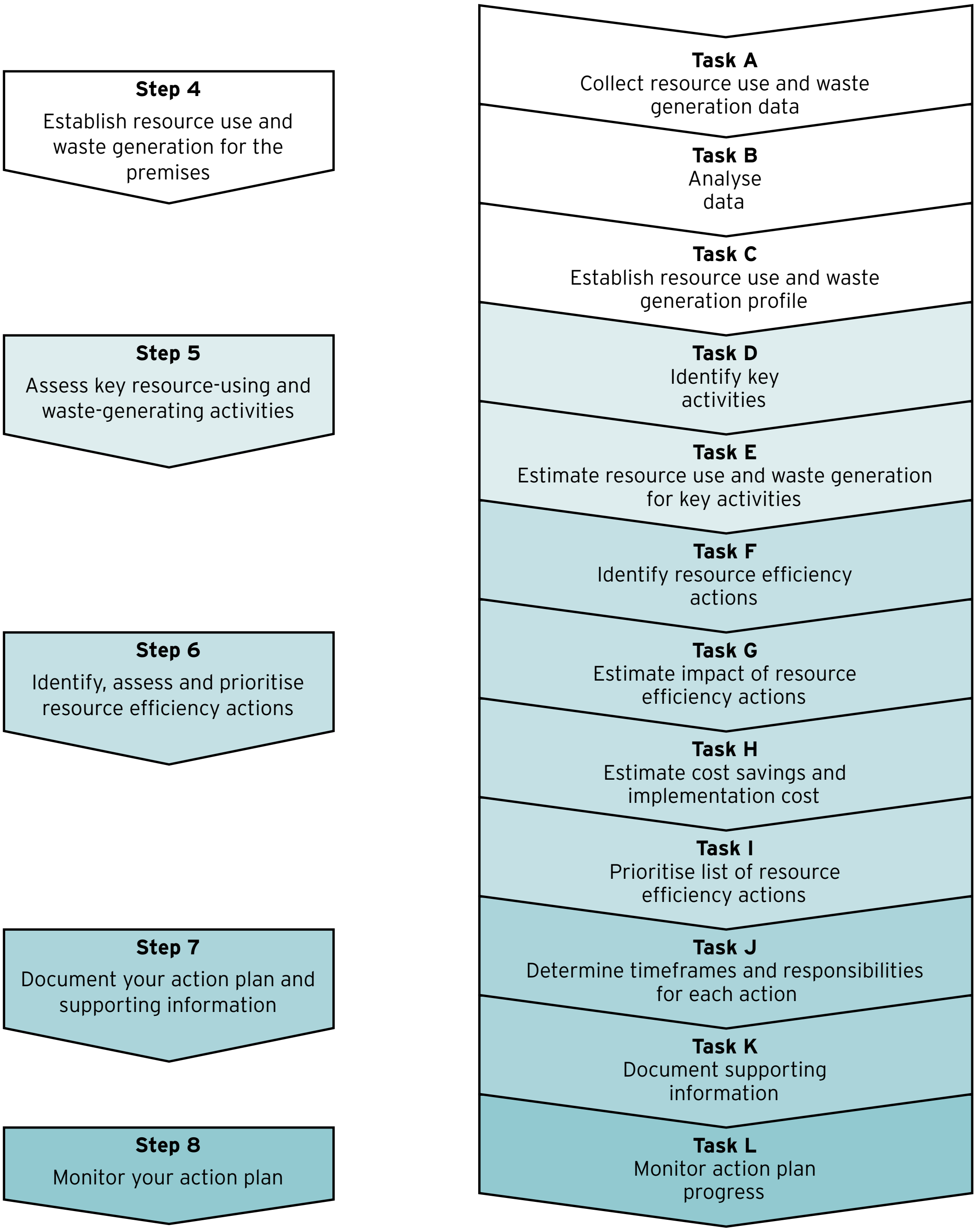


FIGURE 4.1: STEPS AND TASKS IN THE ASSESSMENT STAGE OF A RESA

4.1 Step 4: Establish your resource use, waste generation and efficiency profile

The purpose of this step is to collect, analyse and establish baseline data for the consumption of resources and generation of waste at your premises. This baseline data will be used to identify an appropriate resource efficiency indicator, and together these will track the efficiency gains that are achieved when you implement your action plan.

4.1.1 Task A: Collect data

In order to undertake a resource efficiency site assessment we recommend that you collect the following data:

- the quantity of resources consumed, by type, including:
  - raw materials, chemicals and packaging
  - energy (include load profile data if available)
  - water (include load profile data if available)
- the quantity of production or activity at the site, by type
- the quantity of waste generated, by type
- the quantity of greenhouse gas emissions associated with each input and output
- where possible, separately identify or estimate water usage for fire service testing.

Where available, the data should be collected for a minimum of a continuous 24-month period and recorded on a monthly basis. Data over a 24-month time period will serve to highlight any seasonal trends in your resource use and waste generation.

Note for EREP participants

If you are participating in the EREP program you must collect appropriate baseline data and identify an appropriate resource efficiency indicator (refer to the EREP Guidelines).

See Guidance Note 2

Section 1.1 of Guidance Note 2 provides further support on:

- where to obtain baseline data
- estimating baseline data
- baseline data accuracy
- how to estimate greenhouse gas emissions.

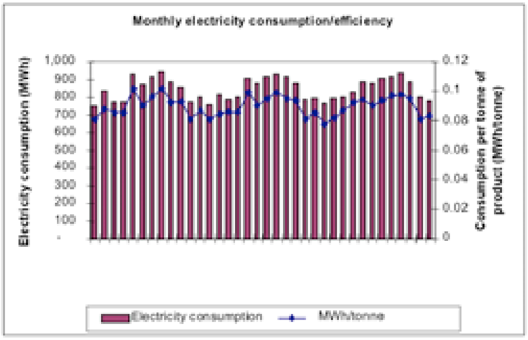
Appendix D provides further guidance on reading and understanding your energy, water and waste bills.

4.1.2 Task B: Analyse data

Most organisations should, as a minimum, monitor resource use and waste generation on a monthly basis, with some streams monitored continuously (such as energy, water and some materials).

Consider how resource consumption and waste generation vary with time and with the level of activity at the premises. By having data for a two year period or longer you will be able to identify patterns in the data. Look for the impact of seasonal factors and consider whether any major changes in operations have affected the resource consumption and waste generation profile for the premises. If the load data for energy and/or water is available you should look for trends within a day, within a week and within a year, to identify both similarities and changes in the load profiles. Figure 4.2 provides examples of profiles for common resources.

You should compare your resource consumption and waste generation with a number of different business acivity indicators. This will help identify the best resource efficiency indicator for your business. Many industry sectors have indicators that are commonly used. Such indicators allow you to compare your efficiency with other businesses. Module 2 of the EREP Toolkit contains more detail on using resource efficiency indicators as part of ongoing benchmarking.



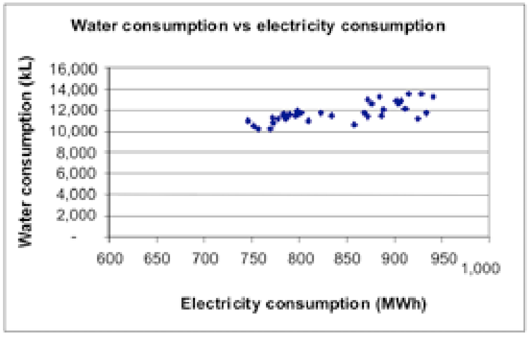


FIGURE 4.2: RESOURCE PROFILES

4.1.3 Task C: Establish the baseline period

The baseline data is what you will evaluate the resource efficiency gains against as you implement your action plan. It is therefore preferable that the baseline period be set so that it represents a typical year of operation at the premises and can be used for future comparisons of your resource consumption and waste generation profile.

We recommend that you use a minimum of a continuous 12 month period as your baseline period that does not start any earlier than 2 years before undertaking the assessment. You may wish to use the financial year period that your organisation uses for other reporting purposes, although you should always consider whether this will represent your future operations. You may also choose a period greater than 12 months if this better represents your typical resource use and waste generation.

You should provide an indication in your assessment as to whether the baseline data is representative of typical operations at the site. If the baseline data is not representative, you should indicate why and what you would expect the baseline data to be in a typical year of operation (e.g., 10 per cent higher, 5 per cent lower) and the basis for this estimate.

Note for EREP participants

If you are participating in the EREP program you may wish to use the EREP trigger year as your baseline period (refer to the EREP Guidelines).

See Guidance Note 2

Section 1.1 of Guidance Note 2 provides further support on:

- deviation from typical resource use
- resource efficiency tracking systems.

4.2 Step 5: Identify and assess resource using and waste generating activities

The purpose of this step is to understand the key areas of resource use and waste generation at your premises. Undertaking a RESA will highlight the activities and processes that consume the most resources and/or generate most of the waste. This data analysis phase will provide guidance on where to focus your efforts when identifying resource saving initiatives.

4.2.1 Task D: Identify resource using and waste generating activities

What is an activity?

For the purpose of undertaking an assessment, an ‘activity’ refers to any task, process or service, and may include one or several items of equipment. Resource efficiency actions will primarily relate to the activity, not the location, as there may be several unrelated activities that occur within an area that contribute to its resource use and/or waste generation. As a result it is preferable to analyse resource use and waste generation by activity and not by area, department and/or building description alone.

In order to identify the activities that are the major resource users and/or waste generators at your premises, start by identifying all of the activities that use resources and generate waste. You can do this through:

- observation
- review of drawings
- collection of raw data
- talking to the relevant staff
- review of relevant case studies.

Following this you should be able to make an educated guess as to which of these activities are likely to have the greatest impact on resource use and waste generation.

The output of this step should be a map or diagram that shows the main areas at your site and the resource inputs and product and waste outputs for each area. You may also list the resource-using and waste generating activities that occur in these areas on the diagram.

See Guidance Note 2

Section 1.2 of Guidance Note 2 provides further advice on:

- activities that may use resources and/or generate waste
- how to identify the key resource using and waste-generating activities
- resource efficiency diagrams.

4.2.2 Task E: Estimate resource use and waste generation for the key activities

The individual resources used and wastes generated are often highly inter-dependent. For example:

- some of the water used will be discharged as trade waste
- some of the raw materials/water used will be discharged as waste heat (evaporation, flare gas)
- some of the raw materials will have water as a component
- some of the chemicals used will have solids as a component (some suspended, some dissolved)
- some of the wastes generated will include water, chemicals, product, raw materials and packaging materials as components.

We therefore recommend that you undertake an integrated mass and energy balance for the entire premises. This should consider all inputs (such as water, raw materials, chemicals, electricity and combustible fuels) and all outputs (such as product, trade waste, commercial/industrial waste, prescribed waste, evaporation, waste heat and air emissions) rather than trying to balance resources, water, energy and waste separately.

Mass and energy balances

The two key principles for estimating resource use and waste generation for a premises are:

sum (Individual activity resources /wastes) = Total resources/wastes

and

sum(inputs) = sum(outputs)

That is, the sum of the resources used by the individual activities must equal the total of the resources used by the premises. Similarly, for waste generation – the sum of wastes generated by the individual activities must equal the total waste generated by the premises. In addition, the sum of all of the energy or material inputs must equal the sum of all of the energy or material outputs.

These principles hold for all applications (e.g., premises, a process or an activity) and are often referred to as a balance or mass and energy balance. The approach follows the principles of mass and energy conservation, which state that neither energy nor mass can be created or destroyed, only transformed.

You will need to estimate the quantity of the inputs (resources) and the outputs (products and wastes) for each major resource consuming and waste generating activity identified as part of Task D. For some activities you may have sub-meter data that will provide you with accurate information for some of the resources and/or wastes. However, for many activities you will need to make an estimate based on engineering calculations. Where this is the case, you should consider what factors can influence the resource usage/waste generation profile of an activity and how this profile may vary throughout a day, over a week, and/or over a year. Some outputs (such as evaporation and waste heat) will not be measured and it may be difficult to calculate these quantities. These streams may be used to 'balance' the mass and energy balance, although you should always consider whether the estimates are logical and appropriate.

As you make each estimate you will account for more and more of the total resource use and waste for the premises. Once your mass and energy balances account for 80 per cent of each type of resource use and waste generation you will be able to identify the key activities at the premises. This level of accuracy will be sufficient to begin the next phase of the assessment, Step 6 (Identify, assess and prioritise resource efficiency actions).

Where possible, existing data should be used, although you may find that installing sub-meters or using additional manual data collection measures is required to accurately complete your RESA. However, this does take time. These measures should be established early in the RESA process, to ensure that your RESA can be completed within the required timeframe.

CASE STUDY: INSTALLING SUB-METERS

Sub-metering programs can be viewed as an instrument of resource management in commercial and industrial facilities. For example, a sub-metering program was successfully conducted in the buildings of University of Sao Paulo in Brazil. The results of the program were:

- Reduction of water consumption: 36 per cent for the whole campus.
- Reduction in water costs from US$6.1 million to US$4.6 million per year (comprising water supply and collection of sewage), despite price rises of 69 per cent in this period (1997 to 2003).

http://www.pura.poli.usp.br/download/CIBW62_2004.pdf

Step 5 can be an iterative process. You may have to revisit Task D in order to account for 80 per cent of your resource use and/or waste generation in Task E.

See Guidance Note 2

Section 1.3 of Guidance Note 2 provides further support on:

- using mass and energy balances in a RESA
- calculating mass and energy balances
- the level of accuracy required for mass and energy balances
- using existing assessments/previous work to complete integrated mass and energy balances.

Section 1.4 of Guidance Note 2 provides further support on:

- information required to estimate the quantity of resource used and/or waste generated by an activity
- using monitoring data to estimate resource use and waste generation for an activity
- using engineering calculations to estimate resource use and waste generation
- the level of accuracy required for individual activity estimations.

Section 1.5 of Guidance Note 2 provides information on approaches to resource efficiency assessment.

4.3 Step 6: Identify, assess and prioritise resource efficiency actions

The purpose of this stage is to identify, assess and prioritise all actions that would improve resource use efficiency and reduce waste generation at your premises. Having established your resource use and waste generation baseline and assessed the key activities that consume resources and generate waste, you will have developed an understanding of your resource efficiency performance. This will provide a framework for identifying resource efficiency opportunities and actions. Once you have completed this step you will be able to document your action plan.

4.3.1 Task F: Identify actions that could reduce the quantity of resources consumed or waste generated by an activity

Once you have identified the activities that account for the majority of your resource use and/or waste generation you need to make an assessment as to whether these activities are efficient in their resource use/waste generation.

In other words, 'Why do we do it this way?' and 'Can we do it better?'

Preferred opportunities approach

As you assess each activity you should apply principles similar to those of the waste hierarchy. Ask the question:

'How can we avoid → reduce → reuse → recycle → recover → switch → treat → contain → offset → dispose of this resource or waste?'

The RESA should focus on the first five elements, as these will have more impact on your resource efficiency. The lower elements only reduce the impact on the environment.

Methods for identifying opportunities

There are a number of approaches you can use to identify resource efficiency opportunities. It is recommended that you start with a combination of basic techniques such as:

- site walkthroughs
- brainstorming
- five whys?
- root cause analysis (see the fishbone diagram technique shown in Figure GN2.3 of Guidance Note 2)
- review of organisational policies and procedures
- case study reviews
- talking to relevant experts.

You can then further investigate your initial list of opportunities using more detailed methods including:

- data analysis (such as trending, correlations and statistical process modelling)
- benchmarking/best practice assessment (refer to Module 2 of the EREP Toolkit):
  - assess individual activities – not just the premises
- internet searches/literature review/research and development (refer to Module 5 of the EREP Toolkit).

CASE STUDY: USING A COMBINATION OF METHODS TO IDENTIFY OPPORTUNITIES

A resource efficiency program, which involved 13 food and drink companies in the United Kingdom, aimed to improve the facilities' environmental performance, operational performance and profitability.

Achievements

- Annual savings of £1,100,000 (which significantly exceeded the investment by the 13 companies). This saving represents an average 0.4 per cent of the members' turnover.
- The average payback time for all implemented resource efficiency opportunities in these companies was less than four months.
- Reduction of raw materials use and solid waste generation of 1400 tonnes/year.
- Reduction of CO_2 emissions of 670 tonnes/year.
- Reduction of water use by 70,000 kL/year.

The above achievements resulted from the implementation of the following approaches:

Adopting best practice technologies

The companies invested £335,000 to upgrade their production to 'cleaner' technologies.

For example: Packaging waste was one of the main solid waste generation sources. New, more efficient packaging systems were installed.

Reviewing business policies and procedures

It was identified that purchasing and selling policies had a significant potential to increase resource efficiency through their impact on the company's supply chain.

For example: Sites held discussions with their distributors about optimum products, packaging and transportation.

Talking to relevant experts

Consultation between the companies and the British Retail Consortium enabled better cooperation between the companies.

Data analysis

Extensive production, purchasing and selling data was used in this program in order to outline the best strategy for these companies to meet the program objectives.

Benchmarking/best practice assessment

The program identified that those vegetable products that could not meet the high quality standard of their main distributors (e.g., supermarkets) were generally disposed of to landfill. However, best practice for sub-standard vegetable products was identified as selling them for use by fast food chains, prisons or state-funded hospitals rather than disposing of them to landfill.

Developing actions from opportunities

Once you have a list of opportunities you will then need to develop a series of specific actions that can be implemented. These actions need to outline what it is you plan to do and for what area you plan to do this. Table 4.1 includes some examples of actions that could be implemented from an opportunity to 'replace inefficient fixtures'.

TABLE 4.1: EXAMPLES OF ACTIONS ASSOCIATED WITH AN OPPORTUNITY

Materials	Action(s)
Replace inefficient fixtures	• Install flow restrictors in all toilet hand wash taps and hoses. • Update preventative maintenance plan to include the replacement of all 36 W fluorescent lights with 28 W fluorescent lights. • Include a minimum standard for taps, toilets, urinals, showers, lights and electric motors in the organisation's purchasing policy. • Communicate the new purchasing policy to all staff with purchasing responsibilities.

See Guidance Note 2

Section 1.6 of Guidance Note 2 provides further support on:

- the preferred opportunities approach
- using 'representative premises' for identifying resource efficiency opportunities
- how to identify resource efficiency opportunities
- facets of the organisation that should be investigated to identify opportunities.

4.3.2 Task G: Estimate the impact on resource consumption, waste generation and other organisation parameters for each action

Once you have identified your resource efficiency actions you will need to determine the potential savings in resources and waste and any other benefits/risks that may be associated with implementing each action.

You will need to consider:

- 'What will change if this action is implemented?'
- 'How will this change impact on EACH TYPE of resource used and waste generated by this activity?'
- 'What will be the new resource use and waste generation profile for this activity?'

Impact on greenhouse gas emissions

Once you have estimated the impact the action will have on resource use and waste generation it is recommended that you estimate the overall impact on the greenhouse gas emissions or carbon footprint of your premises (refer to Section 1.1.4 of Guidance Note 2). Estimating GHG emissions for each action will have several benefits:

- It will identify actions that do not result in a net carbon footprint reduction.
- It will allow you to estimate the financial savings that would be achieved if a carbon trading scheme were introduced in Australia.
- It will provide input for prioritising actions (refer to Section 4.3.4 of this module).

Impact on wider operations

You should also estimate the impact the action may have on your wider operations (for example down time, quality and maintenance frequency). This may highlight additional savings that the action may achieve or identify some disadvantages that the action may introduce, which may need to be addressed before the action can be implemented.

- 'What other benefits/disadvantages might this action have?'

4.3.3 Task H: Estimate the 'total' cost savings and the implementation cost for each action

In this task you will estimate the 'total' cost savings that can be achieved if an action is implemented and the cost to implement the action. This is an extremely valuable exercise as it will provide you with improved estimates for how much it actually costs to produce an item/service.

The 'total' cost savings will not only include the purchase cost of the resources and the cost to dispose of any waste but will also include savings in the 'hidden' costs such as treatment costs, labour, maintenance, etc. For example, if you identified in Task G that an action would increase productivity by two per cent or increase the frequency of maintenance inspections per year by three fold, these additional savings/costs should also be included in your overall savings estimate.

Similarly, when estimating the cost to implement an action you should consider not only the purchasing and installation costs (including labour), but also other costs associated with implementing the action, which may include:

- commissioning costs (including product write-off estimates)
- training costs
- any other fees that may be incurred (such as licensing costs).

When determining the overall cost to implement an action you should also investigate the various funding options that may be available from external parties, including the Australian and Victorian Governments, that can aid your resource efficiency projects.

Once the costs and savings information has been determined, you can calculate the simple payback period for each action. Simple payback period is defined as:

$$\textbf{Financial payback period (years)} = \frac{\textbf{Initial capital cost of implementation}}{\textbf{Net annual savings}}$$

CASE STUDY: INSULFORM PTY LTD

Insulform is a medium-sized, Melbourne-based company that manufactures trim and insulation components for the automotive industry. One of Insulform's main product lines is rear parcel shelves for passenger vehicles. This component, along with others, has traditionally been manufactured from a composite material of mixed textile fibres and a thermoset resin (Triflex). The production process resulted in trimming waste that could not be recycled or reprocessed and was disposed of to landfill. The process also generated fumes, which were extracted and passed through carbon filters prior to discharge to the atmosphere.

Insulform has replaced the Triflex material with a new material known as Hi-Papia, which is a composite of polypropylene and polyester fibres. While the general process of manufacturing parcel shelves using Hi-Papia is similar to that for Triflex, reformulation of the raw material and the process used to manufacture rear parcel shelves has resulted in significant cost savings, with reduced price to the customer and the elimination of a significant solid waste stream.

However, if Insulform had only considered the savings in waste this project would not have gone ahead. Recognising and including the reduction in changeover times and improved productivity makes this a viable project, as shown in table 4.2.

Summary of costs and savings		
Capital and installation costs		$660,700
Training		$30,000
Total costs		**$690,700**
Reduced waste disposal	3800 m^3 (117 tonnes per annum)	$22,000
Elimination of carbon filters		$26,820
Productivity	50% energy reduction 98% reduction in changeover time 58% reduction in operating time 6.5% reduction in reject rate Reduced transport costs Cheaper raw material and end product	$370,000
Other	Improved product quality Elimination of fumes (OH&S)	
Total savings		**$418,820**
Payback period		**1.6 years**

For more information go to:

www.environment.gov.au/settlements/industry/corporate/eecp/case-studies/insulform.html

Over time, things will change within your operations and you may need to revisit this step to update your estimates and assumptions.

See Guidance Note 2

Section 1.7 of Guidance Note 2 provides further advice on:

- how to assess the impact of each action
- identifying areas with potential issues for integrated resource efficiency
- how to use actions from existing assessments/previous work in the RESA
- what level of accuracy is required for estimates of savings
- other organisation factors to consider when assessing actions.

Note for EREP participants

If you are undertaking a RESA as part of the EREP program, you will be required to implement actions with a payback period of three years or less. Therefore, we recommend that the level of accuracy of your estimates for these actions is sufficient to meet your organisation's business case criteria.

Further information

Module 4 of the EREP Toolkit provides detailed guidance on how to:

- estimate the costs and savings associated with an action
- calculate payback periods associated with an action.

4.3.4 Task I: Prioritise the list of actions

Your organisation may have an existing system for prioritising business initiatives, which could be used to prioritise your actions. However, you are encouraged to use an approach that looks at costs and benefits more broadly than just the payback period.

Not only will actions provide cost savings (economic benefits), they will most likely provide other benefits such as increased employee wellbeing, satisfaction and productivity, company reputation and corporate image. Your assessment of actions (task G) should have identified some of these additional benefits/risks. You may even consider implementing actions that will 'cost' the organisation money if they can be shown to have other significant organisational benefits.

Multi-criteria analysis

We recommend that you use a multi-criteria based assessment tool to determine the priority of your actions. A multi-criteria tool enables you to set the criteria that each action will be assessed against (for example, resource savings, waste reduction, GHG emissions and payback periods). You may also choose to include other criteria, such as employee satisfaction, employee wellbeing or corporate image depending on your organisation's values and objectives.

Whilst each criterion can be weighted equally, it is more common to assign weightings that reflect your organisation's objectives and values, or important local or regional issues (such as water shortages). Weightings usually add up to a total of 100.

To assess each action using a multi-criteria analysis tool you assign a ranking for each criterion, based on either a calculated value (for example, resource savings, waste reduction, GHG emissions, implementation costs and payback periods) or a qualitative value (corporate image, other organisational benefits and risks rankings).

Once an action has a ranking for each criterion these values are summed together to calculate the overall 'priority' score. The higher the value, the more likely that the action will deliver significant reductions in resource use, waste generation, cost savings, or other desirable benefits to the organisation.

CASE STUDY: MULTI-CRITERIA ANALYSIS
In recent years, the use of multi-criteria decision support tools such as Analytical Hierarch Process (AHP) as a means of prioritising resource efficiency approaches has become popular. For example, a Swedish offshore oil company used multi-criteria decision making to identify the best strategy to manage the water production at its facility. For more information visit: www.lwr.kth.se/Publikationer/PDF_Files/LWR_EX_2002_14.PDF.

When prioritising your list of opportunities you may also wish to consider whether the organisation and/or premises have any short- or long-term plans which may affect your ability to implement these actions, by including these as additional criteria. For example, a scheduled plant or process shutdown may only occur every four years.

See Guidance Note 2

Section 1.7.6 of Guidance Note 2 provides detailed guidance on how to prioritise your actions using multi-criteria analysis (MCA), and example MCA tables are shown in Appendix F.

Another approach for prioritising actions may be to conduct a life-cycle analysis of an activity, which will help optimise the environmental and economic benefits to be realised from an action.

See Guidance Note 2

Methods for undertaking a life-cycle assessment are included in Section 1.7.8 of Guidance Note 2 and Module 2 of the EREP Toolkit.

4.4 Step 7: Document your action plan

It is recommended that you list all identified actions according to their priority score, which will form the basis of your action plan. Then you need to assign responsibility and a timeframe for completion for each action. You should document the information used to develop the plan for future reference.

4.4.1 Task J: Assign timeframes and responsibilities

Each action needs a timeframe for implementation (when it is going to be completed) and a person who is responsible for implementation (who is going to ensure that the action is completed). This should be undertaken with those who have responsibilities for the implementation of actions. An example of a basic action plan is provided in Table 4.2.

TABLE 4.2: EXAMPLE OF A BASIC ACTION PLAN

Opportunity	Action(s)	Completion date	Person responsible
Replace inefficient fixtures	Install flow restrictors in all toilet hand wash taps	April 2009	Facilities Manager
	Update preventative maintenance plan to include the replacement of all 36W fluorescent lights with 22W fluorescent lights	July 2010	Maintenance Manager
	Include a minimum standard for taps, toilets, urinals, showers, lights and electric motors in the organisation's purchasing policy	September 2009	National Purchasing Executive
	Communicate the new purchasing policy to all staff with purchasing responsibilities	December 2009	National Purchasing Executive

Where possible you should aim to complete those actions with the greatest priority (highest overall score) first. You might consider using Table 4.3 as a guide for establishing timelines.

TABLE 4.3: ASSIGNING TIMEFRAMES BASED ON EACH ACTION'S OVERALL RANKING

Overall ranking	Timeframe
Action has a high overall ranking and requires little or no capital investment	NOW (6 months to 1 year)
Action has a moderate overall ranking but requires medium–large capital investment	SOON (1–3 years, depending on level of capital investment required)
Action has a low overall ranking and requires large capital investment	FUTURE A Ranking should be reassessed every 1 year (Implement within 3–5 years, depending on the level of capital investment required)
Action has a negative overall ranking and/or requires large capital investment	FUTURE B Ranking should be reassessed every 1–2 years (Implement depending on the outcomes of the revised ranking and level of capital investment required)
Once the site has become as resource-efficient as possible, implement actions that will displace energy sourced from non-renewable sources	FUTURE C
Implement 'offset' actions to increase resource efficiency	FUTURE D

You must consider whether you have sufficient resources to be able to complete the actions in the timeframe stated in your action plan. You should also consider how your action plan will impact on, and integrate with, other organisation plans.

Note for EREP participants

The action plan information that must be submitted by EREP participants is set out in the template shown in part 7.1 of Appendix C.

4.4.2 Task K: Document supporting information

Documenting the sources of information and data used as the basis of your assessment is an extremely important task as this data will be required for inclusion in business cases and potentially for the revision of product/service costs. Record this information within your management systems to ensure full business knowledge of planned and completed resource efficiency improvements.

Note for EREP participants

If you are undertaking a RESA as part of the EREP program, you must be able to show your supporting information if your EREP is audited.

As you progress through each step of the RESA make sure you take the time to record your:

- data sources
- assumptions and the basis for these assumptions
- methods
- formulae etc.

4.5 Step 8: Monitor your action plan

4.5.1 Task L: Monitor action plan progress

The success of the assessment and action planning process will be determined by your ability to monitor and track your progress in implementing the adopted actions. You should regularly update your action plan to reflect any progress, delays or significant changes in the implementation process, including identifying which actions are most successful, which actions need to be reviewed, and if there are any new actions that should be included.

Monitoring should be done continuously, as it enables fine-tuning of the overall program targets and enables you to intervene if necessary. Monthly monitoring can provide regular and up-to-date information on resource consumption and savings achieved and allows you to quickly identify any issues.

You may wish to develop additional objectives for the plan's success. This can be achieved by identifying the areas of your organisation where resource efficiency should be prioritised, and setting measures and targets for each of these. Assessments will establish performance indicators and ongoing monitoring will show the effect of any actions that are implemented. These measures can also be used to monitor the progress of your action plan.

Note for EREP participants

A monitoring program must be included in your EREP. Where possible, consider including:

- monthly resource use of each area involved
- monthly resource use of your entire site
- monthly waste quantities and disposal costs
- records of any abnormal operating conditions or events (e.g., a water leak)
- records of any other relevant actions or events.

Further information

Refer to Module 2 of the EREP Toolkit for further guidance on setting objectives and targets, and tracking progress through your management systems.

5. FURTHER REFERENCES AND RESOURCES

Further information about site assessment techniques, including those adopted by other programs, may be found at the following web sites.

Australian Building Greenhouse Rating (ABGR) scheme	www.abgr.com.au
City West Water	www.citywestwater.com.au
Energy Efficiency Opportunities	www.energyefficiencyopportunities.gov.au
Grow Me the Money	www.growmethemoney.com.au
National Australian Built Environment Rating System (NABERS)	www.nabers.com.au
Queensland Water Commission	www.qwc.qld.gov.au
South East Water	www.southeastwater.com.au
Sustainability Victoria	www.sustainability.vic.gov.au
VicWater	www.vicwater.org.au
Yarra Valley Water	www.yvw.com.au

General information and tools that may be of assistance for your RESA can be found in Module 5 of the EREP Toolkit.

GUIDANCE NOTE 1: HOW TO PLAN A RESA

1.1 Determining who will be involved in the RESA

1.1.1 Potential internal assessment team members

Internal staff have an excellent knowledge of your operations, equipment and management protocols, and will often have ideas and expertise that can help in identifying resource efficiency opportunities. You should involve staff from a broad cross-section of the organisation, including management and operational staff. Potential internal assessment team members and where they could be involved is outlined in Table GN1.1.

TABLE GN1.1: ASSESSMENT TEAM MEMBERS – INTERNAL

Title	RESA Tasks	Why they should be involved
Managers	All assessment tasks	Management support of the RESA process is critical to ensure that it is completed on time and that the actions identified are implemented Managers will understand how activities at the premises consume resources and/or generate waste They may know of opportunities to reduce resource use/waste generation They may know the cost of raw materials and some of the hidden costs associated with waste (e.g., downtime, setup/shutdown costs etc) They will have intimate knowledge of the organisation plan They are critical in communicating with staff, encouraging involvement and ensuring that actions are implemented
Engineers	All assessment tasks	Engineers will have an understanding of how activities at the premises consume resources and/or generate waste They may know of opportunities to reduce resource use/waste generation They will be able to estimate cost savings and the cost to implement an action
Maintenance staff and electricians	Tasks A, D and E Potentially, Tasks F, G, H and I	Maintenance staff and electricians may be responsible for reading main meters and sub-meters at the premises They can take instantaneous measurements (e.g., 'tong' motors) They will have an understanding of the operations and the types of equipment that use resources and/or generate waste They may know of opportunities to reduce resource use/waste generation. They can provide maintenance cost estimates for actions
Operations staff	Tasks D, E and F Potentially, Tasks G, H and I	Operations staff will have an understanding of the key activities that consume resources and generate waste They will know how long it takes to perform certain tasks and how often those tasks are performed They may know of opportunities to reduce resource use/waste generation
Finance staff	Tasks H, I, J and L Potentially, Tasks A, B, C, D and E	Accounts staff will have knowledge of resource and waste costs as well as other associated costs (e.g., labour, maintenance, downtime, set-up/shut down, etc.) They will have extensive knowledge of the systems used to cost projects They will understand the organisation's existing operational plans and can help to integrate this resource efficiency action plan within them They may know some of the key activities that consume resources and generate waste
Quality/customer service staff	Potentially, Tasks A, D, E, F, G and I	Quality staff will have some knowledge of what products are wasted due to inadequate quality and can identify opportunities to reduce this waste Both quality and customer service staff will have an understanding of the risks associated with some options

Title	RESA Tasks	Why they should be involved
Organisation improvement staff	Potentially, Tasks A, B, C, D, E, F, G, H and I	Organisation improvement staff will have some knowledge of how resources and wastes are generated and the wider impact these have on the organisation They may have already undertaken work to identify major contributors to waste, bottlenecks in the operations, opportunities to streamline operations, etc. It will be important to include these staff during Task I as some actions will be complementary to existing organisation improvement actions
Logistics Staff	Potentially, Tasks F, G and I	The staff responsible for bringing in raw materials and sending out finished goods will have knowledge of how your supply chain impacts on resource use and waste generation They will often have ideas of how operations can be streamlined to eliminate bottle necks, reduce waste, etc.
Purchasing Staff	Tasks F, G and, potentially, H	People responsible for purchasing have a significant role to play in reducing resource consumption and waste generation, from small items (such as the choice of light globes) to large capital items and how items are packaged or received
OHS & Environment staff	Tasks A, B, C, D, E, F, I and, potentially, G and H	The environment staff should have knowledge of how activities at the premises consume resources and/or generate waste They may know of opportunities to reduce resource use/waste generation OHS staff should be involved in assessing and prioritising actions to ensure that they do not pose an adverse risk to employee health and safety
Human resources	Potentially, Tasks F, G and I	Human resources staff can provide education and communication support as well as training
Tenants (external)	All assessment steps	Tenants can be major resource users and/or waste generators and should be encouraged to participate in all stages of the RESA
Contractors (external)	Potentially, Tasks A, D, E, F, G, H	Depending on the service that contractors provide they may be able to provide data for the assessment, identify actions and assess the impact of actions

1.1.2 Potential external assessment team members

Identifying people outside of the organisation who may be able to assist with developing your RESA, and contacting them early in the process, will be beneficial. External parties can either provide guidance in completing your RESA and/or be a valuable source of information for your RESA – particularly when identifying opportunities. External participants and how they could assist are outlined in Table GN1.2.

Other external parties, such as EPA Victoria, Sustainability Victoria and peak bodies (e.g., AiG, PACIA, VECCI, AFGC etc.) will be able to provide some guidance and advice on how to undertake a RESA and/or where to obtain further assistance.

TABLE GN1.2: ASSESSMENT TEAM MEMBERS – EXTERNAL

Who	Why	Questions to ask	Opportunities
Energy/Water retailer	Understanding of energy/water use and load profiles	What is the accuracy of the meters? Can you provide me with load profiles for my premises? Can you provide advice on sub-metering? Can you provide advice on ways to save energy/water?	Obtaining typical load profiles to identify excessive usage out of hours Sub-metering program Performance contracting
Waste management service providers	Understanding waste generation and management	How do you measure the quantities of waste/recycling? Where is my waste/recycling taken? Are there other alternatives for waste disposal/recycling?	Increased rate of recycling/reuse Improved information on bills (e.g., number of trees saved through paper recycling)
Chemical suppliers	Understanding of chemical composition, usage profile and alternative chemicals for use	What is the chemical composition of each of the chemicals you supply? How do you measure how much chemical has been used? How do you optimise chemical usage?	Optimisation of chemical dosing regimes Use of alternative chemicals with less hazard and/or specific component (e.g., salt) Performance contracting
Equipment suppliers	Understanding of how equipment uses resources/ generates wastes	How much resource and/or waste should each equipment item use/generate? Are there any opportunities to upgrade to more efficient equipment? What is the typical cost of equipment?	Optimisation of existing equipment Identification of more efficient equipment Performance contracting
Consultants	Reducing work overload Obtaining expertise not available in-house Transferring knowledge to staff Obtaining another view	Have you undertaken a RESA before? What is your experience in resource efficiency? What is your experience in my type of operations? What other types of operations have you worked in? How long will a RESA take to complete?	Identification of new resource efficiency opportunities Enhanced understanding of how resources are used and wastes are generated Transfer of experiences from other types of operations

1.1.3 Getting staff involved

Now that you've identified which people in your organisation will be involved in your RESA, you need to get them involved and most importantly keep them involved.

People who can influence resource efficiency in their day to day roles should be included in the early stages of the RESA process. This is critical in developing their interest in the process and will improve the chances of successful implementation of your action plan.

The first step should be to hold a meeting with all the people who will be involved and discuss why you are undertaking a RESA, what you collectively want to achieve from the assessment, key milestones and the role each person will play in the RESA. This will ensure that the objectives match the direction of your organisation and that key staff are involved in determining the assessment's aims.

It is important that managers understand the objectives and importance of the RESA. They should ensure that those participating in the RESA have adequate time made available to them to do so. It is also a good idea to keep management informed as the RESA progresses.

It is important that you regularly communicate with staff regarding the RESA, its importance and its outcomes. All staff members should be encouraged to identify ways that resource consumption and waste generation can be reduced (e.g., staff tool box meetings, suggestion box, etc). Conducting education and/or training programs may also help with staff engagement.

Small measures, such as replacing the shower heads at the premises, installing automatic light switches or introducing recycling bins in the canteen can illustrate to your employees that you are serious about resource efficiency.

To ensure that you achieve the maximum possible from the RESA, it will be critical to recognise the ideas, involvement and achievements of staff that identify or implement resource efficiency measures, and celebrate your successes as these occur.

1.1.4 The role of a consultant in a RESA

Consultants should be used to provide additional skills, an outside opinion or additional resources if those who have the skills within the organisation do not have sufficient time available to complete the work themselves. **However, to achieve the maximum possible from the program it is essential that you retain ownership of the process.**

Using a consultant does not mean that you will no longer need to commit your own resources. You will need to provide the consultant with the same information and contacts as if you were undertaking the assessment yourself.

Whilst a consultant can identify opportunities, estimate savings and make recommendations these will only be as good as the information you supply the consultant. You will have the greatest knowledge of your operations, particularly about operational costs, culture, bottlenecks, OH&S, product/service quality, consumer profiles, etc. As it is your organisation that is responsible for resource efficiency management and implementing any actions, it is imperative that you are involved in each step of the RESA, particularly Steps 6 and 7.

1.1.5 Developing a 'scope of work'

Before tendering for the work or selecting a consultant ensure that you are clear on the reason for appointing a consultant and the tasks you expect the consultant to undertake. Clearly state these expectations up front in a 'scope of work' document, which will consist of the contract and specification describing the task, methodology, and expected outcomes.

The 'scope of work' document is the key reference point for a consultant. A good 'scope of work' will clearly indicate what the consultant is to do and what you will do. It will outline *what you know and what information you have* **and**, just as importantly, *what you don't know and what information you don't have*.

The information included in the 'scope of work' will be used by the consultant to estimate how much work is involved in providing the service, determine how they will undertake the work and understand who, in their organisation, is best placed to provide the service.

It should outline what you expect the consultant to do, including:

- the reason for doing the work
- what the project objectives are
- what the consultant is being asked to do
- how the work must be done and to what level of detail
- what information and/or personnel will be made available to the consultant
- the key outcomes of the project (deliverables)
- the timeframe for the service
- project management/reporting requirements

If you are unsure of what you are asking the consultant to do, you should list as much detail as you can and then consider asking the consultant to provide a detailed scope of work and methodology in their proposal (also referred to as a 'reverse brief'). You can also consider requesting options for the scope and methodology, as there may be another approach that could save money or time. It is preferable that this be clearly documented as an optional submission.

> **Further Information**
>
> An outline of a 'scope of work' document is included in Appendix B of this module.

1.1.6 Working with consultants

Before beginning the detailed tasks, it is worthwhile holding a 'start-up' or 'inception' meeting where you restate your expectations and revise the consultant's proposed methodology. This will help to ensure that the consultant has a clear understanding of what your needs are, that you clearly define the roles of both parties and that any misunderstandings are clarified at the earliest opportunity. Consider appointing one staff member as the project manager and primary contact for the consultant.

Identify clear milestones so that progress of the project can be easily monitored. The earlier any delays are identified the greater the chance of rectifying or changing your own plans to reduce business disruption.

On completion, it is worthwhile undertaking a brief review of the project (close-out meeting). Lessons may be learnt for future projects.

It is up to you to determine how you would like the consultant to present or deliver the work that you have requested. This is commonly done through a report or series of reports that summarises what was done, the findings and the recommendations. You may also want the consultant to hold workshop sessions, undertake communication briefings or education training sessions etc. The deliverables should be clearly stated in the 'scope of work'.

An outline of the format that a RESA report could take is included in Appendix C of this module. This indicates the type of information that could be included in a RESA report provided to you by a consultant. The same format could be used if you are preparing your own RESA report.

1.2 Collecting background information

1.2.1 Identify previous work undertaken to increase resource efficiency

Your company may have already done work in the area of resource efficiency and/or organisation sustainability. Table GN1.3 provides a list of some of the work that may have been undertaken at your premises (or other similar operations) and how this work might provide data for your RESA.

TABLE GN1.3: INDICATIVE LINKS BETWEEN PREVIOUS WORK AND THE FOUR STEPS OF THE RESA

	RESA steps			
	Establish resource use and waste generation profile	**Assess resource-consuming and waste-generating activities**	**Identify, assess and prioritise efficiency opportunities**	**Document action plan**
Benchmarking	√	√	√	
Energy/water/waste audits	√	√	√	
Continuous improvement programs		√	√	√
Technical studies	√	√	√	
Process flow/ de-bottlenecking reviews		√	√	√
Business cases for projects			√	
Projects completed at the premises		√	√	
Literature reviews or research		√	√	

1.2.2 Related programs

Some organisations are currently participating in other resource efficiency programs. Table GN1.4 references some current programs and indicates where they may contribute to the RESA process.

TABLE GN1.4: INDICATIVE LINKS TO OTHER PROGRAMS

	RESA procedure phase				
	Commitment phase Organising management resources	**Understanding phase** Establish an implementation plan	**Planning phase** Develop an action plan	**Implementation phase** Implement projects from action plan	**Monitoring phase** Regular review of reports and establish an annual review
Energy Efficiency Opportunities (Australian Government)	⚡	⚡	⚡	⚡	⚡
Greenhouse Challenge Plus (Australian Government)	⚡	⚡	⚡		⚡
Industry Greenhouse Program (EPA Victoria)	⚡	⚡	⚡	⚡	⚡
National Greenhouse and Energy Reporting (Australian Government)	⚡				⚡
Recent audits	🗑 💧 ⚡	🗑 💧 ⚡			
Resource Smart Business (Sustainability Victoria)	🗑 💧 ⚡	🗑 💧 ⚡	🗑 💧 ⚡		🗑 💧 ⚡
Trade Waste Program (EPA Victoria)	🗑 💧	🗑 💧	🗑 💧	🗑 💧	🗑 💧
Victorian Government facility requirements (Dept of Sustainability and Environment)	🗑 💧 ⚡	🗑 💧 ⚡			🗑 💧 ⚡
Waste Wise (Sustainability Victoria)	🗑	🗑	🗑		🗑
waterMAP (Dept of Sustainability and Environment)	💧	💧	💧		💧

Key benefits to be derived from existing programs:

- May contribute to RESA waste assessments 🗑
- May contribute to RESA water assessments 💧
- May contribute to RESA energy assessments ⚡

See Guidance Note 2

Further guidance is provided on how to build on work undertaken as part of key resource efficiency programs (such as Energy Efficiency Opportunities, the Industry Greenhouse Program and waterMAP) in Guidance Note 2.

Note for EREP participants

Further guidance on the criteria for using previous assessments and/or actions in your EREP can be found in the EREP guidelines.

EPA will work with EREP participants to ensure that your EREP integrates with existing work with EPA, such as sustainability covenants, environment improvement plans and prescribed industrial waste or trade waste partnership programs.

GUIDANCE NOTE 2: HOW TO UNDERTAKE A RESA

The type of information required to complete a RESA will depend on your operations. You will need to collect information on your organisation, your operations, consumption and generation activities, metering data, drawings, etc. A consultant may require some additional information to be able to determine the context of the premises within an organisation.

A list of typical information required for a RESA is included in Appendix A of this module.

1.1 Collecting baseline data

1.1.1 Where to obtain your baseline data

You should be able to obtain the majority of resource use and waste generation data from the accounts and invoices issued to you by retailers and service providers (refer to Appendix D for assistance in interpreting these invoices). Table GN2.1 includes some common data sources.

TABLE GN2.1: EXAMPLES OF BASELINE DATA SOURCES

Data source	Resources	Energy	Water	Products	Waste
Accounts/ Invoices	Invoices	Electricity bills Natural gas bills Fuel purchase dockets/receipts	Mains water bills	Invoices Sales	Trade waste bills Waste disposal invoices
Internal data	Weighbridge dockets Flowmeters Stock take records Financial databases	Smart meters Ammeters	Flowmeters	Production records Stock take records Financial databases	Weighbridge dockets
Specifications	Raw material specifications MSDSs			Production records Stock take records Financial databases	Trade waste limits
Monitoring programs	Raw material composition testing records		Water quality monitoring – rainwater, stormwater, recycled water	Product quality testing records	Trade waste monitoring records Bin inspections/ audits Waste composition analysis results
Internal databases					EPA Waste transport certificates

1.1.2 Estimating baseline data

The sources of baseline data listed in Table GN2.1 may not include sufficient information to determine the quantity of resources consumed or wastes generated, or may not provide data for all of the types of resources or wastes to be accounted for. For example, a site may harvest rainwater and/or stormwater without measuring the amount of water collected and used; or the quantity of waste disposed to landfill may be reported by volume, not the actual weight of the waste.

Where data is insufficient, a number of assumptions will need to be made to establish the baseline data for the site. All assumptions should be documented as part of your assessment, and should include:

- an explanation of the methods or the data source used to estimate a quantity, such as:
  - measurement procedure used
  - external database (e.g., Bureau of Meteorology rainfall data)
  - literature review
  - internal/external benchmarking
- the level of uncertainty associated with the estimate.

Documenting assumptions will allow for an assessment of the uncertainty associated with your data.

Any actions that will be taken to improve data quality for future assessments should be included in your action plan.

1.1.3 Baseline data accuracy

As the baseline data will form the basis of your assessment it is important that the data is as accurate as is practicable.

Where a resource is purchased from an external source or a waste is disposed of to an external site for a fee, the accounts from these service providers should be used as the basis of the baseline data.

Where baseline data is based on intermittent measurement rather than real time monitoring, you should review the measurement data for variations and note any results that do not make sense or appear outside the normal range. Whilst these data points are not necessarily incorrect they may exaggerate the average number and therefore inflate your baseline data.

Use as many data points as possible when calculating your baseline data to increase your level of accuracy.

1.1.4 How to estimate greenhouse gas emissions

Baseline data for greenhouse gas emissions is not usually provided on invoices or accounts and must be calculated. The following general principles apply as guidance for estimating greenhouse gas emissions.

The **Greenhouse Gas Protocol Corporate Accounting and Reporting Standard**, developed by the World Resources Institute and World Business Council for Sustainable Development, together with the ISO 14064.1–2006[1] (Greenhouse Gas Verification and Accounting) standard provide guidance on emission sources to be included in a greenhouse inventory as well as general accounting and assessment methodologies.

The GHG Protocol defines three 'scopes' of emission categories:

- Scope 1: direct emissions from sources within the boundary of an organisation such as fuel combustion and manufacturing processes.
- Scope 2: indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation. These emissions result from the combustion of fuel to generate the electricity, steam or heat used on site and do not include emissions associated with the production of fuel.
- Scope 3: all other indirect emissions that are a consequence of an organisation's activities but are not from sources owned or controlled by the organisation.

GHG emissions should be calculated for, at a minimum, Scope 1 and 2 emissions.

The **National Greenhouse Accounts (NGA) Factors** is the established resource manual for estimating greenhouse gas emissions from a number of common sources. It includes emission factors and calculation formulae for:

- electricity
- combustion fuels (transport and non-transport)
- waste to landfill
- wastewater to sewer.

Technical guidelines for the estimation of greenhouse gas and energy at a facility level are currently being prepared by the Australian Government and will be made available in 2008 as part of the National Greenhouse and Energy Reporting System.

The estimated GHG emission factor associated with potable water consumption is 2.34 kg CO_2-e/m^3, as referenced within EPA Victoria's **Greenhouse Gas Inventory Management Plan**. This includes all water used in pumping reticulated water and sewage, treating water and wastewater, and marginal upgrades to infrastructure.

Emission factors for other materials may be available from suppliers, or information may be published in Journals or related websites.

1 *Greenhouse gases – Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals*, Call No. STA ISO 14064–1:2006

1.1.5 Deviation from typical resource use

In some instances the data for the baseline year will not accurately represent typical usage patterns at your premises. For example, a major upgrade/downgrade may have recently been undertaken or operations may have been affected by an abnormal event, such as a fire, drought, flood, strike, epidemic etc.

If you believe that your baseline resource use levels do not represent typical usage patterns, you should note the reasons, as this will help you analyse the achievements of your action plan when comparing future resource consumption and waste generation profiles to those for the baseline period.

1.1.6 Resource efficiency tracking system

Many organisations that are undertaking a RESA from scratch will not have a system in place to track resource consumption, waste generation and associated indicators, other than through their financial reporting systems.

It is recommended that as part of your RESA you develop a spreadsheet or database that you can use to input relevant resource consumption and waste generation data, establish your baseline profile and track the progress of your action plan. Ideally this would be designed to:

- summarise your resource consumption and waste generation profile for your baseline period
- calculate the costs associated with resource consumption and waste generation
- calculate and track any relevant resource efficiency indicators, utilising baseline resource use/waste generation data against key activities or levels of production (refer to Module 2 of the EREP Toolkit)
- generate graphs and tables for data analysis.

For further support on benchmarking, please refer to Module 5 of the EREP Toolkit.

1.2 Identifying resource using and waste generating activities

1.2.1 How to identify the key resource-using and waste generating activities

This aspect of the RESA requires you to identify resource use and waste generation by activity. Table GN2.2 lists common resource-using and waste-generating tasks, processes, equipment and services.

TABLE GN2.2: EXAMPLES OF ACTIVITIES THAT MAY USE RESOURCES AND/OR GENERATE WASTE

	Energy	Water	Waste
Tasks	Movement of materials within the site	Cleaning	Product changeovers
Processes	Cryogenic separation of liquids Process heating/cooling Food/drink preparation	Product ingredient Cooling water Process water Moisture/dust control Food/drink preparation	Raw material packaging Processing waste Packaging waste Damaged finished products/goods Food/drink preparation
Equipment	All equipment that use electric motors Lighting, heating/cooling Combustion Electronic equipment Sterilisers Monitoring equipment Process machinery Food/drink preparation	Lubrication/seal water Toilets, urinals Showers, taps Renal chairs Sterilisers Food/drink preparation	Faulty product Toilets, urinals Showers, taps Separators Filters Food/drink preparation
Services/ utilities	Compressors Refrigeration systems Air-conditioning systems Boilers Hot water systems	Cooling towers & evaporative condensers Boilers	Wastewater treatment plant Cooling towers and evaporative condensers Boilers

It may be useful to use location descriptions as a sub-set of the overall activity. For example, where water is used for cleaning you may break this down into areas or clean-in-place equipment, or where a site has several air conditioning systems you may break this down into air conditioning – Building A, air conditioning - Admin etc.

You will often know of the major resource-using and waste-generating activities. However, where this is not the case, you could do the following:

- Have the assessment team undertake a walkthrough of the premises and observe –
  - how resources are used and where wastes are generated
  - whether resource use and waste generation are related (positively or negatively).
- Review drawings of the premises (e.g., services drawings, process flow diagrams, piping and instrumentation drawings).
  - Note the location of meters.
- Talk to staff/tenants/contractors from various areas/departments regarding their knowledge of how the resources are used and wastes are generated.
  - Those who can directly impact on resource use and/or waste generation at the site, (e.g., operators, boiler attendants, service staff (e.g., cleaners), nurses/doctors, chefs/cooks).
  - Those who are responsible for resource use/waste generation at the site (e.g., service managers, production managers, engineers).
  - Those external providers who have knowledge of the activities undertaken at the site (e.g., energy/water retailers, waste management service providers, boiler/refrigeration/water treatment service providers, equipment suppliers).
- Review resource efficiency work that has been previously undertaken at the site.
- Review case studies of similar assessments conducted at similar operations.
- Use operational details to guide you in assessing the relevance to the site, such as:
  - pipe size/cable thickness
  - motor size
  - bin size
  - process/equipment output and hours of operation
  - financial process wastage estimates.

1.2.2 Resource efficiency diagrams

It is recommended that you translate the above information into a diagram or map that shows the areas at your site, the resource inputs, product and waste outputs, and recycling loops for each area. You may also list the resource-using and waste generating activities that occur in these areas on the diagram.

If you have existing process flow diagrams of the operation, you should consider updating or modifying these to represent the flow of resources and wastes through all areas at your premises.

An example of a resource efficiency diagram is provided in Figure GN2.1.

1.3 Using mass and energy balances in a RESA

Mass and energy balances are commonly used in energy and water assessments, and can also be a useful tool in estimating waste generation at a production site. The difference between the quantities of raw materials, chemicals and packaging purchased (inputs) and the amount of product produced (outputs) will equate to the waste the process generates. This can be broken down into trade waste, commercial/industrial waste, prescribed industrial waste (PIW) and waste heat (e.g., evaporation). Other sources of waste will also exist at the premises (e.g., raw material packaging, office waste, food waste etc.) and these must also be included in your waste assessment.

Generally, for sites that provide services (e.g., hospitals, universities, shopping centres) the inputs are numerous, are not as easy to measure, and may be recorded by number of units rather than by weight

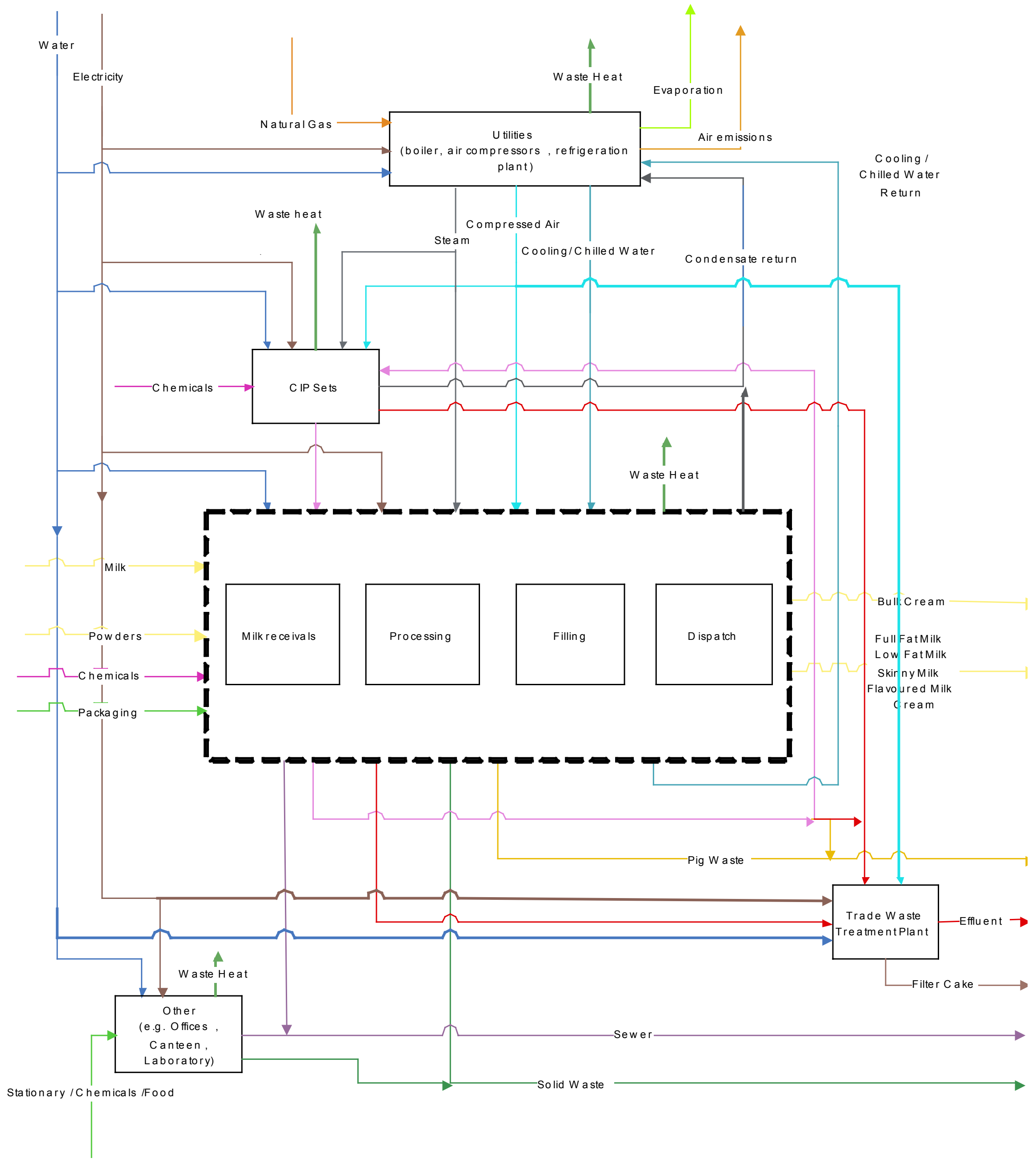


FIGURE GN2.1: RESOURCE EFFICIENCY DIAGRAM FOR A MILK MANUFACTURING FACILITY

or volume. In addition, the majority of waste will come from the disposal of used items (e.g., packaging waste, office waste, food waste etc). For these operations, a detailed mass and energy balance approach to estimating the major activities contributing to energy, water and waste may not be as applicable. However, the key principle of sum (individual activity inputs/outputs) = total inputs/outputs still applies.

1.3.1 How to calculate mass and energy balances

Some companies may have existing mass and energy balance models of their operations but many will need to develop a mass and energy balance spreadsheet from scratch.

Using your resource efficiency diagram as a guide, start by developing overall mass and energy balances for the premises. This could be a table that lists all of the input streams and all of the output streams to the premises and their key parameters, including total usage/generation, composition (e.g., total solids content (%), moisture content (%), suspended solids concentration, total dissolved solids concentration, fat/protein/sugar content (%), active ingredient concentration etc.), temperature, pressure, state (e.g., solid, liquid, gas).

To calculate the quantity of each component, multiply the total usage/generation by the relevant concentration.

To calculate the quantity of energy embodied in the stream, multiply the quantity of the material by its temperature by its heat capacity. For further assistance in calculating energy use refer to **Module 3 of the Energy and Greenhouse Management Toolkit**, prepared by Sustainability Victoria for EPA's Industry Greenhouse Program.

The sum of each row for the inputs should equal the sum of the equivalent row for the outputs.

You now need to follow the same process (i.e. develop mass and energy balances) but for individual areas and/or activities remembering that the sum of the individual uses and generations must equal the total use for each particular resource and waste type.

Further information

Appendix E provides a tabular example of an overall mass and energy balance. The Appendix also shows a Sankey diagram, which can be used to show a single-stream balance pictorially.

1.3.2 How to use existing assessments/previous work to complete an integrated mass and energy balance

Quite often, you will find that your site has already undertaken investigations into resource use and waste generation.

Previous work will provide a valuable starting point for understanding where and how resources are used and wastes are generated at your premises. However, you will need to update this information with data from the baseline period and review any estimates and assumptions to ensure the work is still representative of actual operations.

Even where previous work has focused on only one resource type or one waste type (e.g., energy or water audit), it may provide useful information for identifying the key activities and completing the individual activity assessments. You will need to expand on the previous estimates to include all significant resource inputs and product and waste outputs. This will ensure an integrated approach has been taken to resource efficiency assessment.

Example

A water audit identified that 40 per cent of all incoming water to a food manufacturing operation was used for cleaning of equipment using 'Clean in place' (CIP) systems. An integrated assessment would also consider:

- how much steam was consumed to heat the water
- how much condensate was returned to the boiler
- how much electricity was required to run the pumps, lighting and instrumentation
- the quantity of cleaning chemicals used, and their composition
- how much of the water and chemical was discharged to trade waste (or trade waste treatment plant)
- how much of the water was lost to evaporation
- how much of the heat from the steam and electricity was lost to atmosphere
- whether this heat was lost in an air-conditioned space
- the greenhouse gas emissions associated with all inputs and all outputs (optional).

1.3.3 Level of accuracy required for mass and energy balances

As mass and energy balances are a static simulation of a dynamic operation there will be inevitable inaccuracies. Obviously, the more detailed your monitoring programs and estimate calculations, the greater the accuracy of your balances.

It is recommended that you start out with a minimum level of detail – the total quantities of resources consumed and wastes generated and each stream's temperature and state. Initially, you may choose to ignore the contribution of small inputs (e.g., minor chemicals, one off wastes) or group these together (e.g., other chemicals, other wastes).

As you develop the mass and energy balances you will need to include additional information, such as the composition data, in order to determine how the input streams contribute to the wastes.

If you cannot balance the inputs and outputs within 20 per cent of each other for each component, you will need to review the composition of the smaller streams as they may have high concentrations and therefore contribute more significantly than originally thought.

1.3.4 Information required to estimate the amount of resource used or waste generated by an activity

When estimating the resource use and waste generation for each key activity you should start by asking a few basic questions to better understand the activity:

- What are this activity's inputs (resources used) and outputs (products and wastes generated)?
- What are the relationships between the resources used and the products and wastes generated? For example:
  - water used for cleaning is discharged to trade waste
  - energy is consumed to generate hot water or generate steam
  - the solids that are removed from trade waste generate a PIW as a 'by-product'
  - decreasing packaging material thickness increases production line wastage.
- Is the relationship mutually beneficial (e.g., a decrease in one results in a decrease in another) or conflicting (e.g., a decrease in one results in an increase in another)?
- How is the activity monitored?
  - Are any of the inputs or outputs sub-metered or weighed?
  - Are any of the inputs or output quantities recorded in another form (e.g., number of units used)?
  - How is the activity controlled/managed?
- What factors affect the activity and its resource use and waste generation?
- What factors can influence the usage/generation profile of the activity?
- What is the likely usage/generation profile across a year, a week and throughout the day for the activity?
- What are the hours of operation or frequency of operation?
- What is the building construction type, fabric, siting, and aspect? (Energy assessment only.)

1.4 Estimating resource use and waste generation for an activity

Data gathered through monitoring programs, together with the use of engineering calculations, can provide significant support in the process of estimating resource use and waste generation for an activity. These tools are discussed below.

1.4.1 Using monitoring data

'If you don't measure it – you can't manage it'

Monitoring programs are an important tool in resource efficiency assessment and management. They enable you to accurately know where resources are consumed and waste is generated. More importantly, analysing the data will provide you with valuable insight into where resource efficiency opportunities may exist and where equipment and processes are operating efficiently. They can also be of particular assistance in additional data gathering to support activity assessment.

When considering whether to implement a data gathering or monitoring program you should ask yourself these questions:

- What do you need to know?
- What are you trying to measure?
- Why do you need to know?
- How will the level of accuracy affect the answer?
- What is the ‘prize’?

1. Monitoring – resource use

Main meters

Regular internal monitoring or data logging of the main energy/water meters can be conducted to better understand resource use patterns at your site.

Data logging will establish the load profile for your site, which can help identify any unaccounted energy/water use such as leaks or appliances left operating while the facility is unattended. Your energy/water service provider may already have installed data logging equipment on your main meters and can therefore provide you with this data. Where this is not the case, data loggers may be installed on all main meters and should be continuously monitored for about four weeks; however, issues such as seasonality may require different timeframes. Your energy/water retailer can provide advice on monitoring methods.

Sub-meters

You may already have installed or be considering installing sub-meters at the site. Sub-meters can be either permanently installed or portable units. Portable units can provide a more informed estimate of the breakdown of energy/water use across a site and can also provide a useful check of resource consumption estimates. Permanently installed meters can track resource use over time, enabling you to establish trends for an activity, assess the impact of an action or identify abnormal usage (e.g., leak detection).

Where should sub-meters be installed?

Some sites will set sub-meter ‘rules’ to determine where a sub-meter is required. For example:

- ‘every floor of the building must be metered’
- ‘lighting must be sub-metered separately to other energy uses’
- ‘refrigeration/air-conditioning plants must be metered for electricity’
- ‘all motors greater than 200 kW must be metered for electricity’
- ‘cooling towers must be metered for water make-up and blow-down’
- ‘steam generation and condensate return must be metered’
- ‘any process using greater than 10,000 L of water per hour must be metered’.

Setting rules can be useful in monitoring resource-hungry equipment and processes, although sub-metering will be of most benefit to a site where resource use and waste generation is related to human behaviour or where operational upsets, leakage and wastage are an issue.

Employing unused sub-meters

Often sites will have sub-meters installed but not gathering data. This can be for a number of reasons, including:

- the site is not aware of the sub-meter’s existence (e.g., installed by previous site owner or come with newly installed equipment)
- the site is not reading the meters on a regular basis (e.g., installed in an area that is hard to access)
- meters are installed for another purpose, but could be programmed to monitor resource consumption (e.g., flow meter installed to measure product flow but could also monitor water used to flush between products).

These meters are an asset that can be used in situ or elsewhere in your operations.

When should I consider installing sub-meters?

It is recommended that any activity using greater than 15 per cent of the site's total consumption for a particular resource type is sub-metered (e.g., air conditioning systems, cooling towers/condensers, boilers, water added as an ingredient in a product etc.).

Sub-meters provide the most benefit when measured data is compared with theoretical usage estimates, as this may help you identify activities that are inefficient users of resources.

Your energy/water retailer can provide advice on the use of sub-meters.

How often should I read sub-meters?

Sub-meters should have an electronic data-logging capability or be read daily. Ideally, main meters and sub-meters will be read at the same time and at a regular time each day.

If possible, read the sub-meters when the facility closes for the day and again the following morning (or when activity levels at the site are at their lowest). If the meter readings are not very similar, there may be a leak or appliances may be operating outside operating hours.

Monitoring of the sub-meters should be conducted over at least a four-week period. Document your sub-meter readings and record any details of events that may have impacted on the resource use that day for future reference.

Other resource use monitoring methods

You will most likely be monitoring the use of raw materials at your premises using accounting systems, stock take records, production records, service counters, etc. This raw data may not directly estimate the resource use of an activity but will enable you to estimate this using a conversion factor (e.g., the weight per unit used).

2. Monitoring – waste generation

Sites that are producing a product will often be monitoring losses throughout the production process in real time and reporting these on a daily or weekly basis. This information will be useful in establishing the key activities generating waste, although you will need to consider where the waste ultimately goes after the site (e.g., trade waste, landfill, rework).

Trade waste

Where a site is discharging trade waste it will generally be required to have a monitoring program in place to assess the quality of the discharge and thereby ensure that the site is not in breach of its trade waste agreement (TWA). Only some larger operations will have a flow meter to determine the quantity or volume of trade waste discharged. For the majority of premises, the volume discharged is assumed to be a set proportion of the water consumed.

In order to more accurately determine the site's key sources of trade waste (both volume and load) you may need to undertake a monitoring program of the site's trade waste drainage system.

When developing a monitoring program you should consider the potential trade waste profile (both flow and load) at each sample point. It is recommended that monitoring be conducted over a four week period. Where trade waste loads are likely to vary it is recommended that a 24 hour composite sample be taken. Automatic samplers that can take both time-weighted and flow-weighted (where an electronic flow meter is installed) samples are available for purchase and hire.

Your trade waste service provider will be able to assist you to establish suitable sampling points and develop a monitoring program.

Chemicals used at the site can be a major contributor to trade waste loads (particularly TDS). Water and wastewater treatment chemicals, (e.g., water softening, boiler, cooling tower/condenser and trade waste treatment plant chemicals) and cleaning chemicals (e.g., caustic soda, acids, sanitisers) are generally discharged to the trade waste system. Use of these and other chemicals should be monitored through metering, or by using purchasing and stock take records. Ideally, use will be monitored and recorded on a daily basis for high volume use chemicals and on a weekly basis for low volume use chemicals.

Your chemical supplier should be able to assist you to identify the key components of its products and develop a monitoring program.

Commercial/industrial waste

A monitoring program to determine the site's key sources of commercial/industrial waste could include:

- recording the number of waste bins generated from an activity on a daily basis
- 'auditing' a representative sample of bins to assess what types of materials are being disposed of and the relative quantities
- inspecting bins prior to pick-up to establish how full bins are, on average
- weighing bins to determine the average weight of material per bin
- recording the daily waste levels from a production line or process
- testing to determine the moisture content or solids content for a type of waste.

When developing a monitoring program you should consider how the waste profile may vary across a day.

Your waste management service provider should be able to assist you in developing a monitoring program.

Prescribed industrial waste (PIW)

A monitoring program to determine the site's key sources of PIW could include:

- recording the number of prescribed waste bins/volume generated from an activity on a daily basis
- testing to determine the moisture content or solids content for a type of PIW
- component testing to assess what types of materials are contributing to the PIW stream
- sampling and testing upstream of a process that generates a PIW (e.g., separation process) to determine the root cause of the waste.

When developing a monitoring program you should consider how the PIW profile may vary across a day.

Your waste management service provider should be able to assist you in developing a monitoring program. Further information on identifying and managing PIW is available from the EPA website.

1.4.2 Using engineering calculations

It is not cost effective to monitor all activities at your site so you will need to make reasonable estimates when completing your assessments.

Engineering calculations should be used as the basis of these estimates rather than 'rule of thumb' and assumption based estimates (e.g., approx. 10 per cent of water is used in this activity). The data used in these engineering calculations should be as accurate as possible.

There are several tools available through the internet that can help you to estimate consumption and waste for various types of equipment. For example the Queensland Water Commission (QWC) has developed **water efficiency management plan (WEMP) guidelines** and an assessment tool, which includes a cooling tower calculation model. There are also several websites that provide information on estimating energy consumption for various equipment and appliances. Module 5 of the EREP Toolkit has some web sites that may be useful starting points.

When accurate data is not available you should implement some form of monitoring program (as described above) to provide evidence for your assumptions. Where this is not possible, you should interview relevant people at the site and external suppliers, to provide a basis for your assumptions.

Actions to improve data quality should be included in your action plan.

You should document your data sources and basis for assumptions as part of the assessment, indicating the accuracy of each estimate.

Estimating resource use

A number of energy and water audit procedures and assessment guidelines currently exist that provide techniques and tools to estimate consumption, for a range of activities. A list of recognised auditing and guideline material is included in Module 5 of the EREP Toolkit.

When an estimation technique is used to calculate energy/water usage a number of data inputs will be required, for example:

- kW rating
- flow rate
- volume per task
- inlet and outlet temperatures
- per cent loading
- hours of operation
- frequency of task.

In some instances, accurate data may be available through:

- equipment specifications: Flow rate, kW rating
- log sheets: production log sheets, boiler/cooling tower monitoring sheets, stocktake data
- on-line monitoring: BMS, PLCs, Citect, SCADA, Door counters.

However, in many cases the information will not be readily available and assumptions will be required to estimate resource use for an activity.

Estimating waste generation

Trade waste

When estimating the volume and load of various trade waste streams you should first consider the water use for that activity and the percentage of water that is eventually discharged as trade waste. Other inputs to the activity that could be lost to the trade waste system should also be considered (e.g., chemical additives that must be bled from a recirculating water system, product losses to the drainage system).

In some instances, accurate data may be available through:

- log sheets: production log sheets, boiler/cooling tower monitoring sheets, stock take data
- on-line monitoring systems: PLCs, Citect, SCADA.

Commercial/industrial waste

Whilst waste streams are often quantified at a site level (e.g., Line 1 ran at an average 3 per cent waste for the year) this may not always refer to the volume (for liquid wastes) or weight (for solid wastes) of the actual waste generated.

Similarly, a site may have many commercial/industrial waste inputs that do not directly relate to goods or services being produced at the site (e.g., raw material packaging waste). This waste is generally not measured.

In some instances, accurate data may be available through:

- log sheets: production log sheets, stock take data
- on-line monitoring: PLCs, Citect, SCADA.

Many production facilities will include an estimate of waste in their ‘Bill of Materials’. Similarly, organisations that provide a service may have estimated waste quantities in establishing the cost of that service. This data may not have a high level of accuracy, however it will provide a basis for assessing the relevance of a process or activity to waste generated at the site.

Prescribed industrial waste

Prescribed industrial waste (PIW) is often generated by a treatment process that operates at the site, however this process is not always the main source or root cause of the waste. You should consider this process and its inputs to estimate the key activities at the site that contribute to the generation of the PIW.

In some instances, accurate data may be available through:

- log sheets: production log sheets, stock take data
- on-line monitoring: PLCs, Citect, SCADA.

1.4.3 Level of accuracy required for individual activity estimations

As the individual activity estimates will inform and focus your resources in the opportunity identification assessment task (Task F) it is important that the data is as accurate as is practicable. The sum of the individual activity assessments should be at least 80 per cent of the total resource use or waste generation for the premises. If you can account for more than 100 per cent of total resource use or waste generation you will need to revise your estimates.

Where a resource is sub-metered or monitored in another manner this data should be used as the basis of the mass and energy balances.

Where mass and energy balance data is based on intermittent measurement rather than real time monitoring, you should review the measurement data for variations and any results that do not make sense or appear outside the normal range. Whilst these data points are not necessarily incorrect they may exaggerate the average number and therefore exaggerate your mass and energy balances.

The more activities for which you estimate resource use and waste generation, the smaller the overall error will become. Therefore, you should include as many activities in your mass and energy balances as possible to increase your overall level of accuracy.

1.4.4 Using mass and energy balances to identify leakage

You may find that some activities do not contribute as significantly to the operations as you had originally thought. Often you will find that your mass and energy balances do not balance (i.e. they do not 'account' for a minimum of 80 per cent of the inputs and/or the outputs).

If this is the case you will need to review all of your estimates and assumptions made in developing the mass and energy balances. You should review the premises once again to ensure that you have not missed any activities that could contribute to the 'unaccounted' portion.

If you are satisfied that you have identified and accurately assessed the activities that are occurring at the site and you still cannot account for all of the inputs to the site it is possible that you are losing some of the inputs as leakage.

If you suspect that leakage could be an issue at your premises you should undertake monitoring of main meters and sub-meters when the premises is unoccupied or at a low level of activity. You may consider using portable meters or conducting a site walkthrough when the site is unoccupied or at low activity levels to try and track the source(s) of the leak(s).

CASE STUDY: USING SUB-METERS TO IDENTIFY ABNORMAL USAGE

The University of Sao Paulo in Brazil used sub-meters to identify abnormal water consumption in the Electric Engineering building. The building is composed of four linked blocks (A, B, C and D), all of them supplied by the same service connection with no underground storage tank.

Metering points were selected based on building layout and water reticulation system design. Monitoring of sub-meters indicated abnormal usage (a sharp increase of 1500 per cent) on a Sunday evening. The flow rate curve showed a typical sudden fracture of a pipe.

Data from the sub-meters indicated the occurrence of leakage in the stretch between the main meter and the sub-meters. Maintenance staff identified the exact leakage spot (an underground leakage) and carried out correction as soon as was practicable.

Sum mary of costs and savings		
Repair cost		USD$2,422
Water loss	15 kL/hour Monthly loss if unchecked @ 10,950 kL/month	USD$35,920
Payback period		**49 hours**

1.5 Approaches to resource efficiency assessment

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

The RESA does not include assessment levels. Rather, it is suggested that for each task included in the RESA you begin with an initial (basic) assessment and as you progress within each task and through the assessment and your understanding of resource efficiency at your premises grows, you should undertake more detailed analysis to revise your estimates and assumptions.

The RESA procedure is best undertaken as an iterative process. You will no doubt need to revisit earlier tasks as you progress through the procedure, to ensure you can achieve the savings in resources, wastes and costs assigned to each action.

Basic/initial assessment

This initial assessment level is designed to provide an overview of resource consumption and waste generation at your premises. A high-level analysis (for example, a desktop analysis) of the major contributors to resource consumption and waste generation could be undertaken in order to assess where resource savings could be made. A basic assessment should generate a list of potential opportunities to increase resource efficiency with indicative savings and costs, which require further investigation. Accuracy of figures would generally be within ±40%.

Detailed assessment

This assessment level will provide you with a detailed analysis of resource use, waste generation and the costs and savings associated with specific resource efficiency measures for all of the key resource-using and/or waste generating activities.

As part of a detailed assessment you should determine overall resource consumption and waste generation at your site and trends in use/generation across processes and time. You will need to investigate the drivers of resource use and waste generation for key resource using activities through data analysis and interviews with staff/ tenants/ experts. Opportunities to reduce resource consumption and/or waste generation will need to be thoroughly investigated to determine costs, savings, other benefits and risks for identified actions. The level of accuracy needs to be consistent with the company's business rules for the required investment – see section 1.7.4 of this Guidance Note.

1.6 Identifying opportunities

1.6.1 Using a preferred opportunities approach

A key element of the *Environment Protection Act 1970* is the 'waste' hierarchy. The purpose of the waste hierarchy is to extract the maximum practical benefits from products, while generating the minimum amount of waste.

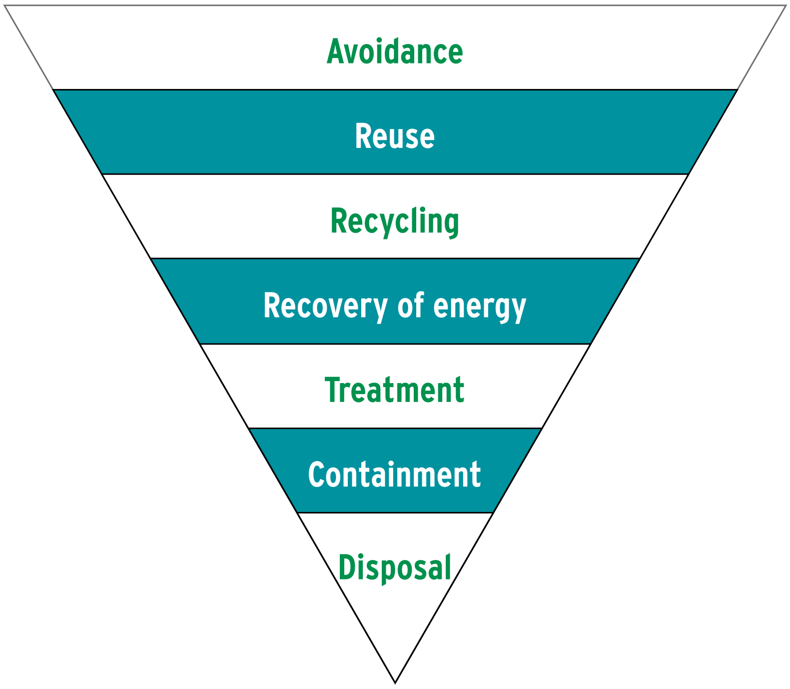


FIGURE GN2.2: THE WASTE HIERARCHY

This approach can also broadly be applied to energy and water efficiency. Table GN2.3 outlines how similar principles to those supporting the waste hiererarchy can be applied to your premises to identify resource efficiency opportunities. The benefit of this approach is to preferentially identify higher level actions ('switch' and above), as these will generally provide more cost-effective opportunities for your RESA assessment and will result in a more holistic resource efficiency strategy that gives the best environmental and economic outcomes.

TABLE GN2.3: EXAMPLES OF RESOURCE EFFICIENCY OPPORTUNITIES

	Waste	Water	Energy
Avoid	• Choose products with less packaging and purchase raw materials in bulk to minimise packaging. • Match raw material quantities to batch sizes. • Establish 'take-back' loops with suppliers for packaging waste and faulty/used product.	Ensure you are not using water unnecessarily: • Minimise the use of water safety standby mode. • Where practicable shut down production lines when not in use.	Ensure you are not using energy unnecessarily: • Don't leave equipment on standby. • Where practicable shut down production lines when not in use.
Reduce	Minimise product changeovers and process upsets.	Reduce water use through Improved efficiency: • Ensure appliances and equipment are running efficiently. • Schedule production runs to ensure less change-over. • Consider water use efficiency when purchasing new equipment.	Reduce energy use through efficiency: • Ensure appliances and equipment are running efficiently. • Ensure smart building design and retrofit (materials, orientation, insulation, shading).
Reuse	Investigate whether your waste could be used as a resource elsewhere and find opportunities for reuse.		
Recycle	• Share recycling resources with other organisations to reduce costs. • Increase the opportunity for recycling – sort and segregate wastes prior to collection.	Use treated wastewater from existing treatment processes for: • vacuum pump seals • cooling tower make-up • toilet flushing and other amenities.	
Recover	Minimise product residue in packaging and processes by removing and recovering more raw materials.	Where possible, recover water from existing processes: • Segregate and reuse process wastewater into another process stream.	Where possible, recover energy from existing processes: • Co-generation. • Waste (solid and gas) to energy.
Switch		Switch to alternative water sources: • Are you able to use recycled water or harvested rainwater?	Switch energy or fuel sources: • Use renewable energy. • Switch fuels to reduce greenhouse intensity.
Treatment	Treat residual waste on site to reduce its hazard ranking or facilitate reuse.	What cannot be avoided, reduced, reused or recycled would then need to be treated.	
Containment			Sequester emissions through: • natural sequestration • carbon capture and storage.
Offset			Offset residual greenhouse gas emissions: for more information go to www.epa.vic.gov.au/greenhouse.
Disposal	Disposal as per licence requirements.	Disposal as per licence requirements.	

1.6.2 How to identify resource efficiency opportunities

Using the preferred opportunities approach outlined above and knowing the major resource-using and waste-generating activities, you should be able to identify a range of potential opportunities to reduce resource consumption and/or waste generation.

You should initially focus on the key activities and the first two or three elements of the resource efficiency hierarchy (i.e., avoid, reduce, reuse), as this is likely to identify the opportunities that have the greatest potential to achieve significant resource, waste and cost savings.

A range of techniques and methodologies can be used to identify these opportunities, some of which are discussed in more detail below.

Further Information

A list of references, including additional case studies and ideas for reducing resource consumption and waste generation, can be found in Module 5 of the EREP Toolkit.

Data analysis

- Look for daily, weekly, monthly, yearly trends.
- Look for correlations/relationships between resources and wastes, between individual resources and between individual wastes.
- Look for data that doesn't add up or make sense (e.g., usage during periods of low activity).
- 'Pinch' analysis[2] [3]: used to determine the minimum resource requirements for an operation.

Site walkthroughs

- Undertake with one or two other 'assessors'.
- Include all areas and activities.
- Note observations.
- Highlight activities for improvement.
- Undertake at different times of the day, over a period of 2–4 weeks.

Continuous improvement techniques

- Brainstorming[4].
- Root cause analysis[5] (see Figure GN2.3 below).
- Five whys[6].
- Six Sigma[7].
- Kaizen[8].
- Total Quality Management (TQM)[9].

2 The Chemical Engineers' Resource Page (2008), 'Pinch Technology: Basics for the Beginners', **www.cheresources.com/pinchtech3.shtm**l, last accessed 13 February 2008

3 J Geldermann, M Treitz, O Rentz (2007), 'Towards Sustainable Production Networks', *International Journal of Production Research*; Sep 2007, Vol. 45 Issue 18/19, p4207–4224, 18p

4 Redmond M (2007), '60 Minutes to a Solution', *Quality Progress*; Feb 2007; 40, 2; pg. 80

5 Perry M (2006), 'A Fish(bone) Tale', *Quality Progress*; Nov 2006; 39, 11; pg. 88

6 A question-asking method to determine a root cause of a problem, also used within Six Sigma methodology

7 Process improvement methodology developed by Motorola, see Motorola Inc. (2008) 'What is Six Sigma?' **www.motorola.com/content.jsp?globalObjectId=3088**, last accessed 13 February 2008

8 Continuous improvement approach developed by Toyota Motor Corporation; see **www.toyota.com**.

9 An approach to quality management that can be applied at an organisational, supply chain or product life-cycle level, building on ISO standards for quality and environmental management systems.

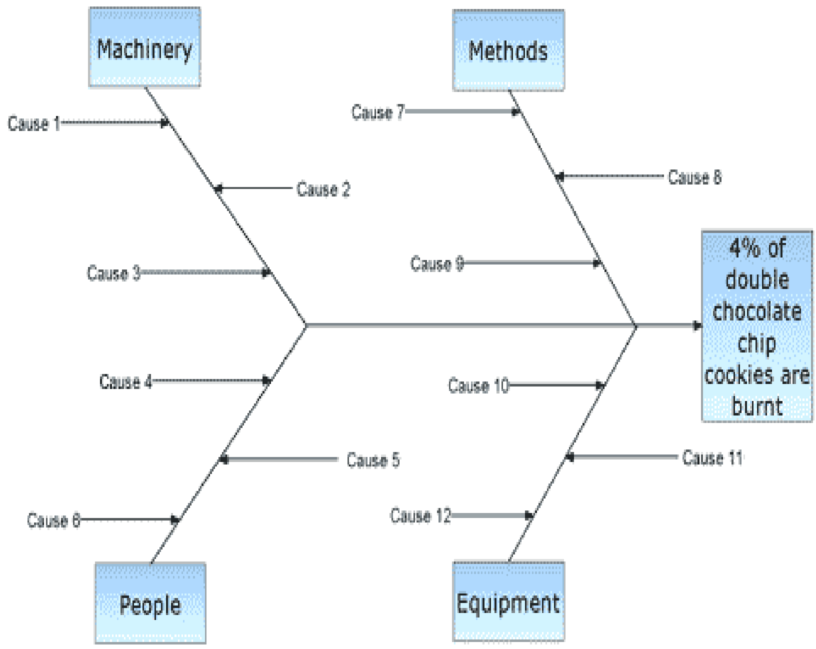


FIGURE GN2.3: FISH-BONE DIAGRAM

Activity best practice assessment

How does the resource use or waste generation for each activity compare with industry standards?

- Five-star energy or WELS (water efficiency) rating.
- Internal recycling loops (water and waste).
- High-efficiency motors.
- Variable-speed drives.

Further Information

Information about undertaking a best practice assessment for an activity and/or premises is detailed in Module 2 of the EREP Toolkit.

Benchmarking activity resource use and/or waste generation

To gain an understanding of the relative efficiency of activities and to track improvements, you should develop resource efficiency indicators (REI), related to specific activities.

You may wish to use one or more activity measures to benchmark key resource-using/waste generating activities. The data for this measure should be collected for the baseline period.

REIs will provide a more useful snapshot of resource efficiency than baseline data alone, as REIs account for variables such as the size of your premises and fluctuating levels of activity and production. This enables you to compare your REIs against those for other similar operations.

Further Information

Benchmarking is discussed further in Module 2 of the EREP Toolkit.

Internet searches/literature review/research and development

- Case studies.
- Patents.
- Equipment supplier websites.
- Published paper databases.

Case studies outlining opportunities to reduce resource use and waste generation can be found at:

www.environment.gov.au/settlements/industry/corporate/eecp/industry.html#9

www.epa.vic.gov.au/bus/resource_efficiency/outcomes/default.asp

www.environment.nsw.gov.au/sustainbus/casestudies.htm

https://citywestwater.com.au/business/water_and_resource_efficiency_casestudies.htm

www.sydneywater.com.au/SavingWater/InYourBusiness/FactSheets.cfm

Interview resource efficiency key stakeholders and experts

Examples of people who could be interviewed as part of the review of opportunities to reduce resource use and waste generation:

- energy, water and waste service providers
- raw material, chemical suppliers
- equipment suppliers
- personnel at other sites within the organisation
- people who can influence resource consumption and/or waste generation (e.g., staff, contractors, tenants, visitors etc).

Review relevant organisation policies and procedures

A review of organisation policies and procedures is recommended as part of the RESA as this will help to highlight actions that can 'indirectly' reduce resource use and waste generation.

The review will generally cover all aspects of the organisation, such as environmental policies, financial policies, human resource and training policies, maintenance procedures and other operational procedures developed for key resource using and waste generating activities. It should also include a review of training and communication programs and how these could be better used to support resource efficiency. Refer to Module 2 for of the EREP Toolkit further guidance in this area.

1.6.3 Facets of the organisation to investigate to identify opportunities

Initially you should focus on your operations as it is important to review an activity in the context of the organisation. For example, review work flow design and work methods, look for technical improvements and review management systems. You should also consider how upstream and downstream operations impact on the resource use and waste generation of each key activity (e.g., just-in-time scheduling increases the number of production runs, raw materials received in small packages rather than bulk containers will increase packaging waste).

You could consider the following:

Logistics

- Product scheduling.

Raw materials supply

- Raw material packaging (e.g., package size).
- Frequency of deliveries.

Workflow design

- Location of equipment/areas.
- Rework.
- Bottlenecks.
- Separation of hot and cold processes/areas.

Technical improvements

- Avoid product spillage through installing conveyor and gutter guards.
- Install more efficient equipment — for example, boilers, pumps or lighting.

- Replace existing fixtures with more efficient fixtures.
- Change a process from a batch operation to a continuous operation.
- Increase equipment capacity.

Management improvements (organisation systems and/or staff behaviour)

- Accountability (e.g., linked to performance) for resource consumption and waste generation.
- Staff awareness and training regarding the cost of resources and ways to minimise use.
- Maintenance cycles so equipment and processes are performing optimally and leaks and blockages are identified.
- Monitoring and review systems for resource use and waste generation.
- Purchasing policies that aim to minimise resource consumption and/or waste generation.

1.6.4 Using 'representative premises' for identifying resource efficiency opportunities

A premises may use an opportunities assessment undertaken at another premises of the organisation to provide the basis for a RESA where both premises have similar operational practices, resource use and waste generation profiles. You may need to modify the assessment to ensure that it accounts for your own site-specific factors.

> **Note for EREP participants**
>
> For further details on using a 'representative premises' for identifying resource efficiency opportunities for your EREP, refer to the EREP Guidelines.

1.7 Assessing and prioritising actions

1.7.1 How to assess the impact of each action

Once you have the list of potential actions that could be implemented at your premises you will need to estimate the impact of each action on resource efficiency, waste generation and other organisation factors. When estimating the impact of an action, you should review the answers to some of the following questions:

- What are the relationships between the resources used and the products and wastes generated?
- Is the relationship mutually beneficial (e.g. a decrease in one results in a decrease in another) or conflicting (e.g. a decrease in one results in an increase in another)?
- How is the activity controlled/managed?
- What factors affect the activity and its resource use and waste generation?
- What factors can influence the usage/generation profile of the activity?

You may also want to include some additional questions:

- What will be the new parameters for the activity (e.g., flow rate, energy rating, temperature, hours of operation, loss of product etc)?

Some of these actions may require further investigation to enable adequate assessment.

For example, you may have identified the air conditioning system as an opportunity for improvement. You may require a technical review of its operation to determine exactly what improvements can be made. In this case a HVAC specialist could be engaged to review the energy and water efficiency of the air conditioning system. A wider assessment would consider how heating and cooling requirements may be modified, with factors including the types of equipment operating in air-conditioned spaces and whether these actually need to be controlled to the same temperature, etc.

Another example of a potential improvement that requires further investigation could be the collection and use of rainwater instead of drinking water for certain processes. You may need to investigate how this could be achieved.

1.7.2 Identifying areas with potentially competing resource impacts

While it will be possible to identify activities where resource or waste savings can be made, the relationship between resource use and waste generation and the relationship between two individual resources or waste types must be carefully examined to ensure an adequate understanding of:

- actions that reduce resource use that may have an adverse impact on waste generation or vice versa
- actions that reduce the use of one type of resource that may have an adverse impact on the use of another type of resource
- actions that reduce the generation of one type of waste that may have an adverse impact on the generation of another type of waste.

The impact of actions on resource use and waste generation should be considered together (using an integrated approach) to develop the most resource efficient options. You need to understand these relationships so that the best overall decision can be made.

For example, installing a reverse osmosis plant to recycle wastewater can reduce potable water consumption but will increase electricity consumption and perhaps result in a negative net carbon footprint. This may still be a good decision if water supply is a key issue in the region.

1.7.3 How can I use existing actions from previous work/ other resource efficiency studies in my RESA?

Quite often, you will find that your site has already undertaken investigations into resource use and waste generation.

This information will provide a valuable starting point for identifying how resource use and waste generation may be reduced. However, you will need to update this information with data from the baseline period and review any estimates and assumptions to ensure they are still representative of actual operations.

If the previous work focused on only one resource type or one waste type (e.g., energy or water audit) you should expand on these estimates to include the impact of the option on all significant resource inputs and product and waste outputs. This will ensure an integrated approach has been taken to resource efficiency assessment and may highlight additional savings to build into your payback model.

EXAMPLE: WATERMAP ACTION

A premises participating in the waterMAP program included an action in its waterMAP to reduce Cleaning in Place (CIP) pre-rinse times for its silos and lines on CIP set #1. It identified that this action had the potential to reduce water usage by 5,860 kL/year with associated cost savings of $5,160 in water charges. However, the cost of assigning someone to undertake the 'CIP tuning' was estimated to be $10,000 and consequently this option did not meet the company payback requirement.

Action	Water savings, kL	Total cost savings, $	Cost to implement, $	Payback period, yrs
Reduce CIP pre-rinse times for silos and lines on CIP Set #1	5,860	5,160	10,000	1.9 Does not meet company payback requirement.

When the impact of the action on all resources and wastes was considered it became clear that savings in electricity consumption, water, chemicals, trade waste volume and TDS load, prescribed waste and greenhouse gas emissions would also be achieved. A small reduction in downtime could also result. The integrated assessment determined the total cost savings for the action were approximately $32,142 per year, which will pay back the implementation cost ($10,000) in less than 1 year.

Action	Electricity	Water	Chemi-cals	Trade waste volume	TW TDS Load	Prescribed waste	GHG-e	Other benefits/ risks
	kWh	kL	tonnes	kL	kg	tonnes	t CO2-e	
Reduce CIP pre-rinse times for silos and lines on CIP Set #1	1,289	5,860	20	5,274	1,420	2	8	Reduction in 'waiting for CIP' downtime Low risk of product spoilage

EXAMPLE: EEO ACTION

A premises participating in the Energy Efficiency Opportunities program identified that replacing its existing 36 W fluorescent lights with 28 W lights would reduce energy consumption by approximately 52,600 kWh per year.

Action	Electricity, kWh	Cost savings, $	Cost to implement, $	Payback period, yrs
Replace all 36W fluorescent lights in production areas with 28W lights	52,560	$5,256	$14,000	2.7

Undertaking an integrated assessment of this action found that it would also result in a small reduction in water use, chemical consumption (in the cooling towers), trade waste discharges, solid waste and prescribed waste. The total cost savings rose to $5,277, reducing the payback period from 2.7 to 2.6 years.

Although the additional savings may be minor this integrated assessment highlights the relationship between electricity consumption and water consumption at the site, due to the use of cooling towers in the refrigeration plant. Reducing the heat load on the air conditioning system is an important aspect of reducing resource consumption at the premises.

Action	Electricity	Water	Chemicals	Trade waste volume	TW TDS load	Solid waste	Prescribed waste	GHG-e	Other benefits/ risks
	kWh	kL	tonnes	kL	kgs	tonnes	tonnes	t CO_2-e	
Replace all 36W fluorescent lights in production areas with 28W lights	52,560	21	minor	4	minor	minor	minor	70	

1.7.4 What level of accuracy do I require for estimates of savings and costs?

As you may need to use this data to support a business case for an action it is important that estimates of savings and costs are as accurate as is practicable.

You may start your assessment of an action by making rough estimates (e.g., percentage reduction) of the impact the action will achieve and the cost to implement the action. You can then calculate the paypack period for the action. If the payback period is low and the action can be implemented with little or no capital investment, this rough calculation may be sufficiently accurate. Where the payback period is within or close to your minimum requirement for financial approval you should revise your initial estimate with a more detailed analysis of savings, and potentially obtain equipment quotes etc. You may even need to revise your initial consumption or generation estimate (Task E) to ensure that the basis of the estimate is sound. For those actions that are to be implemented in the medium to long term (e.g., 2–5 years away) your initial assessment may be sufficient for inclusion of the action in your action plan. A more detailed investigation would be carried out before the organisation commits to proceeding with implementation.

Where the payback period for an action is within (or slightly above) your organisation's project approval criteria it is recommended that you revisit Task E and Task G of the RESA to review the level of accuracy for the estimates of activity resource usage and/or waste generation and estimates of savings for actions associated with these activities. You may need to improve the accuracy of estimates through more detailed analysis, extra monitoring programs, and/or use of an external expert or consultant, to eventually be able to put forward a business case for the action.

Ultimately, the level of accuracy required will be determined by your organisation's internal finance standards. If actions are to be included in an EREP action plan the level of accuracy should be sufficient for your organisation to approve funding based on the estimates included in the business case.

Further Information

Refer to Module 4 of the EREP Toolkit for more details of estimating costs and cost savings.

1.7.5 Other organisation factors to consider when assessing actions

Some of the other organisation factors to consider when investigating the impact of an action include:

- productivity
- labour resources
- labour rates
- change-over times
- maintenance requirements
- supply chain
- employee satisfaction
- OH&S
- quality.

For example:

- increasing the air conditioning temperature set point may have an impact on staff/visitor satisfaction and/or staff productivity.
- reducing cleaning times to save water, energy and waste may jeopardise product quality or visitor satisfaction.

1.7.6 How to develop a multi-criteria assessment tool

Determine criteria

The first step in developing a multi-criteria assessment tool is to determine the criteria you wish to use to assess an action. These may include savings in resource use/waste generation, payback period, as well as criteria such as product/service quality, employee satisfaction, corporate image, greenhouse gas emissions etc.

If a particular resource or waste type is of more importance to your operations than others (e.g. drought affected area, approaching trade waste agreement limit) you may choose to include these individual resources and/or wastes as criteria rather than including them in an 'overall resource use' or 'overall waste generation' category.

Assign weightings

You may consider applying weightings to each criterion, to indicate the importance of some criteria over others. For example, you may weight the 'overall resource consumption' criterion higher than the 'overall waste generation' criterion as this supports the resource efficiency hierarchy. If your organisation prides itself on its product or service quality you may wish to increase the weighting for the corporate image criterion or if you operate in an area with extreme water shortages you may wish to increase the weighting of the water savings criteria.

Typically, weightings sum to a total of 100.

Rank each action against the criteria

For each criterion you will need to determine the 'rank' for an action. Where an action's impact can be calculated (e.g., five per cent saving in electricity consumption) you can use this value to calculate the rank using the formula:

$$\text{Action criterion ranking} = \frac{\text{Action \$ reduction} \times \text{criterion weighting}}{\text{Criterion \% reduction target}}$$

By dividing by the criterion percentage reduction target (i.e., the percentage reduction that you would like to achieve for that criterion) you will increase the ranking of that action. This is important to ensure that criteria are not ranked so low that they have a negligible impact on the overall priority score.

Where the impact cannot be accurately estimated you will need to make a quantitative assessment to determine the rank. Rankings may be assigned between 0 and the maximum criterion ranking where:

0	=	no benefit/risk
± 20–30% of maximum value	=	some benefit/risk
± 30–60% of maximum value	=	moderate benefit/risk
± 60 –100% of maximum value	=	high benefit/risk

Determine the 'overall resource consumption' or 'overall waste generation' rank

If you include 'overall resource consumption' and/or 'overall waste generation' criteria in your assessment you can weight each of the resource/ waste types and, using the action criteria ranking formula above, calculate the overall rank. This will be of particular importance when an action has a positive impact on one resource/waste type but a negative impact on another.

Further information

An example of determining the 'overall resource consumption' and 'overall waste generation' ranks is included in Appendix F.

Calculate the 'priority score'

After you have determined the rank for each criterion you sum these values to calculate the 'priority score' for the action.

Priority score = sum(criterion rankings)

This value should be between 0 and 100 (if your weightings add to 100). The greater the value the more likely the action is to deliver significant savings in resources and/or wastes as well as operational costs.

Further Information

An example of a multi-criteria assessment of actions is included in Appendix F.

1.7.7 Who should be involved in the multi-criteria assessment of actions?

As a multi-criteria assessment is somewhat subjective it is important to include people with a range of experience and expertise to ensure that the assessment is not biased. For example, the areas of operations, finance, engineering/maintenance, environment, OH&S and quality should be represented.

You may choose to use an external party or someone from within the organisation who has little knowledge of the RESA to facilitate the assessment. This person may help to focus the assessment and ensure consistency of approach.

1.7.8 Life cycle assessment

Life cycle assessment (LCA) is a method for assessing the environmental impacts associated with a product, process or service over its entire life cycle, from the extraction of raw materials through to processing, transport, use, reuse, recycling or disposal.

LCA has a number of advantages over other environmental management tools in the way it draws the boundaries between the 'system under study' and the 'environment'. Whereas most environmental management tools concentrate specifically on one site (and therefore have a limited spatial dimension), LCA encompasses the whole life cycle of a product, process or service (see Figure GN2.4), irrespective of site boundaries.

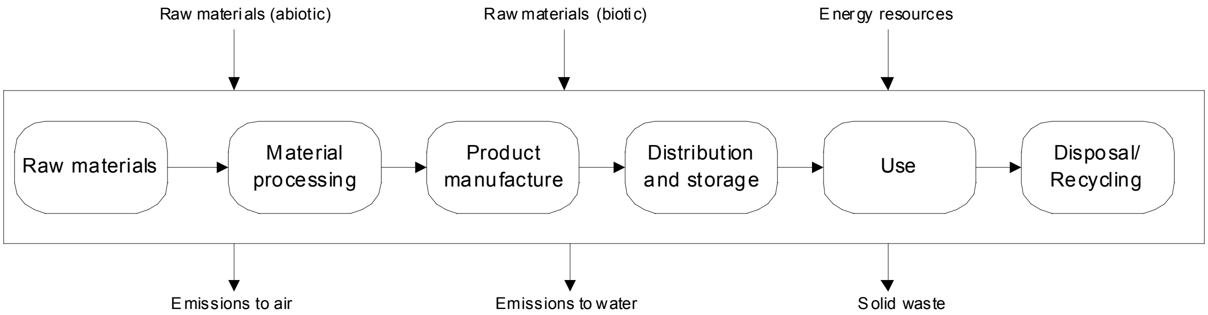


FIGURE GN2.4: AN EXAMPLE OF THE LIFE CYCLE OF A PRODUCT

For this reason, the approach is often termed 'cradle to grave assessment', and has become a widely recognised tool for analysing the environmental performance of systems. As the approach encompasses the entire life cycle it facilitates the identification of 'hotspots' or significant impacts both within and outside the immediate system boundaries. A further advantage of the technique is that it produces quantifiable information about systems and allows comparative assessments to be made.

The brief outline of the LCA methodology presented here follows the terminology and four phases recommended by the international standards ISO 14040[10] and ISO 14044[11]. These are:

- **Phase one: Goal and scope definition.** This phase defines the purpose of the study, and should unambiguously state its intended application, the audience for which the results are intended, the product or function that is to be studied, and the scope of this research. When defining the scope, the functional unit, system boundaries, and data quality requirements of the study must be considered.
- **Phase two: Inventory analysis.** This phase enables the quantification of the environmental burdens associated with a product or service, and relates to the collection, analysis and validation of data that identifies and quantifies all resource use, emissions and waste across the life cycle related to the functional unit being studied. The results include a process flow chart and a list of all environmental inventories associated with the product, process or service under study.
- **Phase three: Impact assessment.** This phase allows the aggregation of all the environmental burdens quantified within the inventory analysis into a limited set of recognised environmental impact categories. For example abiotic resource depletion (kg Oil eq.), global warming (kg CO_2 eq.), acidification (kg SO_2 eq.), nutrification (kg PO_4 eq.) and ozone depletion (kg CFC 11 eq.). The primary aim of an impact assessment is to identify and establish a link between the product, process or service's life cycle and the potential environmental impacts associated with it.
- **Phase four: Interpretation.** The final phase is a systematic evaluation of the results with further recommendations to bring about a reduction in the environmental impacts associated with providing the product or service. This involves the interpretation of results to aid understanding of the issues involved, and the potential for improvements to be made to reduce the environmental burden of the product, such as changes in product, process and service design, and reductions in raw material and/or energy usage.

10 *Environmental management – Life cycle assessment – Principles and framework*, Call No. STA ISO 14040:2006

11 *Environmental management – life cycle assessment – requirements and guidelines*, Call No. STA ISO 14044:2006

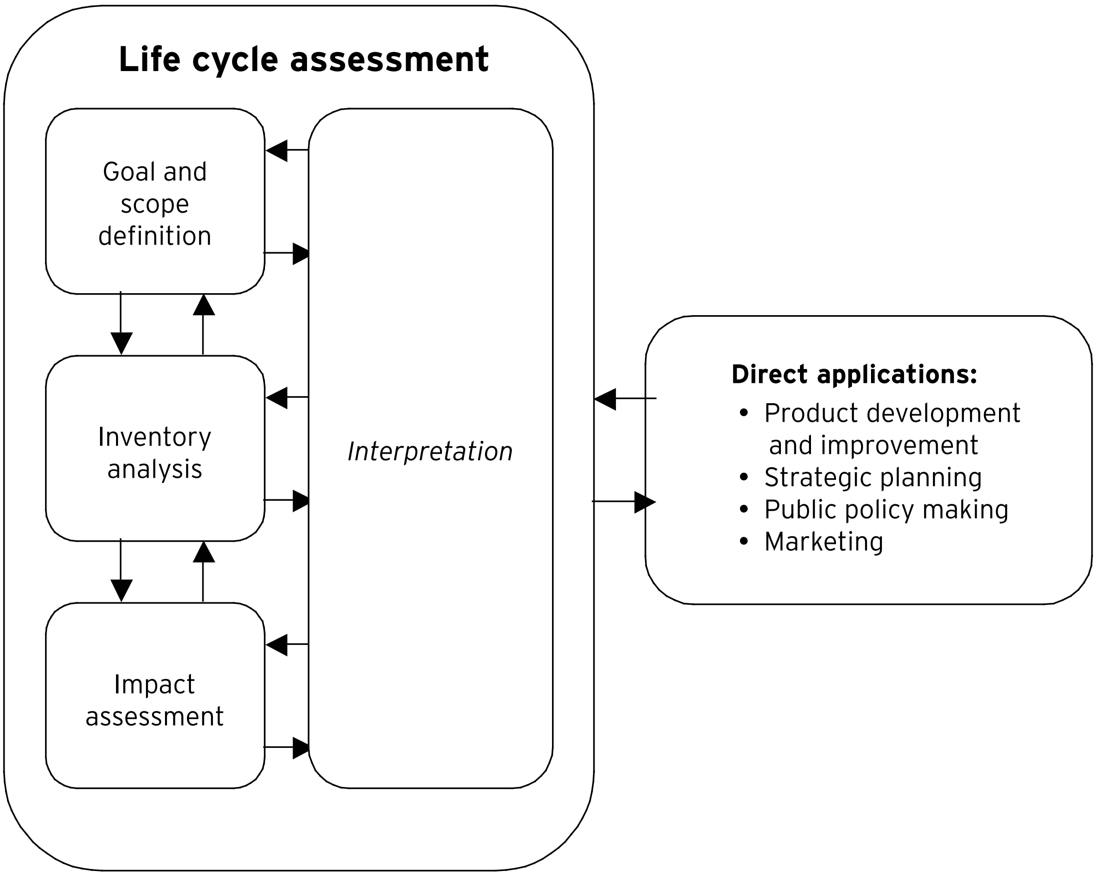


FIGURE GN2.5: THE FOUR-PHASE ISO LCA METHODOLOGY[10, 11]

LCA is a dynamic and iterative process of evaluation, and continuous interaction between the components of an LCA is essential for a successful study. However, the four phases can be described as distinct. For example, the Inventory alone may be used to identify opportunities for reducing emissions, energy and material use, while the Impact Assessment examines the environmental impacts associated with the inventory and highlights where the efforts should be concentrated in order to improve the system as a whole.

Further information about LCA methodology and its application is referred to in Modules 2 and 5 of this Toolkit.

APPENDIX A: INFORMATION THAT MAY BE REQUIRED TO UNDERTAKE A RESA

General organisation information

- Name of organisation
- Operating name (if different to organisation name)
- Type of operation
- Extent of operation (e.g. local, national, international)
- Number of sites in:
  - Australia
  - Victoria

General site information

- Your activities and operations at the site.
- The site's position in your overall organisation.
- Your supply chain.
- Your customers.
- How your organisation and your site approaches environmental management.
- Site address.
- A site map.
- Drawings:
  - service drawings
  - process flow diagrams (PFDs)
  - piping and instrumentation diagrams (P&IDs).
- A description of the operations at this site:
  - main products manufactured/services provided
  - main site areas/descriptors (e.g. processing, administration offices, laboratory, area B, building A, food court – Level 1, kitchen etc)
  - basic description of main activities in each area.
- Number of employees on site per day:
  - staff
  - shift
  - contractors
  - visitors
  - indication of seasonal variability
- Hours of operation:
  - weeks per year
  - days per week
  - number of shifts per day
  - hours per shift
  - any major shutdown, turnaround periods.
- Consumption **and** cost data for all resources used by the site
- Consumption **and** cost data for all wastes generated by the site
- Composition **and** cost data for raw materials, chemicals, products and wastes

- Other cost data:
  - labour
  - maintenance
  - contractor rates
  - equipment costs
- A list of motors and drives at the site with name plate data
- Equipment/process design and operational parameters
  - flow rates
  - temperatures
  - pressures
  - composition.
- Any environmental licences or permits that apply to the site
  - EPA licence (accredited or not)
  - trade waste agreement
  - major hazard facility.
- Current environmental management plans (other than those discussed above)
  - environmental improvement plans
  - internal environmental organisation/action plans.
- Involvement in community committees
- Other organisation contextual information:
  - site challenges (e.g., age, complexity)
  - known bottlenecks
  - known upgrades, refurbishments, changes in operation.
- Previous work/studies relevant to resource efficiency and any known opportunities.

APPENDIX B: 'SCOPE OF WORK' EXAMPLE

This appendix outlines a sample structure for a 'scope of work' document for ABC Ltd, a business seeking to engage a consultant to undertake a RESA. An indication of the type of information that should be provided to or requested from consultants is presented within each section. Contact details and deadlines for the response should be provided upfront.

1. PROJECT BACKGROUND

In this section you should provide relevant company information and outline the context of the RESA.

ABC Ltd, Melbourne

You should include relevant context/background information on the organisation, the site and its operations. Where applicable provide information on the following:

- What does ABC Ltd do?
- What does this site do?
- What are the key areas/processes at the site?
- What are the main products manufactured/services provided?
- Have there been recent major changes at the premises or are there future plans for major changes?
- Do you have any existing environmental licences or agreements (e.g., EPA licence, trade waste agreement etc)?
- Do you have any tenants, contractors and/or joint venture partners within your operations? If so, how many?

Resource efficiency at ABC Ltd, Melbourne

You should include relevant context/background information on resource efficiency at the site. Tell the consultant what you do know and also what you don't know.

Where applicable and where you have existing knowledge provide information on the following:

- Why are you undertaking a RESA?
- Are you participating in EPA Victoria's EREP program?
- Is the site participating in (or has it participated in) any other resource efficiency programs?
- What is your level of commitment to/understanding of resource efficiency at your premises?
- What are your resource efficiency objectives and targets?
- What are the key activities that use resources/generate wastes?
- What work has been undertaken in the past on resource efficiency?
- What were the outcomes of this previous work?
- How will this assessment be integrated with other assessments to be undertaken at the site?
- How do your tenants/contractors/joint venture partners impact on your resource use and waste generation?

Scope of site assessment

It is important to define the site boundary for the assessment and provide relevant information on the area(s) to be included in the assessment. Provide information including:

- the site address
- size of the site
- operations overview
- area(s) to be included in the assessment

- areas to be excluded from the assessment
- whether tenant/contractor/joint venture operations are to be included in the assessment.

You should include a site map showing the assessment area.

Resources/wastes

You should include information on the resources and wastes that are to be included in the assessment. Tell the consultant what you do know and also what you don't know.

Where applicable and where you have existing knowledge provide information on the following:

- resources/waste types used/generated at the site
- approximate total quantities of each resource/waste type
- resource/waste types that are excluded from the assessment
- resource/waste types that you would like the assessment to focus on.

Business context – factors to be considered

You should include information on the business factors (other than costs) that are to be considered when assessing actions. Provide an outline of:

- other factors that are significant at the site
- what the organisation considers when evaluating a business case.

2. OBJECTIVES

In this section, you should outline the key objectives of the RESA, which would include the following:

- Establish the site's baseline data for resource use and waste generation.
- Determine the resource use and waste generation for the site's key activities and account for at least 80 per cent of all resource use and waste generation.
- Identify opportunities to reduce resource use and/or waste generation at the site and develop actions that potentially could be implemented.
- Determine the impact these actions will have on resource use, waste generation and other organisation aspects (specify, e.g., OH&S, downtime, maintenance requirements) and any potential barriers (specify, e.g., tenants, product quality risk).
- For each action, determine estimated operational costs savings, the cost to implement the action and determine the simple payback period.
- Make recommendations for actions that could reduce resource use and/or waste generation.

3. SCOPE OF WORK

In this section you should clearly outline the services expected of the consultant. Modify the list below in accordance with your needs.

The consultant will be required to provide the following services:

1. Attend a project inception meeting with the ABC Ltd, RESA team to further discuss scope, receive additional information for completion of the assessment and undertake a site inspection (specify date and location).
2. Attend an induction session (specify time and location).
3. Review any relevant previous work undertaken by the site and/or reports for the site.
4. Determine the quantity of each of the resources/wastes described in the project background that were used/generated for a 2 year period, ending (insert end date).
5. Analyse total resource use and waste generation data to determine the resource use/waste generation profile across the 24 month period.
6. Determine an appropriate baseline period for the site in consultation with the RESA team.

7. Conduct a site inspection with the RESA Site Champion.
8. Identify the activities that consume at least 80 per cent of each of the resources/generate at least 80 per cent of each of the wastes.
9. Conduct interviews with key ABC Ltd personnel, boiler and cooling tower water treatment service providers, waste management service provider and XYZ equipment supplier to establish the resource use/waste generation of key activities.
10. Update existing process flow diagrams to create resource efficiency diagrams that represent the flow of resources and wastes through the premises.
11. Prepare mass and energy balances (M&EBs) for the premises, which includes each of the resources/ wastes described in above. For each type, the M&EB should be able to accurately account for at least 80% of the premises resource use and waste generation.
12. If insufficient information currently exists to perform task 11, develop an additional monitoring program to complete the mass and energy balance for the assessment area to an accuracy of 80-90%, in consultation with the RESA team.
13. Facilitate an opportunities workshop(s) (specify number) to:
    - present the mass and energy balance data, including the list of key resource-using and waste-generating activities, and the resource efficiency diagrams
    - brainstorm potential opportunities for reducing resource use and waste generation at the site
    - determine the actions that could be implemented to achieve reductions in resource use and waste generation at the site.
14. Conduct interviews with key ABC Ltd personnel, boiler and cooling tower water treatment service providers, waste management service provider and equipment suppliers to determine the impact of each action on resource use, waste generation and the other organisation factors described in the project background. These estimates should be of an accuracy level sufficient to satisfy ABC's finance approval criteria.
15. For each action identified, estimate the cost savings and the cost to implement the action, in consultation with the RESA team. These estimates should be of an accuracy level sufficient to satisfy ABC's finance approval criteria. Where the payback period for an action is 2.5 – 4.0 years quotes should be obtained (where applicable) and the basis for the estimate should be provided in the report.
16. Develop an action ranking tool that can be used to prioritise actions, in consultation with the RESA team.
17. Facilitate an action ranking workshop to:
    - present the savings, costs and other benefits/risks associated with the actions
    - rank the actions
    - determine which actions will be eliminated from consideration
    - assign timeframes and responsibilities for all remaining actions.
18. Prepare a draft report which summarises the findings from Items 3–16 of this 'scope of work', using the 'Sample format for a RESA report' (provided in Appendix C of this module). The report should include:
    - assessment methodology
    - the resource use and waste generation profile for the baseline period
        - data sources
        - an assessment of the level of accuracy of this data
    - the mass and energy balance for the assessment area
    - a description of the key activities contributing to resource use/waste generation
        - data sources
        - an assessment of the level of accuracy of this data

- the entire list of actions that could reduce resource use and/or waste generation including:
    - a description of the action
    - the impact of the action on all types of resource use and waste generation
    - the impact of the action on other organisation factors
    - the cost savings, cost to implement and payback period
- the action ranking table
- an action plan, including the assigned timeframes and persons responsible
- a summary of the findings, including recommendations for future investigation.

19. A copy of the draft report is to be submitted to the ABC Ltd, RESA team for review and comment by (insert date).
20. The final report will be submitted by the (insert date).
21. Provide regular updates on the progress of the assessment to the RESA site champion. At the completion of each day on site you shall provide an update to the RESA site champion. During other stages of the project a fortnightly update phone call or email is preferred.
22. Any matters which arise that may materially affect the progress of the contract work should be communicated to the RESA Site champion within twenty-four (24) hours of the matter being known to the Contractor.

4. SUPPORTING INFORMATION

In this section, you should outline useful information that can be provided to consultants to assist with the RESA. (Note: You should expect to provide the types of information shown in Appendix A of this module.)

The following information will be made available at the inception meeting to assist in the RESA:

- site map showing the location of existing buildings, equipment and operations on the site
- drawings (e.g., services drawings, process flow diagrams, piping and instrumentation diagrams)
- an outline of all existing site processes and proposed site processes that may impact on resource efficiency.
- existing reports and studies for the site
- contact names for personnel in ABC Ltd and external parties of interest (e.g., tenants, water and waste service providers)
- electricity, water and waste bills for the previous two years
- organisation activity data for the previous two years
- internal electricity and water sub-meter data (Specify where these are located and what they are monitoring)
- waste analysis data (specify exactly what data is available for what waste streams, what has been tested, when the testing was undertaken and how often is it undertaken)
- MSDSs for all chemicals on site
- raw material and product/service specifications
- stocktake data for raw materials and finished goods.

Further technical information will be supplied on request during the assessment.

5. DELIVERABLES AND TIMING

In this section, you should clearly outline project milestones and completion dates associated with each. These may need to be further negotiated with the consultant depending on the complexity of the task.

Table B.1: Project deliverables and timing

Milestone	Latest completion date	Deliverable
Inception meeting	Insert date	Attendance at meeting
Opportunities workshop	Insert date	Facilitation of workshop Mass and energy balance for assessment area List of key activities in assessment area
Multi-criteria analysis tool	Insert date	Multi-criteria analysis tool
Action ranking workshop	Insert date	Facilitation of workshop List of actions
Draft report	Insert date	1 copy in Word format
Final report	Insert date	3 paper copies of report including diagrams and figures. 1 digital copy of the report in word & pdf format.

APPENDIX C: SAMPLE FORMAT FOR A RESA REPORT

RESA EXECUTIVE SUMMARY

1. Introduction

1.1. Participation in EREP Program (if applicable)

1.2. Scope of works

1.3. Methodology

2. Background information (where relevant)

2.1. Organisation details

2.2. Site details

2.3. Physical facts

2.4. Activity description

2.5. Operational details

2.6. Other current resource management programs applicable to the site

2.7. External programs

2.8. License requirements

2.9. Other internal management systems

2.10. Membership/participation in external committees

3. Environment and resource efficiency baseline

3.1. Baseline period

3.2. Baseline data

Table 3.1: Environment and resource efficiency baseline

3.3. Discussion of baseline data

3.4. Resource efficiency indicators

Table 3.2: Eco-efficiency indicators – 12 month period minimum

Table 3.3: Integrated efficiency indicators – 12 month period (optional)

4. Management system review

4.1. Discussion of existing resource management systems and 'gaps'

5. Mass and energy balances

Figure 3.1: Resource flow diagram(s)

5.1. Mass and energy balances

- Data sources
- Metered data
- Other recorded data
- Data quality

- Key activities contributing to resource use and/or waste generation
- How were these activities determined to be 'key'?
- How is resource use and waste generation integrated for key activities?
- Description of key activities
- Analysis of resource use/waste generation for key activities

6. Actions to increase resource efficiency

6.1. Actions implemented to date

6.2. Actions required for inclusion in EREP

6.3. EREP Methodology

6.4. Identifying actions

6.5. Assessing savings, costs, benefits, risks

6.6. Prioritising actions

- A list of all the resource and waste saving actions that were identified as part of the project with a brief description of what the action is.

Table 4.1: Action assessment summary

7. Action plan

7.1. Action plan

- See Table 7.1.

7.2. Monitoring

7.3. Action plan Timeframe

Appendices

- Supporting calculations
- Data/estimate quality ranking system
- Benefits scoring system and basis
- Risks scoring system and basis
- Multi-criteria analysis results, weightings and basis for weightings
- Other relevant material.

EREP ACTION PLAN TEMPLATE INCLUDING EXAMPLES

COMPANY NAME
SITE ADDRESS

Action Item			Action Implementation			Financial Assessment								Resource Savings				
							Annual Cost Savings Note: annual cost increase entered as negative											
Action ID Number	Activity	Action Item	Project Responsibility	Planned Project Start Date	Planned Project Implementation Date	Project Cost	Energy savings, $/yr	Water savings, $/yr	Waste savings, $/yr	Other savings, $/yr	Total Savings, $/yr	Payback Period, Years	GHG Reduction, tCO2-e/yr	Energy, GJ/yr	Water, kL/yr	Solid Waste, tonnes/yr	Liquid Waste, kL/yr
1	Main Brick Kiln	Optimal Tuning of Combustion Control System	Kiln Process Engineer	09/2009	04/2010	$ 103,000	$97,000	$0	$0	$0	$ 97,000	1.1		28,524	0	0	0
2	Main Compressed Air Supply	Air Compressor Sequencing and Control	Maintenance Manager	01/2009	06/2009	$ 50,000	$97,293	$0	$0	$1,750	$ 99,043	0.5		6,780	0	0	1
3	Glass Cutting Area	Water Recycling Unit	Environment Manager	06/2009	12/2009	$ 1,000	$0	$65	$113	$3,822	$ 4,000	0.3		0	75	0	75
4	Water Treatment Plant	Increase waste water treatment capacity	Treatment Plant Operator	06/2010	12/2010	$ 42,365	-$3,573	$10,440	$11,400	-$3,350	$ 14,917	2.8		-1,051	12,000	0	12,000
5	Glass Treatment Furnace.	Computer controlled heat exchanger to maintain furnace temperature	Furnace Operator	09/2011	11/2011	$ 2,957	$0	$2,001	$0	$0	$ 2,001	1.5		0	2,300	0	0
6	Paint Shed	Recycling Paint Wash Water and High Pressure Cleaning.	Maintenance manager	07/2010	11/2010	$ 5,915	$0	$650	$0	$0	$ 650	9.1		0	747	0	0
						$ 0	$0	$0	$0	$0	$ 0	#DIV/0!		0	0	0	0
						$ 0	$0	$0	$0	$0	$ 0	#DIV/0!		0	0	0	0
						$ 0	$0	$0	$0	$0	$ 0	#DIV/0!		0	0	0	0
						$ 0	$0	$0	$0	$0	$ 0	#DIV/0!		0	0	0	0
					TOTAL	$205,237	$190,720	$13,156	$11,513	$2,222	$217,610		0	34,253	15,122	0	12,076

Notes	
Activity	The task, process, service or item of equipment where the resource efficiency action is being implemented.
Annual Cost Savings	Figures presented in positive terms represent annual cost savings and figures presented in negative terms represent cost increases.
GHG reduction, tCO2-e	The formula applied to calculate greenhouse gas reductions will depend on the fuel source. Please refer to the National Greenhouse Accounts Factors (Australian Department of Climate Change) for emission factors and calculation formulae.
Project Responsibility	Nominate a Job Title.

TABLE 7.1: SAMPLE ACTION PLAN

APPENDIX D: READING AND UNDERSTANDING YOUR ENERGY, WATER, TRADE WASTE AND WASTE BILLS

This Appendix will assist you to interpret billing charges and other related information contained within accounts and invoices issued by energy and water retailers and waste services providers. It will also provide guidance on relevant information to record as part of your RESA.

Understanding how to read your bills has several benefits:

- You can check that you are being charged correctly.
- Resource consumption and waste generated can be tracked and monitored.
- Greenhouse gas emissions can be accurately calculated.

1. ENERGY BILLS

Energy bills are useful for providing information on the 'big picture', including:

- seasonal increases or decreases in average daily electricity use (which may show increased consumption due to increased requirements over summer or winter)
- large differences (over 10 per cent) in the total annual electricity or gas consumption, which may indicate a change in consumption patterns
- unusual peaks in electricity or gas consumption
- a high proportion of off-peak electricity use (for example, it could indicate plant and equipment operating out of normal operating hours)
- a comparison of the actual electricity demand versus the contract demand.

It is often easier to obtain energy data directly from the energy retailer than it is to extract all the data from your own accounts department.

A discussion of electricity and gas billing components follows.

1.1 Electricity Bills

Domestic electricity accounts are usually relatively straightforward to interpret. By contrast, electricity bills for large accounts are more complicated.

The relevant information to record is:

- account number
- service address (where the power comes in— not necessarily the building's street address)
- period of the account, particularly the period end date
- network tariff code
- number of days in the billing period
- consumption, also known as 'usage' or 'energy'. It is often (but not always) divided between:
  - peak energy in kWh
  - off-peak energy in kWh
- demand, comprised of:
  - 'billed', 'contract', 'minimum chargeable' or 'network' demand, in kW or kVA
  - 'actual' or 'highest' demand in kW or kVA
- other charges:
  - NEMMCO charges
  - metering contract
- total cost for the period (with and without GST).

In an electricity bill, there are four main components to your charges.

1. Retail energy charges – for use of electricity

Typically, these rates are expressed as 'peak' and 'off-peak' charges. Customers can negotiate any structure they prefer from a single flat rate to very complex rates that change according to the time of day, month and season that best matches the needs of a particular organisation.

2. Network charges – for use of the electricity network

The Essential Services Commission regulates these charges and maximum set charges cannot be exceeded. Each distributor has its own network charges which are generally based on:

- peak and off-peak consumption – cents/kWh
- demand – $/kW/annum
- standing charge
- maximum demand charge – $/kW.

These fees are charges to the retailer and passed at cost to the customer for the use of the system.

3. Other charges

These are mainly regulated market fees that the electricity retailer is subject to, and the cost of providing you with the retail service.

'NEMMCO Charges' is National Energy Market's (NEM) main revenue stream as the market operator.

'NEMMCO Ancillary Services' is for provision of services necessary for system operation, such as voltage control. 'Smelter Reduction Payment' is a levy for the Alcoa smelter electricity contract.

4. Metering charges

These are costs for the provision and maintenance of a new meter and the forwarding of billing data, which is required if you change electricity retailers.

Other information

Transmission and distribution loss factors

Transmission and distribution loss factors are used to determine the energy rates. The actual transmission losses (TLF) in each trading interval (normally 30 minutes) are calculated as the difference between energy put into the transmission network by generators and the energy out of the transmission network to customers. Distribution loss factors (DLFs) are used to allocate a share of the losses in a distribution network to the customer connected to that network.

Maximum demand

Electricity accounts may include a 'demand' charge in the network (distribution) charges section. Electricity demand is the rate at which electricity is consumed, continuously averaged over 15 or 30-minute intervals. Two demand terms are commonly referred to:

- 'network' or 'maximum' demand—the highest demand recorded during the month.
- 'contract' or 'billed' demand—the demand level at which the demand charges are based. This is equal to the site's historical maximum demand, or the minimum chargeable demand, whichever is the greater. Whenever the contract demand is exceeded by the maximum demand, then the current maximum demand becomes the new contract.

As the demand charge makes up a sizeable percentage of an electricity bill, it is in your interest to have the charged demand as low as possible. Therefore, if your actual demand is consistently less than the contract demand and it is above the minimum chargeable demand, then you should request a reduction in the charged demand.

Electricity Act 1993—Section 158A Tariff order

Attachment 10 of this tariff order states that where a customer requires a reduction in contract demand they must give 12 months written notice to the distribution company serving the site.

The electricity distribution company must then notify the customer in writing within the 12 month period of the new contract demand. However, following the installation by the customer of energy management equipment approved by the distributor, or implementation of a demand management initiative approved by the distributor, this 12 month notice period may be reduced at the discretion of the distributor.

The contract demand requested by the customer is the highest actual demand recorded in the previous 12 months, or the minimum chargeable demand of 120/250 kW (or kVA).

1.2 Natural gas

The relevant information to record from gas bills is:

- account number
- service address (where the gas meter is located— not necessarily the building's street address)
- period of the account, particularly the period end date
- tariff code
- number of days in the billing period
- consumption, also known as 'usage' or 'energy' in MJ
- total cost for the period

Large accounts may have demand charges expressed as Maximum Hourly Quantity (MHQ) and Maximum Daily Demand (Max Daily).

Natural gas is measured in cubic metres (m^3) but is billed in megajoules (MJ). MJ are calculated by using the formula:

MJ = cubic metres (m^3) of gas x Pressure Correction Factor x calorific value of the gas (MJ/m^3).

Metered gas flow is corrected to standard conditions by application of a Pressure Correction Factor which will depend on the existing supply or metering pressure.

2. WATER AND TRADE WASTE BILLS

2.1 Water

The relevant information to record from your water bills is:

- account number
- service address (where the water comes in— not necessarily the building's street address)
- period of the account, particularly the period end date
- network tariff code
- number of days in the billing period
- water volume charges, also known as consumption or usage
- total cost for the period.

Fixed service charges apply to every titled property that is connected to the water and/or sewerage services. These charges are usually billed every three months along with your water volume charges. The charges for non-residential customers are:

Volume charges

These are the charges for water that you use. Your total volume charges are made up of two separate charges, Water Usage and Sewage Disposal.

Water usage charge

The charge for the actual amount of water used during the billing period. The amount of water that you have used is calculated by reading your meter. This occurs approximately every three months. Customers who regularly consume a large volume of water, may have the meter read every month.

Sewage disposal charge

This charge is for the part of your water consumption that is discharged to the sewer. Water that is said to be 'discharged to the sewer' is water that you dispose down any interior drains, sinks, toilets, troughs and any other drains that connect to the sewer.

To calculate the amount of water that you discharge to the sewer every three months, the total volume of water that you consume is reduced by a discharge factor. The formula for calculating the sewage disposal charge for business/commercial customers is:

Total Water Consumption x Discharge Factor x Price per Kilolitre = Sewage Disposal Charge

The standard discharge factor for business/commercial properties is 0.90.

If your property discharges less than 90% of your total water use to the sewer (e.g. you are a commercial nursery, a school or a sporting ground) then you may be able to apply to have your discharge factor reduced.

Fixed service charges

Fixed service charges apply to every titled property that is connected to a water and/or sewerage system.

Drainage charge (Melbourne only)

Your water retailer bills and collects the Drainage Charge quarterly on behalf of Melbourne Water. It is a percentage of the net annual value of the property, with a minimum annual charge.

Increased revenue from the drainage rate will be used to protect and improve our rivers, creeks and bays. Major projects include the construction of wetlands to reduce nitrogen inputs to Port Phillip Bay, river bank revegetation, improving habitat for native fish, platypus and frogs, and works to reduce pollution from the stormwater system.

Drainage revenue is also used to maintain and upgrade drainage infrastructure and to provide flood protection.

Parks Charge (Melbourne only)

Your water retailer bills and collects the annual Parks Charge on behalf of Parks Victoria. This charge helps fund the purchase, development and maintenance of Melbourne's major parks, gardens and waterways. This amount is usually charged in the July-September quarter and may be why your account, for that period, seems higher than normal.

The Parks Charge is a percentage of the net annual value of the property, with a minimum annual charge.

2.2 Trade waste

Trade waste is wastewater generated as the result of any commercial, trade, experimental or industrial processes and discharged to the sewerage system. It may contain chemicals, fats or detergents and is typically wastewater from boilers, cooling towers, and washing, cleaning or rinsing processes.

The discharge of trade waste to sewer is only permitted with your water retailer's consent, which can be sought by completing the Application for Commercial Waste Consent. A 'Trade Waste Agreement' (TWA) between the premises and your water retailer is then agreed.

The relevant information to record from your trade waste bills is:

- account number
- service address (where the water enters the property— not necessarily the building's street address)

- period of the account, particularly the period end date
- network tariff code
- number of days in the billing period
- consumption, also known as 'usage'.
- concentrations of key parameters, such as:
  - biochemical oxygen demand (BOD)
  - suspended solids (SS)
  - total dissolved salts (TDS)
  - total nitrogen (TKN)
- total cost for the period.

Each retailer uses different parameters for charges. In general the charges will include both volume and 'quality' charges.

Volume charges

These are the charges for the volume of trade waste that you discharge. If you have a trade waste flow meter, this charge will be based on the meter readings. However, many premises do not meter their trade waste and the trade waste volume is calculated using a 'factor' that is considered to be representative of your type of operations.

Cost = Volume (kL) x Volume cost per kilolitre

Quality charges

These are dependent on:

i. trade waste concentrations, as measured in milligrams per litre by parameters including:
   - biochemical oxygen demand (BOD)
   - suspended solids (SS)
   - total dissolved salts (TDS)
   - total nitrogen (TKN)

ii. trade waste volume, as measured/calculated in kilolitres.

Different quality parameters may be applied to your discharge, depending on your operations and the likelihood that your trade waste will contain each parameter.

The trade waste load is calculated by multiplying the trade waste volume by the concentration for each parameter. This mass load is then multiplied by the rate ($/kg) to calculate the cost for that parameter.

Cost = Volume (kL) x Parameter Concentration (mg/L) x Parameter cost per kilogram / 1000

Other charges

Other pricing factors may apply to all discharges. For example food waste discharged into the sewer from a commercial insinkerator or food waste disposal unit may be charged a separate fee.

3. WASTE BILLS

Each waste management company will use a slightly different invoicing arrangement; however, the following information will commonly be found on waste invoices:

- account number
- service address
- period of the account, particularly the period end date
- itemised list of services and date service was provided
- total cost for the period.

The services are often in two categories – those that are charged by weight and those that are charged by volume.

Charges by weight

When a service is provided to a single customer (i.e. collection of waste does not involve other sites) the service is usually charged by weight (e.g. skips, compactors, bulk liquids). In this case the cost of the service is equal to:

Cost = Weight (tonnes) x disposal charge ($/tonne) + transport charge ($/trip)

Charges by volume

When the quantity collected is smaller or the waste service provider collects from multiple sites the charge is most often by volume or units (e.g. bin volume, number of bins, estimated pit volume etc.). In this case the cost of the service is agreed in the service contract and includes the cost of transport.

The cost of the service will be the same if the bin is quarter full or full to the brim. As you implement waste reduction actions you should review the frequency of the waste service.

4. BILLING PERIODS

In most cases, the 'month' or 'quarter' period reported on an energy or water bill will not align exactly with the calendar month or calendar quarter. Similarly, organisations may use an accounting month rather than a calendar month to report organisation activity, which doesn't correlate with the billing period either.

By using a minimum of 12 months data to establish the baseline, much of the inaccuracy introduced by using data from slightly different time periods will be eliminated.

Organisations that undertake regular readings of their major energy and water supply meters may choose to use this data, rather than billing data, to establish their baseline. However, where internal data is used you should verify this data against external data and you should note this in your assessment.

TABLE E.1: OVERALL MASS AND ENERGY BALANCE EXAMPLE

INPUTS		Energy		Water	Milk Ingredients				Chemicals						Packaging				Total Inputs
									CIP		Other Chemicals	TWTP		Total				Total	
		Electricity	Natural Gas		Raw Milk	Powders	SMP	Ingred. Total	Caustic	Acid Sanitiser		PAC	Acid		Bottles	Cartons	Packag. Other		
	State	—	G	L	L	S	S		L	L	L	L	L						
Total	Tonnes		0.94	142,368	117,986	287	147	118,420	226	29	81	345	130	812	2,169	603	0	2,773	264,373
% Solids	%			—	12.5	97.0	97.0		50	40	36	43.5	35		100	92	100		
Solids In	Tonnes			—	14,787	278	143	15,208	113.2	11.5	29	150	46	349	2,169	555	0	2,724	15,558
% Moisture	%			100	87	3	3		50	60	64	57	65		—	8	—		
Water In	Tonnes			142,368	103,199	9	4	103,212	113	17	52	195	85	462	—	48	—	48	246,042
Temp.	°C			18	2	20	20		20	20	20	20	20		20	20	20		
Pressure	kPa, g			900	—	—	—		—	—	—	—	—		—	—	—		
Heat Capacity	kJ/kg. Deg C			4.18	3.77	1.83	1.70		3.3	2.8	3.5		3.0		1	1	1		
Energy	GJ	36,490	40,436	10,712	889	11	5	905	15	2	6	—	8	26	43	12	0	55	88,623

OUTPUTS		Products							Trade Waste	Sewer	Wastes				Losses to Air			Total			Diff.
		Full Fat Milk	Low Fat Milk	Skinny Milk	Cream	Flavoured Milks	Cream Bulk	Total			Liquid Waste	Industrial Waste	Filter cake	Total	Evapo-ration	Air Emissions	Waste Heat	Outputs	Inputs	In–Out	%
	State	L	L	L	L	L	L		L	L	L	S	S		G	G					
Total	Tonnes	64,575	32,609	11,024	390	2,968	2,539	114,103	104,697	5,410	605	357	297	962	13,632	0.9	—	238,806	264,373	25,567	10%
% Solids	%	12.2	10.0	9.9	47.2	17.2			1.00	—	4	95	55		—	100					
Solids Out	Tonnes	7,897	3,269	1,090	184	511	—	12,952	303	—	24	339	163	363	—	1	—	13,618	15,558	1,940	12%
% Moisture	%	88	90	90	53	83	100		99.0	100.0	96	5	52		100	—					
Water Out	Tonnes	56,677	29,339	9,933	206	2,457	2,539	96,156	103,650	5,410	581	18	154	599	13,632	—	—	219,447	246,042	26,595	11%
Temp.	°C	4	4	4	4	4	4		25	18	20	20	20		180	205					
Pressure	kPa, g	0	0	—	—	—	—		—	—	—										
Heat Capacity	kJ/ kg.Deg C	3.9	3.9	3.9	3.9	3.9	3.9		4.2	4.2	4.1	1.0	1.0								
Energy	MJ	1,004	507	171	6	46	39	1,774	10,941	409	50	7	6	63	30,673	6,065	35,000	84,925	88,623	3,698	4%

FIGURE E.1: MASS BALANCE SANKEY DIAGRAM

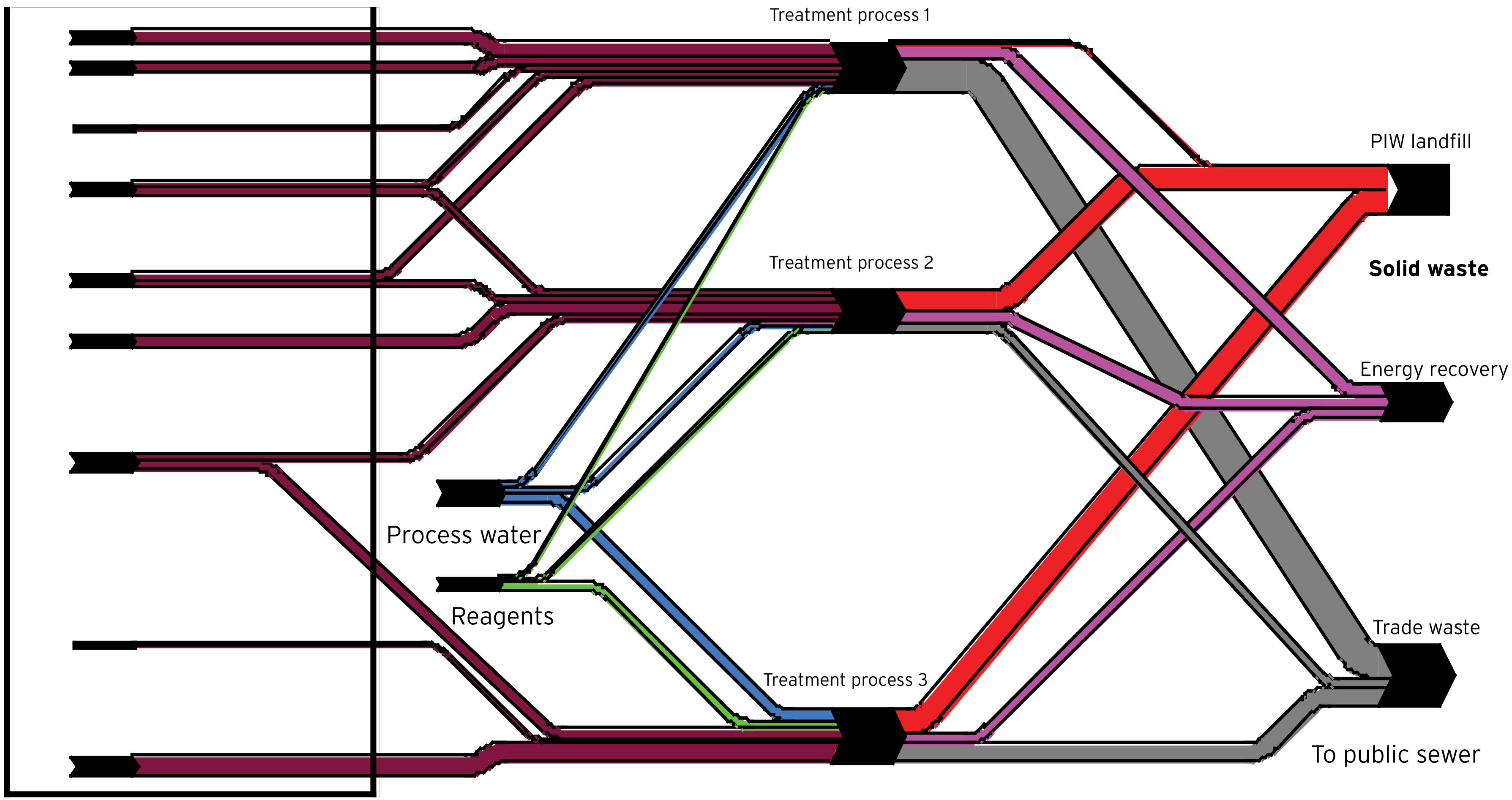


TABLE F.1: INTEGRATED ASSESSMENT OF ACTIONS AND THEIR IMPACTS ON RESOURCES, WASTES AND OTHER BUSINESS FACTORS

	Resources						Wastes						
	Electricity	Natural gas	Water	Ingred.	Packaging	Chem.	Trade waste volume	Trade waste TDS load	Trade waste BOD load	Liquid waste	Solid waste	Prescr. waste	GHG emissions
	kWh	GJ	kL	tonnes	tonnes	tonnes	kL	kg	kg	tonnes	tonnes	tonnes	t CO_2-e
Annual usage – 2006–07	**10,136,000**	**40,436**	**142,368**	**118,420**	**2,773**	**812**	**106,776**	**256,262**	**512,525**	**605**	**357**	**297**	**20,787**
Greenhouse gas emission factor (kg CO_2-e/unit)	**1.325**	**63.4**	**1**				**0**	**0**	**7.75**		**1900**		
Total Greenhouse Gas Emissions (t CO_2-e)	**13,430**	**2,564**	**142**	**—**	**—**	**—**	**—**	**—**	**3,972**	**—**	**678**	**—**	

	Resources						Wastes							
Action description	**Electricity**	**Natural Gas**	**Water**	**Ingred.**	**Packaging**	**Chem.**	**Trade Waste Volume**	**Trade Waste TDS Load**	**Trade Waste BOD Load**	**Liquid Waste**	**Solid Waste**	**Prescr. Waste**	**GHG Emission**	**Other benefits/risks**
	kWh	GJ	kL	tonnes	tonnes	tonnes	kL	kg	kg	kL	tonnes	tonnes	t CO_2-e	
Reduce CIP pre-rinse times for silos and lines on CIP Set #1	1,289	—	5,860	—	—	20	5,274	1,420	—	—	—	2	8	Reduction in 'waiting for CIP' downtime Low risk of product spoilage
Repair leaking steam traps and fittings	—	2,306	820	—	—	0.1	—	0.00	—	—	Min.	—	147	Reduction in OH&S risk
Replace all 36 W fluorescent lights in production areas with 28W lights	52,560	—	21	—	—	Min.	4	Min.	—	—	Min.	Min.	70	
Replace cooling towers with combination cooling tower and air cooler	109,200	—	9,710	—	—	10	971	490	—	—	Min.	0.4	135	New technology has reduced likelihood of legionella
Modify silo design to enable all milk to drain prior to CIP	—	—	—	1,205	—	Min.	1,205	3,374	144,598	—	—	164	1,121	improved milk yields
Increase frequency of maintenance for bottle fillers from once every 3 months to once every 6 weeks to reduce line wastage	**Min.**	**—**	**—**	**40**	**16**	**Min.**	**40**	**112**	**4,820**	**—**	**16**	**5**	**68**	**Overall reduced downtime Improved product quality**

TABLE F.2: INTEGRATED ASSESSMENT OF SAVINGS AND COSTS

	Electricity	Natural gas	Water	Ingredients	Packag.	Chem.	Trade waste volume	Trade waste TDS load	Trade waste BOD load	Liquid waste	Indust. waste	Prescr. waste
	kWh	GJ	kL	tonnes	tonnes	tonnes	kL	kg	kg			
Annual usage – 2006–07	10,136,000	40,436	142,368	118,420	2,773	812	106,776	256,262	512,525	605	357	297
Cost	$0.10	$3.00	$0.88	$435	$312	$1,200	$0.51	$0	$0	$10	$50	$320
Total Cost	$1,013,600	$121,308	$125,284	$51,477,174	$865,041	$973,967	$54,456	$2,358	$202,652	$6,052	$17,852	$94,912

Action description	Electricity cost savings	Natural gas cost savings	Water cost savings	Ingredients cost savings	Packag. cost savings	Chem. cost savings	TW Vol. cost savings	TW TDS load cost savings	TW BOD load cost savings	Liquid waste cost savings	Solid waste cost savings	PIW cost savings	Other cost savings	Total cost savings	Capital cost to implement	Payback period	Comments
Reduce CIP pre-rinse times for silos and lines on CIP Set #1	$129	-	$5,157			$23,472	$2,690	$13				$682	–$10,000	$22,142		N/A	Est. labour cost – 1 person, 2 months
Repair leaking steam traps and fittings	—	$6,919	$722			$100						—	–$3,000	$4,740		N/A	Est. annual maint. costs
Replace all 36 W fluorescent lights in production areas with 28 W lights	$5,256	$0	$19			—	$2							$5,277	$14,000	2.7	
Replace cooling towers with combination cooling tower and air cooler	-$10,920	$0	$8,545			$11,760	$495	$5				$113		$9,997	$45,000	4.5	
Modify silo design to enable all milk to drain prior to CIP				$523,807			$615	$31	$57,174			$52,581		$634,208	$375,000	0.6	
Increase frequency of maintenance for bottle fillers from once every 3 months to once every 6 weeks to reduce line wastage				$17,460	$5,075	—	$20	$1	$1,906	—	$813	$1,753	–$10,000	$17,029	—	N/A	Est. annual maint. costs

TABLE F.3: EXAMPLE OF 'OVERALL RESOURCE RANKING'

This example shows how the calculated resource savings for each action, the organisations reduction targets and other considerations can be used to determine the overall resource ranking for an action. In this example the ranking is equal to

$$\text{Action criterion ranking} = \frac{\text{Action \% reduction} \times \text{Criterion weighting}}{\text{Criterion reduction target}}$$

Ingredients and electricity have been given greater weightings. This could be due to their impact on wastes (e.g., product losses increase BOD and PIW), their relative cost or other constraints (e.g., electricity surety of supply).

	Resources												
Action description	Electricity % Reduction	Elec. ranking	Natural gas % reduction	Natural gas ranking	Water % reduction	Water ranking	Ingred. % reduction	Ingred. ranking	Packag. % Reduction	Packag. ranking	Chemicals % reduction	Chemicals ranking	**Overall resources ranking**
Reduction target	10%		20%		20%		5%		5%		20%		
Weighting		20		10		15		25		15		15	
Reduce CIP pre-rinse times for silos and lines on CIP Set #1	0.01%	0.03		—	4.12%	3.09		—		—	2.41%	1.81	**4.9**
Repair leaking steam traps and fittings		—	5.70%	.85	0.58%	0.43				—	0.01%	0.01	**3.3**
Replace all 36W fluorescent lights in production areas with 28W lights	0.52%	1.04		—	0.01%	0.01		—		—		—	**1.0**
Replace cooling towers with combination cooling tower and air cooler	–1.08%	2.15		—	6.82%	5.12		—		—	1.21%	0.91	**3.9**
Modify silo design to enable all milk to drain prior to CIP		—		—		—	1.02%	5.09		—		—	**5.1**
Increase frequency of maintenance for bottle fillers from once every 3 months to once every 6 weeks to reduce line wastage		—		—		—	0.03%	0.17	0.59%	1.76		—	**1.9**

TABLE F.4: EXAMPLE OF 'OVERALL WASTE RANKING'

This example shows how the calculated waste savings for each action, the organisations reduction targets and other considerations can be used to determine the overall waste ranking for an action. In this example the ranking is equal to

$$\text{Action Criterion Ranking} = \frac{\text{Action \% reduction} \times \text{Criterion Weighting}}{\text{Criterion Reduction Target}}$$

In this example PIW and BOD have been given greater weightings. This could be due to their relatively high cost or an external constraint (e.g. trade waste agreement limit, limited landfill space).

	Wastes												
Action description	TW Vol. % reduction	TW Vol. ranking	TW TDS load % reduction	TW TDS load ranking	TW BOD % reduction	TW BOD load ranking	Liquid waste % reduction	Liquid waste ranking	Solid waste % reduction	Solid waste ranking	PIW % reduction	PIW ranking	**Overall waste ranking**
Reduction target	20%		10%		50%		10%		10%		75%		
Weighting		10		10		20		5		20		35	
Reduce CIP pre-rinse times for silos and lines on CIP Set #1	4.94%	2.47	0.55%	0.55		—		—		—	0.72%	0.34	**3.4**
Repair leaking steam traps and fittings		—		—		—		—		—		—	—
Replace all 36W fluorescent lights in production areas with 28W lights	0.004%	0.00		—		—		—		—		—	**0.0**
Replace cooling towers with combination cooling tower and air cooler	0.91%	0.45	0.19%	0.19		—		—		—	0.12%	0.06	**0.7**
Modify silo design to enable all milk to drain prior to CIP	1.13%	0.56	1.32%	1.32	28.21%	11.3		—		—	55.40%	25.85	**39.0**
Increase frequency of maintenance for bottle fillers from once every 3 months to once every 6 weeks to reduce line wastage	0.04%	0.02	0.04%	0.04	0.94%	0.4		—	4.56%	9.11	1.85%	0.86	**10.4**

TABLE F.5: EXAMPLE OF PRIORITY SCORE TABLE

This table ranks each action for a series of criteria. Where a cost or savings can be calculated the ranking is based on that value, with the maximum ranking achievable equal to the weighting score. The payback period has been disproportionately ranked, resulting in those actions with little or no capital investment scoring highly. The resources ranking has been set higher than the waste ranking to reflect the resource efficiency hierarchy. Action 4 (replace cooling towers with a combination cooling tower and air cooler) has a negative ranking, suggesting that, according to the organisations criteria, this action should not be implemented.

Action description	Overall resources ranking	Overall waste ranking	GHG-e ranking	Payback period ranking	Employee satisfaction	Corporate image	Overall ranking	Other benefits/ risks
Target			10%					
Weighting	15	10	5	45	15	10	100	
Reduce CIP pre-rinse times for silos and lines on CIP Set #1	4.9	3.4	0.02	45	5	0	58.3	Reduction in 'waiting for CIP' downtime Low risk of product spoilage
Repair leaking steam traps and fittings	3.3	—	0.35	45	3	0	51.6	Reduction in OH&S risk
Replace all 36W fluorescent lights in production areas with 28W lights	1.0	0.0	0.17	5	3	3	12.4	
Replace cooling towers with combination cooling tower and air cooler	3.9	0.7	0.32	–23	0	3	–15.3	New technology has reduced likelihood of legionella
Modify silo design to enable all milk to drain prior to CIP	5.1	39.0	2.70	36	0	0	82.9	Improved milk yields Requires staged shut-downs
Increase frequency of maintenance for bottle fillers from once every 3 months to once every 6 weeks to reduce line wastage	1.9	10.4	0.16	45	8	0	65.5	Overall reduced downtime Improved product quality

TABLE F.6: PRIORITY SCORE TABLE – WATER A HIGHER PRIORITY

This table shows an assessment of the same set of actions with different weightings. The premises are in a drought-affected area with limited water supply and has therefore segregated water savings from 'Overall resource savings' and weighted this criteria highly. The payback period priority has been reduced as a result. Action 4 (replace cooling towers with a combination cooling tower and air cooler) has a negative ranking, although this is mainly driven by the payback period ranking. If the company raised its payback criteria from three to five years for large water-saving projects this action may still be implemented.

Action description	Water ranking	Overall resources ranking – minus water	Overall waste ranking	GHG-e ranking	Payback period ranking	Employee satisfaction	Corporate image	Overall ranking	Other benefits/ risks
Target	20%			10%					
Weighting	20	15	10	5	30	10	10	100	
Reduce CIP pre-rinse times for silos and lines on CIP Set #1	4.12	1.2	3.4	0.02	30	4	0	42.7	Reduction in 'waiting for CIP' downtime Low risk of product spoilage
Repair leaking steam traps and fittings	0.58	2.9	—	0.35	30	2	0	35.8	Reduction in OH&S risk
Replace all 36W fluorescent lights in production areas with 28 W lights	0.01	1.0	0.0	0.17	3	2	3	9.7	
Replace cooling towers with combination cooling tower and air cooler	6.82	1.6	0.7	0.32	–15	0	3	–6.4	New technology has reduced likelihood of legionella
Modify silo design to enable all milk to drain prior to CIP	—	5.1	39.0	2.70	24	0	0	70.9	Improved milk yields Requires staged shut-downs
Increase frequency of maintenance for bottle fillers from once every 3 months to once every 6 weeks to reduce line wastage	—	1.9	10.4	0.16	30	6	0	48.5	Overall reduced downtime Improved product quality