Implementation guide

Measuring to manage your resources

Advice and support for organisations in Scotland

RESOURCE EFFICIENT SCOTLAND

Growth that doesn't cost the earth

A programme from ZERO WASTE SCOTLAND

natural scotland
SCOTTISH GOVERNMENT

RESOURCE EFFICIENT SCOTLAND

Want to cut costs?

Scottish organisations could save £2.9 billion every year by using energy, water and raw materials more efficiently. We can help you take a cut of the savings with our free specialist advice, support, training and funding.

Find out what you could save:
www.resourceefficientscotland.com | 0808 808 2268

Growth that doesn't cost the earth

A programme from ZERO WASTE SCOTLAND

natural scotland
SCOTTISH GOVERNMENT

Contents

We hope this guide will help you identity actions your organisation can take to become more resource efficient.

When you do take action, make sure you the get the recognition you deserve, and the organisation-wide support you need, by making a Resource Efficiency Pledge.

RESOURCE EFFICIENCY PLEDGE

Motivate your staff and senior management, and bolster their commitment to achieving your business's environmental goals.

Focus your efforts on a clear set of achievable performance improvement actions.

Get the recognition you deserve from employees, customers and wider stakeholders.

Join hundreds of organisations across Scotland that have already made a Pledge.

Make your Pledge today
http://pledge.resourceefficientscotland.com

Introduction

Most organisations can find ways of eliminating wasteful practices and reducing their resource use. Installing new equipment; upgrading building fabric, fixtures and fittings; and improving processes can all save you money on energy, water and raw materials. However, if you want to get in control, and stay in control of your costs and environmental impact, then good measuring and monitoring is vital.

Measuring and monitoring resource use is a key skill that all organisations should master, regardless of size or sector. It should be one of the first steps your organisation takes to improve its environmental performance.

Why is measuring and monitoring important?

By regularly measuring and monitoring your organisation's use of energy, water and raw materials, you will start to identify patterns of wasteful behaviour and opportunities to reduce resource use, improve environmental performance and save money.

Below are other reasons why measuring and monitoring programme is particularly important for your organisation:

Troubleshoot
Accurate measuring and monitoring enables you to see what's not working as it should be. Human error, equipment faults and a host of other problems can arise in your organisation, and when undetected they eat away at your profits. Measuring and monitoring lets you quickly spot the resulting increase in your resource use caused by these issues, enabling you to take swift remedial action.

Impress senior management
Measuring and monitoring your resource use will enable you to quantify the savings your resource efficiency projects achieve, which will help you impress your management and gain their support for future funding.

Motivate staff
Measuring and monitoring provides you with clear evidence to show your staff how their behaviour directly impacts on your organisation's resource use and its environmental impact and is a great way to encourage them to adopt and maintain resource efficient behaviours.

Benchmark
A measuring and monitoring programme allows you to compare your organisation's performance against industry standards or exemplar sites and is a great way to appraise your environmental performance and competitiveness.

Seven secret profit monsters - and one simple solution

There are many benefits to measuring and monitoring your use of resources. A key benefit is that it enables you to find and stamp out hidden but avoidable gremlins that can eat away at your bottom line.

Download this free article and find out if any of these secret profit monsters are at large in your organisation

Case study
Glasgow High School Club

Associated with the independent High School of Glasgow, The Glasgow High School Club Limited promotes and facilitates affiliated clubs and societies, ensuring the smooth running of the Pavilion and upkeep of the rugby, hockey and cricket grounds and their dressing room facilities at Old Anniesland.

Following a Resource Efficient Scotland workshop, the club started monitoring their water use by taking monthly meter readings and logging them using a simple spreadsheet. Staff later found that taking more frequent meter readings helped them to better understand how the water profile at the Pavilion changed during periods of use and non-use.

By accurately and regularly measuring and monitoring how much water the Pavilion used, the Club was able to identity and investigate areas of intensive water use further. Indeed the Club discovered that seven urinals in the building accounted for over 75% of the total water used.


Case study

Quick, low cost water saving measures save business over £500 a month

RESOURCE EFFICIENT SCOTLAND

Growth that doesn't cost the earth

Associated with the **independent High School of Glasgow**, The Glasgow High School Club Limited promotes and facilitates affiliated clubs and societies, ensuring the smooth running of the Pavilion and upkeep of the rugby, hockey and cricket grounds at Old Anniesland.

Background

Keith Hodgson, Estate Manager, attended Resource Efficient Scotland's water efficiency workshop in November 2013 at Hampden Park Stadium. The workshop provided delegates with the tools and knowledge to implement a water efficiency programme, allowing them to benefit from the implementation of no- and low-cost measures, ultimately reducing water costs.

The workshop detailed the latest technologies and techniques that can be used to reduce costs and how they can be implemented in an organisation.

Measuring and monitoring water use

From what he had learned at the Resource Efficient Scotland Water Efficiency Workshop, Keith investigated and purchased urinal timer control devices which limited the flushing of each urinal to six times per day.

He also negotiated an annual maintenance agreement with the supplier which allows the devices to be serviced and alterations made to the flush cycles as required. This will maximise the cost savings that can be achieved.

This low-cost change has reduced water consumption by over 75%, giving a payback period of under 4 months and savings of over £500 per

"Resource Efficient Scotland's water efficiency workshop provided me with the knowledge I needed to consider water use in my organisation. As a result, I have made

The club has now purchased urinal timer control devices which limit the flushing of each urinal to six times per day.

This low-cost change has reduced water consumption by over 75%, giving a payback period of under 4 months and savings of over £500 per month.

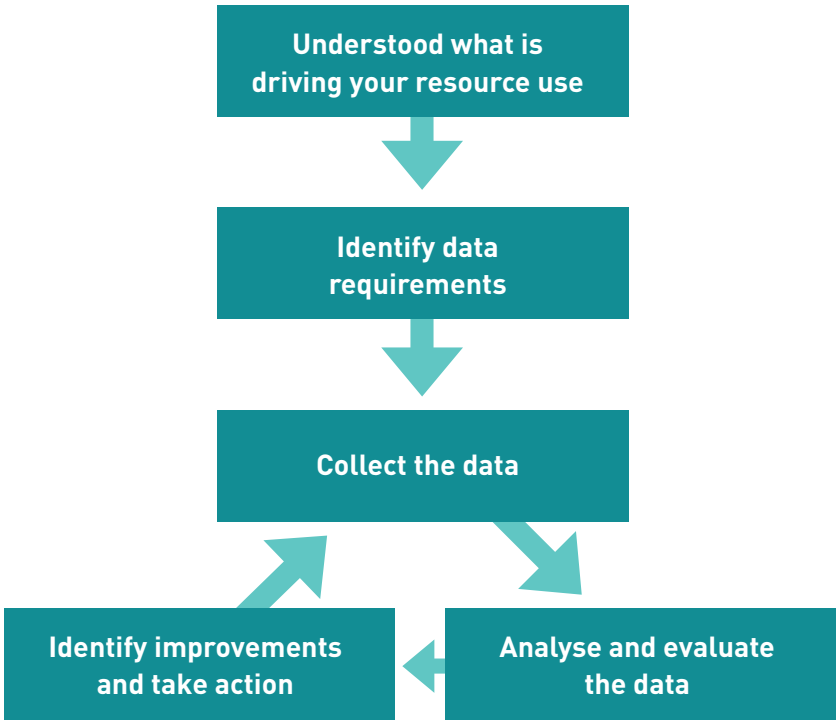
Find out more on the Resource Efficient Scotland website

How this guide will help you

A measuring and monitoring programme does not have to complex. Resource Efficient Scotland recommends following the simple five step process illustrated in Figure 1.

This guide takes you through the process stage by stage, explaining techniques and providing links to useful tools and further support along the way.

Figure 1 – The simple five-step measuring and monitoring process



Step 1 – Understand what is driving resource use

The first step is to understand what is driving resource consumption in your organisation. You should identify the factors that are driving how much waste you produced, and how much energy and water you use. To help you, Table 1 outlines potential factors that are driving resource use for a number of sectors.

Table 1 – what is driving resource consumption in your organisation?

Sector	Factors driving resource use
Hotels, guesthouses and B&Bs	• Number of guests • Number of occupied rooms
Pubs, bars and restaurants	• Number of covers served
Manufacturing	• Number of products produced
Business and professional services	• Number of staff • Gross internal floor area
Retail	• Number of hours open • Number of staff
Construction	• Construction output
Visitor attractions and venues	• Number of attendees • Number of events
Health and leisure centres	• Number of hours open • Number of visitors

Once you have established what is driving resource use in your organisation, you can select Key Performance Indicators (or KPIs) that will help you understand the performance of your organisation and identify opportunities for improvements.

Case study
Edinburgh Zoo

Just as is any other organisation, opportunities to reduce costs are always welcome at Edinburgh Zoo. With an annual heating bill of £240,000, nearly 60% of the total energy costs, any opportunities to reduce heating costs are particularly welcome at the Zoo.

To investigate opportunities to cut costs in this area, staff undertook an energy reduction trial in the Budongo Trail, an area of the Zoo used to house chimpanzees.

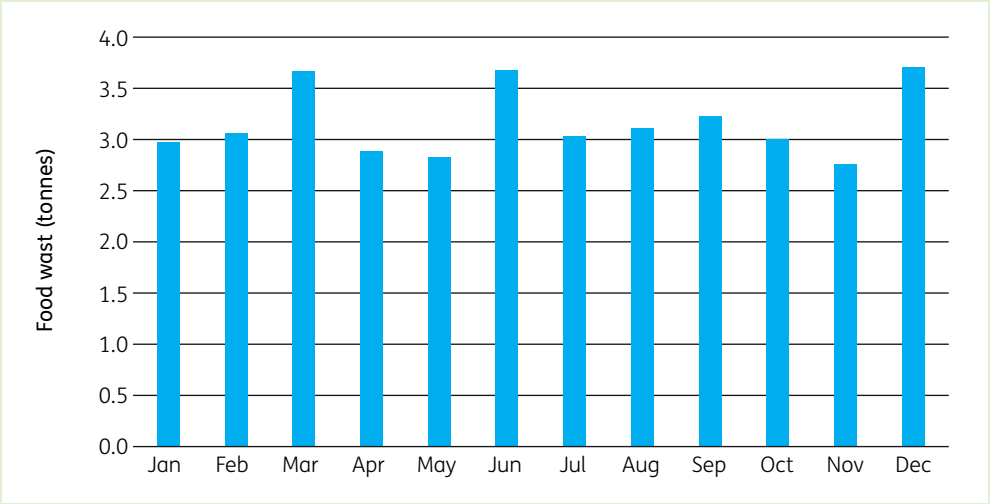
Measuring and monitoring resource use was a critical part of this trial to provide robust data for verification of savings. Therefore, the Zoo installed automatic energy metering prior to the trial taking place. At the end of the trial, this equipment helped the Zoo document how their actions had resulted in a 24% reduction on heating costs, while maintaining the comfort of their permanent residents. Replicating the trial to all areas of the Zoo has the potential to save over £100,000 per year - that's a lot of bananas.

Find out more on the Resource Efficient Scotland website

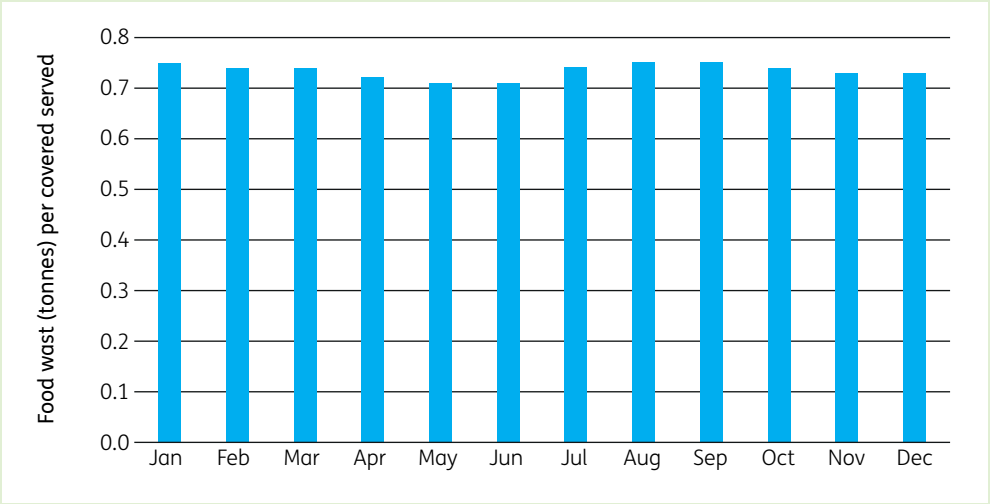
Don't be put off by KPIs

If you get confused by what KPIs are all about, then you are not alone - but KPIs can be very simple and without them it will be very difficult to understand your resource efficiency performance.

For example, imagine you only monitor and act on basic waste data. This graph shows the amount of food waste a restaurant has produced over a 12-month period, and more food waste seems to have been generated in March, June and December. Is that bad? Was the restaurant less efficient during those months? Was more food wasted during food preparation? Or could it just be that the restaurant served more meals during those months, and that drove up food waste?



You need to consider the factors that are driving your resource consumption in your organisation to truly understand your performance. This new graphs shows that month-by-month, food waste per meal served is actually fairly consistent and the increase in food waste is in line with an increase in the number of meals served.



1.1 What are Key Performance Indicators?

KPIs are metrics that will help your organisation understand its resource efficiency performance. KPIs can be specific to an industry, department or even an activity.

There are two main categories of KPIs: absolute and specific.

Absolute KPIs

Absolute KPIs measure resource consumption without reference to any other factors, for example:

- litres of water used;
- tonnes of waste produced; and
- kilowatt-hour of electricity used.

However, all organisations should consider associated factors that influence resource consumption to understand their performance.

Specific KPIs

Specific KPIs therefore, consider the associated factors that influence resource consumption and provide a more accurate indication of performance. For example:

- litres of water used per tonne of product manufactured;
- tonnes of waste per number of members of staff employed; and
- kilowatt-hour of electricity used per cover served.

Specific KPIs can also be expressed as percentages, for example percentage of waste recycled per tonne of product manufactured.

1.2 Choosing the right KPIs for your organisation

Organisations often struggle to use meaningful KPIs and instead collect and report a vast amount of data. Typically, they report on all the things that are easy to monitor, or simply pick the KPIs that everyone else seems to be using. However, what is important to one organisation might be irrelevant to another.

To help you, Table 2 outlines potential KPIs for a number of sectors.

For more information on setting meaningful KPIs and for more examples of KPIs you could use in your organisation, see our article: Try these environmental KPIs - Measure and improve your use of energy, water and waste.

Table 2 – Example KPIs for specific sectors

Sector	Example KPI
Hotels, guesthouses and B&Bs	Energy consumption (kWh) per guest
Pubs, bars and restaurants	Food waste (kg) per cover
Manufacturing	Water consumption (m^3) per tonne of product
Business and professional services	Energy consumption (kWh) per staff member
Retail	Energy consumption per gross internal floor space
Construction	Waste to landfill (tonnes) per unit of construction output
Visitor attractions and venues	Recycling (tonnes) per number of attendees
Health and leisure centres	Water consumption (m^3) per visitor

Case study
Max Fordham

Max Fordham is a sustainable design and environmental engineering business with five offices across the UK and over 200 partners and employees. In 2003, the company opened an office in Edinburgh and, in 2015, moved to larger premises in the city centre due to continued growth.

The company is passionate about sustainability and is always striving to improve its performance and minimise resource use. Measuring and monitoring resource use plays an integral part of this.

For example, measuring and monitoring has helped the business to engage staff which has resulted in reduced waste and increased recycling rates. It has also allowed the business to use benchmarks to compare its performance with similar organisations in the sector, and use that to assess the opportunities and appropriateness for investing time in further improvements.

Find out more on the Resource Efficient Scotland website

Further support

Try these environmental KPIs – Measure and improve your use of energy, water and waste

KPIs like net revenue and customer satisfaction levels have always been important for businesses to measure and monitor. Increasingly, environmental KPIs are being added to the measuring and monitoring activities of leading businesses.

Whether you are a hotel, food business, manufacturer, office, retailer or entertainment venue we've put together some example KPIs that you can download and start tracking in your business.

1.2.1 What areas of your organisation should the KPI relate to?

The KPIs you choose to use should directly link to your organisation, whether it is your whole site, specific departments or specific activities.

Site level KPIs are most useful for senior managers and external stakeholders, and are often used in environmental reports. Alternatively, measuring KPIs by department or activity allows production problems or inefficiencies to be pinpointed and action to be targeted effectively. This can also help you set targets for departments to make them accountable for raw material and utility use and waste generation.

1.2.2 How many KPIs should you have?

The number of KPIs used to measure your organisation's performance should be kept to a minimum. Think carefully about which KPIs you want to measure and don't overload yourself. Try to choose between four and eight KPIs to focus on.

A common problem with KPIs is a lack of monitoring. It is no good measuring a KPI once, this will not provide any useful data. KPI monitoring should be an ongoing process, requiring regular monitoring to spot trends and determine whether or not you are on track to achieve your objectives.

Step 2 – Identify data requirements

With your chosen KPIs identified, and benchmarks ready for comparison, the next step is to decide what data are to be collected. It is important to collect the right information, at the right time and in the right format. You will already have useful information on your resource use in your organisation and the key is to think about where it is kept, who to ask about it, what format it is in and how often it is collected or received.

Key questions to ask yourself to help you identify your data requirements include:

- **What data are needed to calculate your chosen KPIs?**

  It is important to write a list of the data that might be available already.

- **How much detail is needed?**

  The level of data required depends on what the data are going to be used for. Generally speaking, detailed data help to pinpoint problems and provide an accurate picture of what has happened. Higher level data are useful for showing general trends. Collecting and analysing detailed data can be expensive and time-consuming, so plan ahead and collect only as much as is needed.

- **When and how often are data needed?**

  The more frequently you can collect data the quicker you will be able to spot problems and the more accurately you will be able to pinpoint performance issues. But data can take time to collect, and sometimes you will be limited by the availability of data from your suppliers. So experiment to find the balance that works for you, and aim for a minimum of a monthly data collection cycle.

  The earlier you can start to collect data the better. Don't wait until after you have started making resource efficiency improvements. Having data before and after taking action will help you make comparisons and track the progress of your projects.

- **What format is the data required in?**

  Remember that data come in different forms. Extra work may be required to reformat data that are not in an accessible format.

- **Who holds the data?**

  Data can come from many different sources (e.g. finance department, senior managers, facilitates team).

- **Are the data available, accurate and reliable?**

  If data are not available or are not of sufficient quality or relevance, you may need to put in processes to collect the data manually.

Table 3 illustrates the type of information you might need, the common sources of the data and the data you might need to collect.

To help you monitor your KPIs try to collect data on key metrics such as staff head count, visitor numbers or floor space. For any data you don't have, you may be able to get them from primary sources (e.g. supplier invoices) or you might need to take measurements yourself. You may find it helpful to fill in a table like this for your own business.

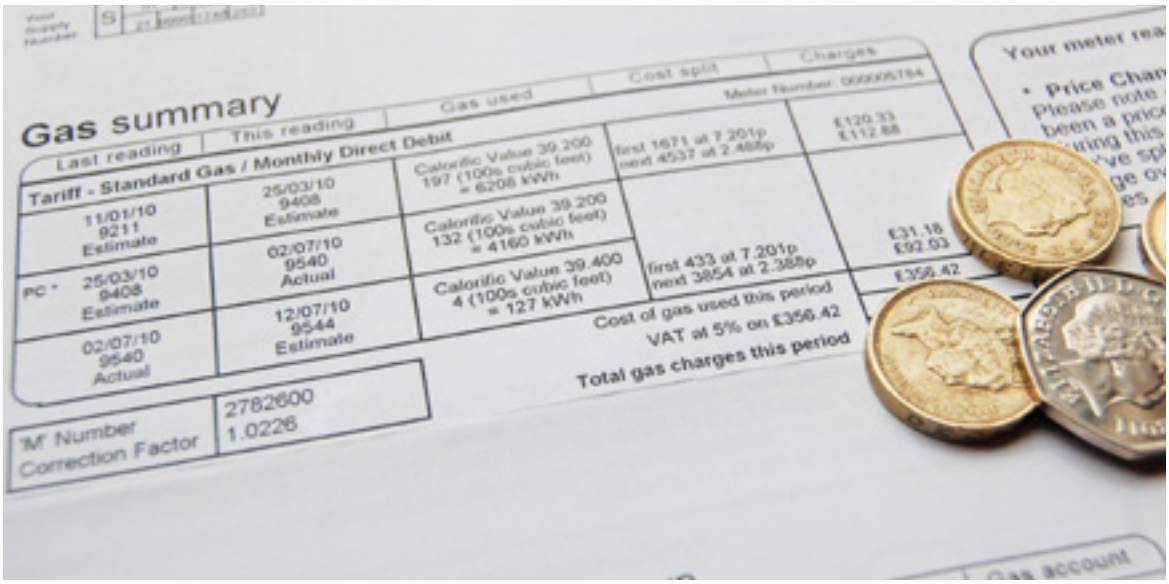
One technique to help you identify your data requirements is to conduct a site walkaround.

A site walkaround will help you develop a complete overview of activities on your site, help you identify your resource use and identify what sources of data are available.

For more information on carrying out a site walkaround, download the free Resource Efficient Scotland implementation guides, How to conduct an energy audit, Save money on waste and Save money on your water bill.

Table 3 – Common sources of data

Information needed		Who to ask	Existing information available	Data to collect
Overall business	• Number of units produced • Operating hours • Number of shifts/cycles • Number of staff per building • Number of covers • Number of guests	Finance, team managers, facilities	• Production records • Sales figures	
Raw material usage	• Number of products produced • Number of covers served • Raw materials consumed in each product • Number of realms of paper consumed • Food ordered each month	Facilities, finance, environment team	• Stocktaking information • Purchasing records • Delivery notes	• Number of rejects and damaged products • Amount of process waste (e.g. offcuts)
Waste	• Total waste produced • Waste disposal costs • Waste disposed to landfill • Waste disposed by other routes, including recycling • Total food waste produced • Total waste produced for specific activities and departments (e.g. manufacturing process) • Total packaging waste produced	Facilities, finance, environment team	• Waste invoices • Waste transfer notes • Packaging waste forms	• Amount of waste produced for each activity and department • Composition of residual and recycling waste stream • Types of packaging material used • Amount of packaging waste to landfill, recycled and re-use
Energy use	• Total electricity use • Total gas use • Energy use for specific departments and activities (e.g. lighting, manufacturing process)	Facilities, maintenance, finance	• Energy supply invoices • Main meter and sub-meter readings • Manual meter readings • Automatic meter reading (AMR) logged data	• Energy use for specific activities and departments
Water use	• Total water usage • Water usage for specific departments and activities (e.g. toilets, manufacturing process) • Effluent discharge	Facilities, maintenance, finance	• Water supply invoices • Main meter and sub-meter readings • Portable meter readings • Effluent discharge consents	• Water use for specific activities and departments • Flow volumes of waste-water



Step 3 – Collect data

Step four in your measuring and monitoring programme is where you collect and quantify all of the related data held in the organisation.

Ideally you will be able to access information going back several years as this will help you to build up a historical picture and start identifying performance issues and immediate savings opportunities. Where this is not available, you will soon start to build up a picture by collecting new data.

3.1 Key points to consider when collecting your information

With all forms of data collection, it is important to keep three points in mind.

First, use common units of measurement to allow useful comparisons (e.g. between time periods or areas of the organisation) to be made. Table 4 shows the appropriate units for measuring resource consumption.

Table 4 – Common units of measurement

Electricity	Kilowatt Hour (kWh)
Gas	Kilowatt Hour (kWh)
Oil	Litres (l) or Kilowatt Hour (kWh)
Water	Litres (l) or cubic metres (m^3)
Effluent	Litres (l) or cubic metres (m^3)
Waste	Kilograms (kg) or tonnes (t)
Raw materials	Kilograms (kg) or tonnes (t)

Second, make one person responsible for collecting the data to ensure measurements are taken frequently and consistently. Remember to appoint a deputy in case the main person is absent.

Third, processes used for information collection should be recorded so that anyone can follow them if the main person is absent.

3.2 Collecting energy data

There are three key methods for collecting information on energy use. These are:

- examining energy bills;
- taking meter readings; and
- estimating energy use data.

For more information on collecting energy data, see the free Resource Efficient Scotland implementation guide: How to conduct an energy audit.

3.3 Collecting raw material and waste data

There are four methods for collecting information on raw material use and waste. These are:

- examining waste bills, purchase records and waste transfer notes;
- taking direct measurements;
- carrying out a waste composition analysis; and
- estimating waste data.

For more information on collecting raw material and waste data, see the free Resource Efficient Scotland implementation guide: Save money on waste.

3.4 Collecting water data

There are three methods for collecting information on water use. These are:

- examining water bills;
- taking direct measurements; and
- estimating water use.

For more information on collecting water data, see the free Resource Efficient Scotland implementation guide: Save money on your water bill.

3.5 Storing your data

Different organisations have their own way of storing and managing the data that they hold. Ideally, your data should be stored electronically. Storing data electronically, for example in a spreadsheet, allows easy manipulation, and enables you to plot your data on graphs and develop more insight into what is happening.

Resource Efficient Scotland has developed three Measuring and Monitoring Tracker spreadsheets which you can download for free to record and analyse your resource use data in this way.

Best practice for the management of resource data

Top Tips

- All electronic data should be held in a central system with daily back-up.
- The system used should be expandable and use different formats of data.
- The system is password protected with limited access and the majority of access is read only.
- Paper records should be stored in a secure location, and kept for a timeframe set by any relevant regulation. Copies of all primary data should be kept in chronological order and in good condition. Access should be restricted to key individuals.
- Each dataset has a clear owner and responsibilities are outlined.
- Procedures for data collection should be documented to allow for succession planning or absences of key individuals.

3.6 Producing a data collection plan

It's very advisable to keep track of all the different data you collect, its purpose and where it comes from. A data collection plan will help you capture this information.

A data collection plan is designed to reduce the effort required for data collection and keep track of where you are in the data collection process. Having this process documented can also assist in delegating responsibilities and transferring knowledge to others.

The key areas to document are explained below, but you may choose to add others that are more appropriate to your organisation:

- Indicator – what is the exact KPI you have to report against?
- Method – how do you collect or calculate the KPI?
- Frequency – how often do you have to collect the data?
- Data recording – what format does the data come in?
- Responsibility – whose role is it to collect the data?
- Status – when was the latest data received, what action has been taken to collect data?

An example data collection plan is shown in Table 5.

Table 5 – Example data collection plan

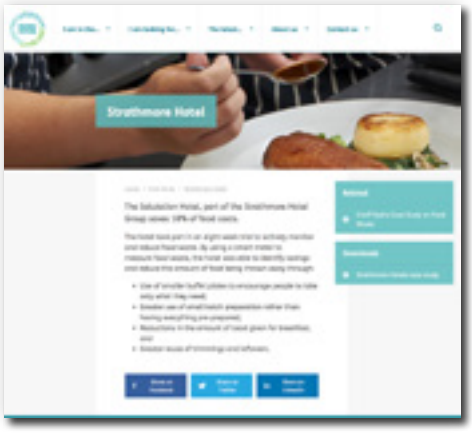
KPI	Data collection method	Frequency	Data recording	Responsibility	Status
Energy • Energy consumption (kWh) per tonne of product • Energy consumption (kWh) per staff member	Data from property managers, utilities bills and suppliers	Weekly	Spreadsheet of use and cost data by building	Sustainable Manager and Property Managers	Regional offices sent data
Paper • Total paper use (reams of A4 equivalent) per staff member	Report from stationery supplier via purchasing manager	Monthly	Listing of A4 purchases and % recycled content by work unit	Sustainable Manager and Purchasing Manager	Regional offices sent data
Water • Water consumption (m^3) per tonne of product • Water consumption (m^3) per staff member	Data from property managers, utilities bills and suppliers	Weekly	Spreadsheet of use and cost data by building	Sustainable Manager and Property Managers	Regional offices sending water data
Waste • Total waste (tonnes) generated per tonne of product	Waste audits, waste bills, report from waste contractor	Monthly	Waste audit template	Sustainable Manager	In progress
• Landfill (tonnes) per tonne of product • Landfill (tonnes) per staff member	Waste audits, waste bills, report from waste contractor	Monthly	Waste audit template	Sustainable Manager and Department Managers	In progress
• Total recycled (%) per tonne of product • Total recycled (%) per staff member	Waste audits, waste bills, report from waste contractor	Monthly	Waste audit template	Sustainable Manager and Department Managers	In progress
Staff	Report produced by HR	Quarterly	–	Sustainable Manager and HR Manager	In progress
Number of units produced	Report produced by Operations Director	Monthly	–	Operations Director	In progress

Case study
The Salutation Hotel

The Salutation Hotel, part of the Strathmore Hotel Group, took part in an eight week trial to actively monitor and reduce food waste. By using a smart meter to measure food waste, the hotel was able to identify savings and reduce the amount of food being thrown away through:

- the use of smaller buffet plates;
- greater use of small batch preparation;
- reductions in the amount of toast given for breakfast; and
- greater reuse of trimmings and leftovers.

The trial at the Salutation Hotel successfully reduced the weight of food waste per cover by 36% and achieved financial savings worth approximately £10,900 per annum.



Replicating these savings across all seven hotels in the group could lead to reductions of 29 tonnes of food waste and £76,000 of savings due to reduced food purchasing costs each year.

Find out more on the Resource Efficient Scotland website

Step 4 – Analyse and evaluate the data

With your data collected, the next stage is to analyse and evaluate the data to highlight any problems and identify areas for possible improvements and cost savings. This may be done at the company, site, department or process level depending on the data that has been gathered.

4.1 Using Graphs

Visualising the data in graphs and charts will make interpretation easier, helping you to understand what it means about your performance and what can be done to improve it. While time consuming for large datasets or for organisations with multiple locations, it can often help to quickly identify possible inefficiencies.

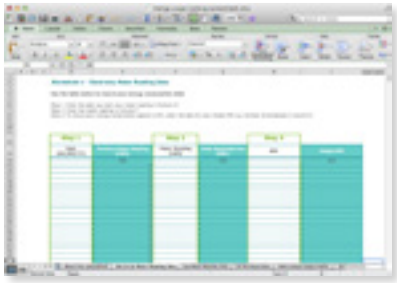
The Resource Efficient Scotland Measuring and Monitoring Tracker spreadsheets help you to easily produce a wide variety of graphs from your data.

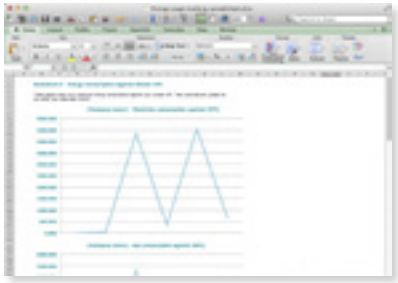
- Energy usage tracking spreadsheet
- Waste tracking spreadsheet
- Water usage tracking spreadsheet

Free tool

Measuring and Monitoring Tracker spreadsheets

These Measuring and Monitoring Tracker spreadsheets will help you to collate your data and easily produce graphs to illustrate performance. There are three available: one for water, one for waste and one for energy. Each has a handy introductory video that quickly explains how you can get the most of each tracker.





Download the trackers from the Resource Efficient Scotland website

Spreadsheet packages contain easy-to-use tools for creating charts which allow you to display data contained within a spreadsheet as a graph. There are many different types of graphs including line charts, pie charts, bar charts and scatterplots.

Your choice of graph will depend on whether you are dealing with solely continuous, or categorical and continuous data.

4.1.1 Bar charts

A bar chart uses bars or columns to show frequencies or values for different categories of data. Typical examples of the types of data that can be presented using bar charts include quantity of waste produced per month, recycling rate per month or water use per quarter.

For example, Figure 2, shows the water consumption (in m^3 per tonne for production) for an example site. The graph shows that there has been a reduction in the water use in each quarter, over the last three years.

4.1.2 Line graphs

A line chart uses lines joining datum points to show values for different data categories. Line graphs are particularly useful for comparing data over time, where regular time intervals (or other units of change) are plotted on the horizontal axis. Typical examples of the types of data that can be presented using line graphs include gas consumption, electricity consumption and water consumption.

For example, Figure 3 shows the hourly water consumption profile for a business. The graph shows that water is being consumed when the site is closed (from 21:00 to 06:00). This type of graph can be useful to understand how much water is used when the site is unoccupied, any out of hours water consumption may indicate that there might be a leak or perhaps fixtures, like automatic urinals, are operating unnecessarily.

Figure 2 – Bar chart of water consumption in relation to production

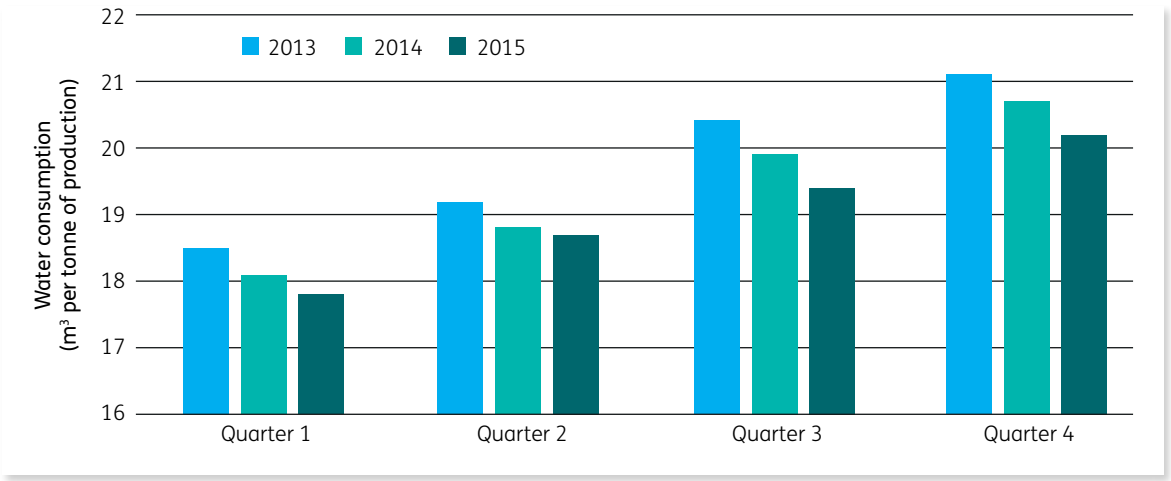
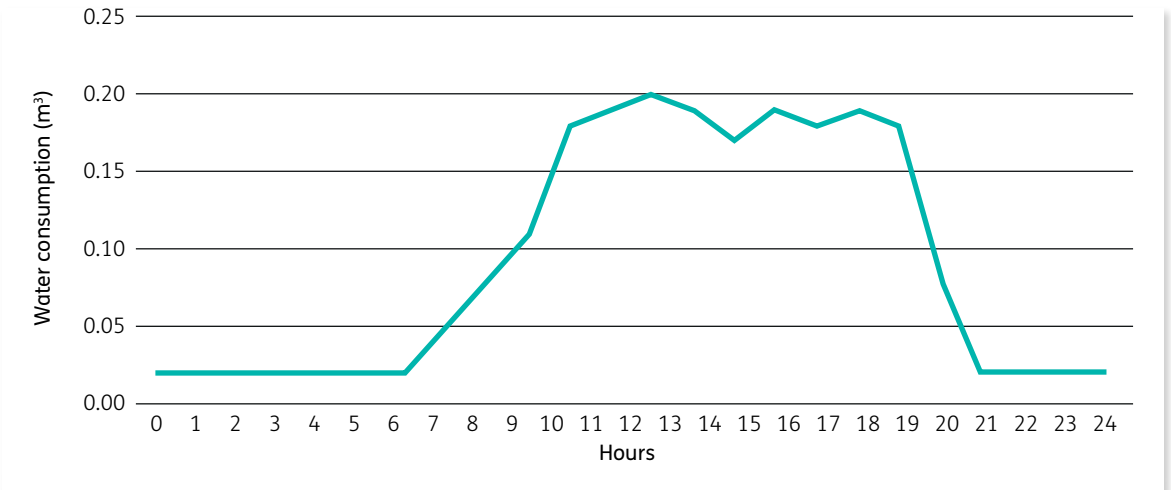


Figure 3 – Line graph of an hourly water consumption profile



Adding more data to your line graph

You can plot more data on the same line chart, and this can be particularly useful for analysing or comparing the trends in different datasets. For example, Figure 4, shows the expected electricity consumption compared to the actual electricity consumption.

Adding a secondary axis to your line graph

If you need to plot data with very different ranges on the same chart, you can use a secondary y-axis. For example, Figure 5 shows the electricity consumption (in kWh) compared to the number of units produced.

Figure 4 – Line graph of actual and expected electricity consumption

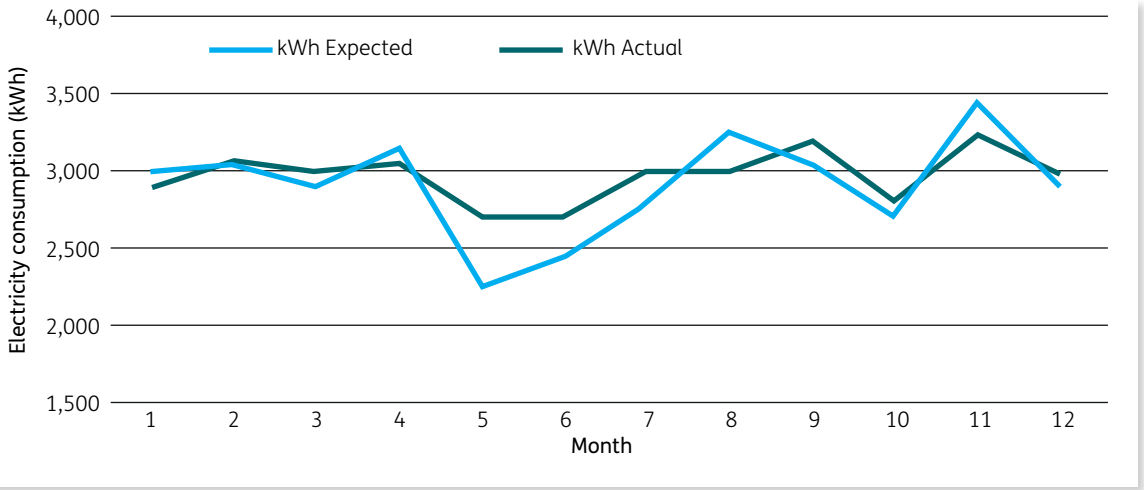
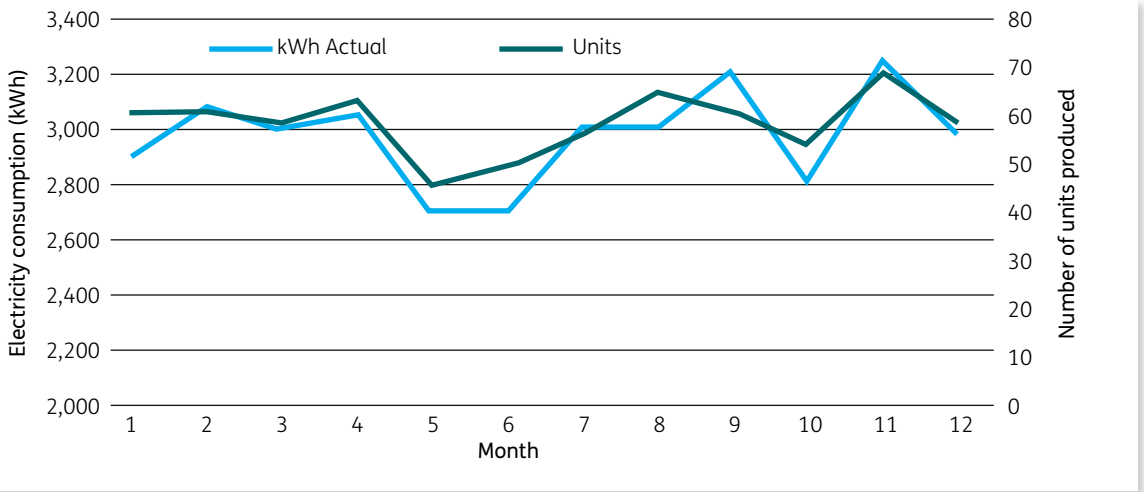


Figure 5 – Line graph of actual electricity consumption and production



Analysing your selected KPI

You can analyse the data based on your selected KPIs. For example, Figure 6, shows the waste produced in tonnes by unit produced. Further investigation is needed to understand why the production process is less efficient towards the end of the year.

4.1.3 Pie charts

Pie charts are a visual way of displaying how the total data are distributed between different categories. Pie charts should only be used for displaying data that are classed into different categories. Typical examples of the types of data that can be presented using pie graphs include waste composition data, proportion of energy use or proportion of water use.

For example, Figure 7 shows the composition of the general waste stream for a hospitality business and Figure 8 presents the proportions of energy used in an office.

Figure 6 – Line graph of waste produced per unit produced

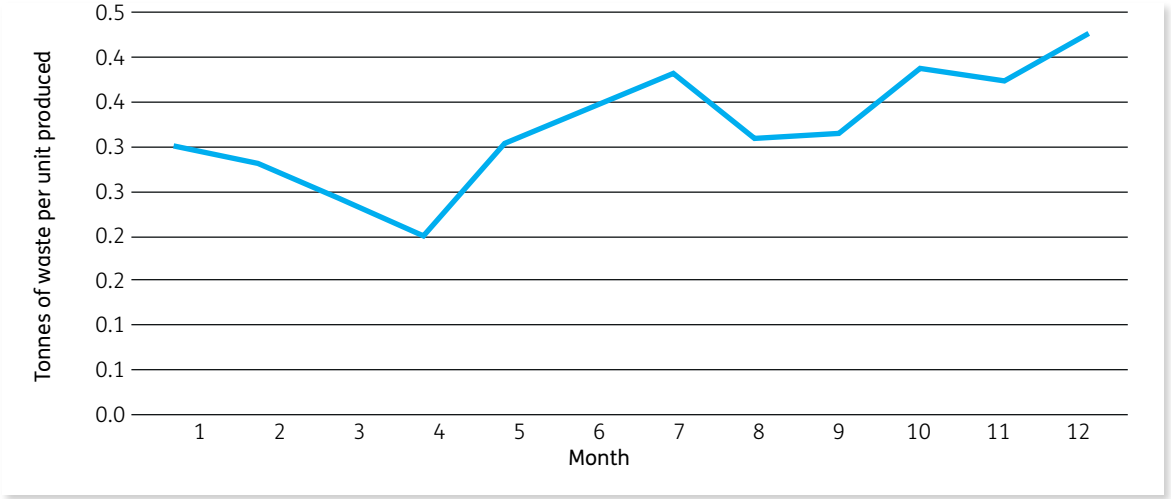


Figure 7 – Pie chart of the composition of a residual waste bin

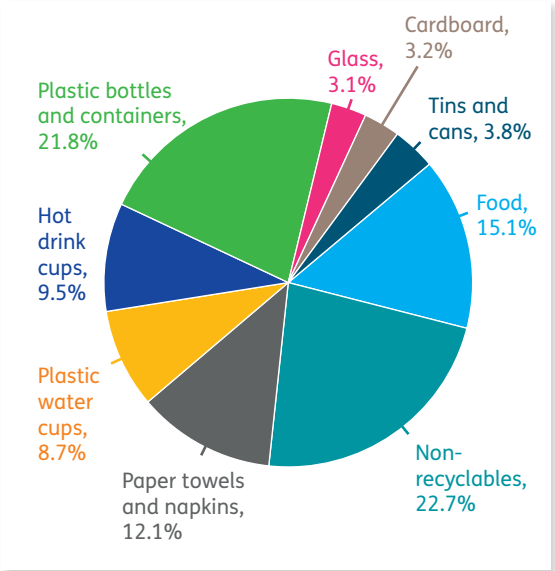
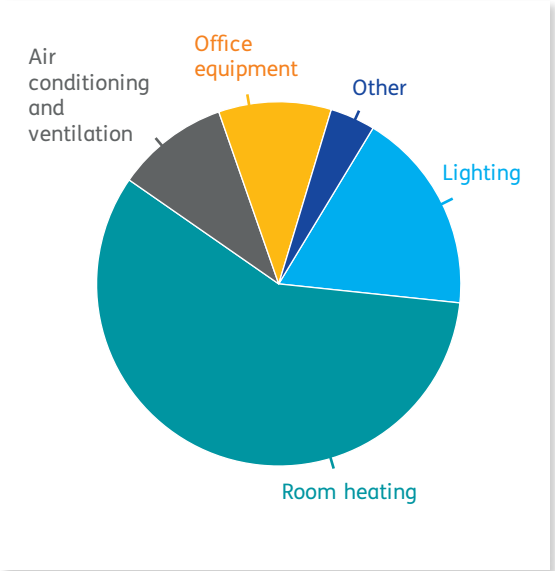


Figure 8 – Pie chart of the proportion of energy use in an office

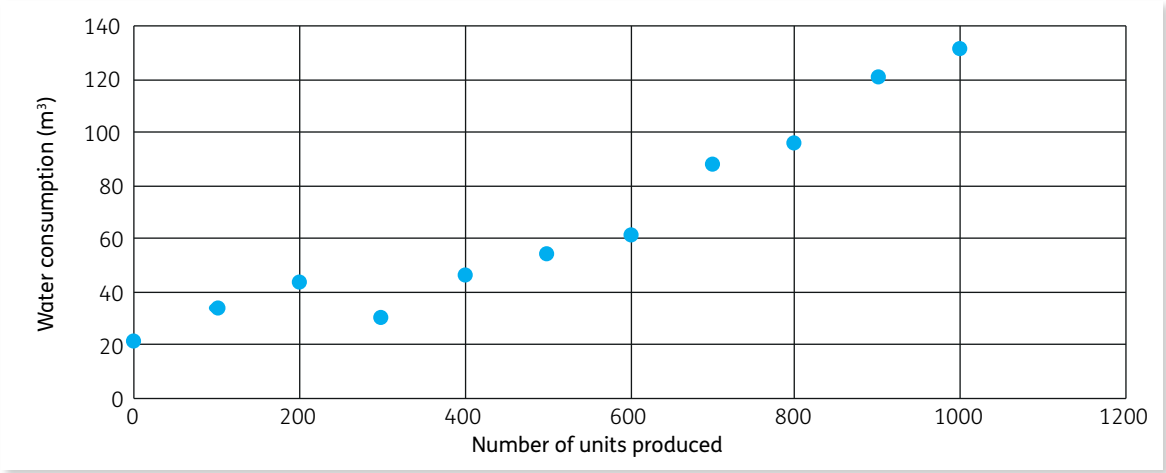


4.1.4 Scatter graph

A scatter graph shows the relation of two or more continuous variables. By analysing the pattern of dots that make up a scatter chart it is possible to identify whether there is a relationship between the two measurements.

In this type of graph, the various time periods of data collected are scattered about rather than ordered chronologically. For example, Figure 9 shows water consumption and the number of units produced over a certain period.

Figure 9 – Scatter graph of water consumption in relation to unit production

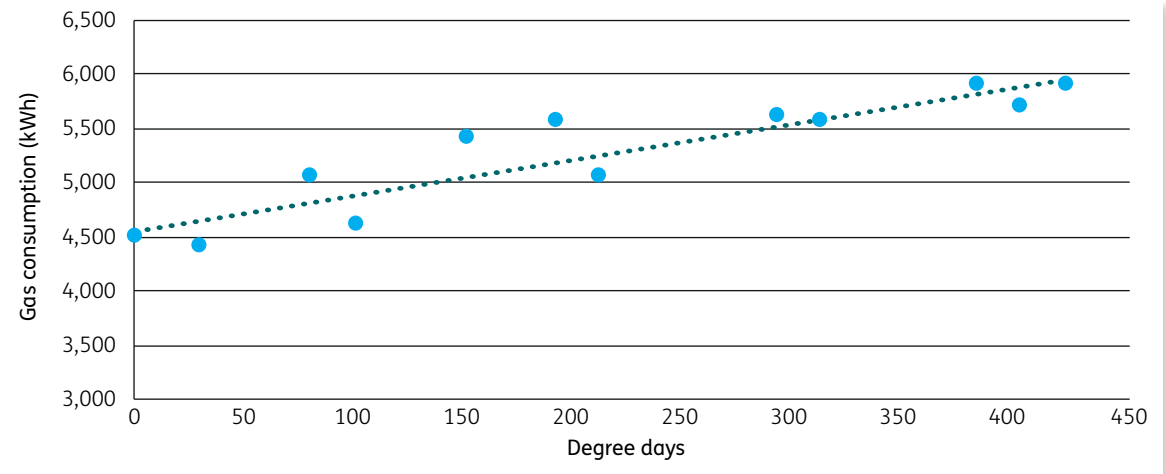


It is often useful to add a trend line to a scatter graph. A trend line will give a graphical representation of trends in the data, and can help you see if your performance is improving, staying the same or declining. Spreadsheet packages enable you to show trend lines for bar, line or scatter graphs.

For example, Figure 10 shows a trend line added to the previous water consumption graph. The gradient of the trend line indicates the efficiency of the manufacturing process, and the amount of scatter either side of the trend line indicates the level of variation in the efficiency of the manufacturing process.

The manufacturing process is most efficient in terms of water use at production rates of between 300 units and 600 units. Equipment-related or human factors could be affecting water use and further investigation should be carried out to understand the reasons for the variation. Further investigation is also needed to find out why water consumption is so high (20 m³) when there is no production as there could be a leak.

Figure 10 – Scatter graph of water consumption in relation to unit production



Top tips for good graph design

- Give your graph a meaningful title so that readers know what it shows, even if removed from its original context.
- If the graph you are presenting is based on data from another source, then you should acknowledge the source of the original data somewhere within the chart area or title.
- Label the axes so it is clear what the graph is showing.
- Consider adding annotations to the graph, if this helps to tell the story.
- Remove anything from your graph which detracts from the story such as shaded backgrounds, patterns, textures and 3D shapes.
- Keep grid lines to a minimum, so they do not clutter the graph.
- Think about the size of your graph. Oversized graphs are perceived as being unprofessional and lack authority. If a graph is too small, it is hard to see what the graph is showing. Graph text should be about the same size as the body text in the document. You should be able to take in a graph at a glance, and not need to click, scroll or enlarge a graph to view it.

4.2 Adding graph elements to help interpret the data

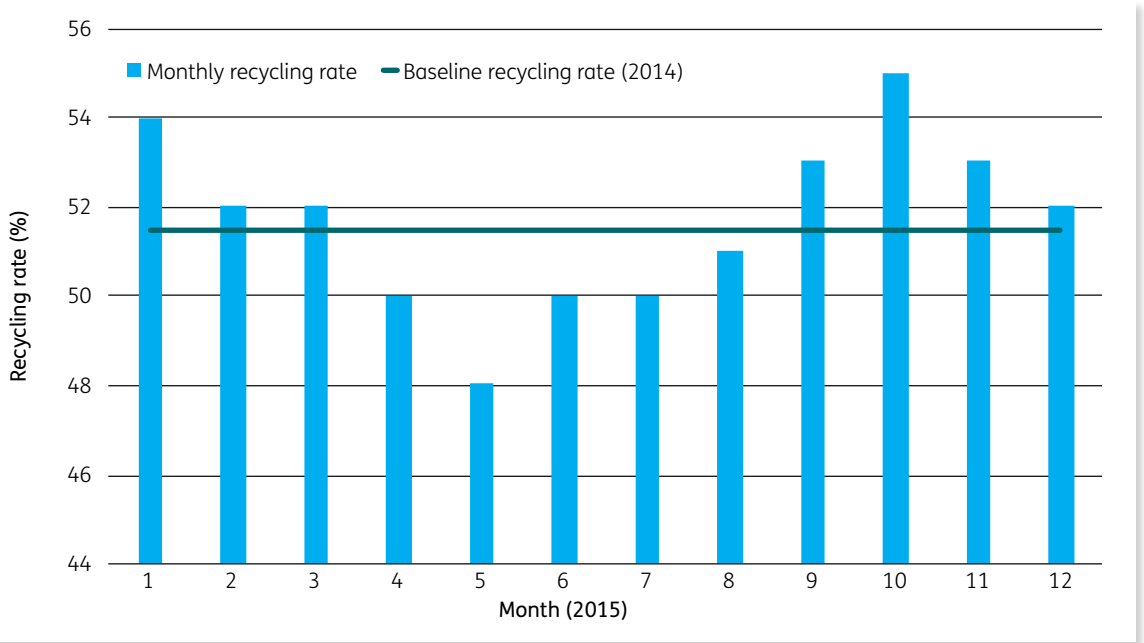
At this point, you have created a graph that corresponds to a particular question of interest. You can add graph elements to help facilitate your interpretation of the data.

4.2.1 Adding a baseline

Once you have collated your information over a representative period (typically 6 to 12 months), you can set a baseline. The baseline represents your organisation's current resource efficiency performance and is a point from which improvements (or otherwise) can be gauged. Setting your baseline is an important task as it enables you to see the improvements that you have made after changes have been implemented.

It can be useful to plot your data and your baseline on the same graph. This comparison allows you to easily see how your performance is changing. For example, in the example in Figure 11, the baseline recycling rate in 2014 was 51.5%, and can be compared with the recycling rate each month in 2015.

Figure 11 – Bar chart showing recycling rates by month compared to a baseline



4.2.2 Adding a projection line

It can help to add a projection line to forecast what future performance or cost may look like, based on current trends. This could be particularly valuable when you are putting together a business case for improvements that will reduce resource use, as it can help you forecast how costs will continue to rise if you do not take action.

For example, Figure 12, shows the total energy cost for a business over a 12-month period. You can use your software package, to add a projection line (as shown in Figure 13), to forecast energy costs for the next 12 months.

Figure 12 – Line graph showing total energy cost over 12-month period

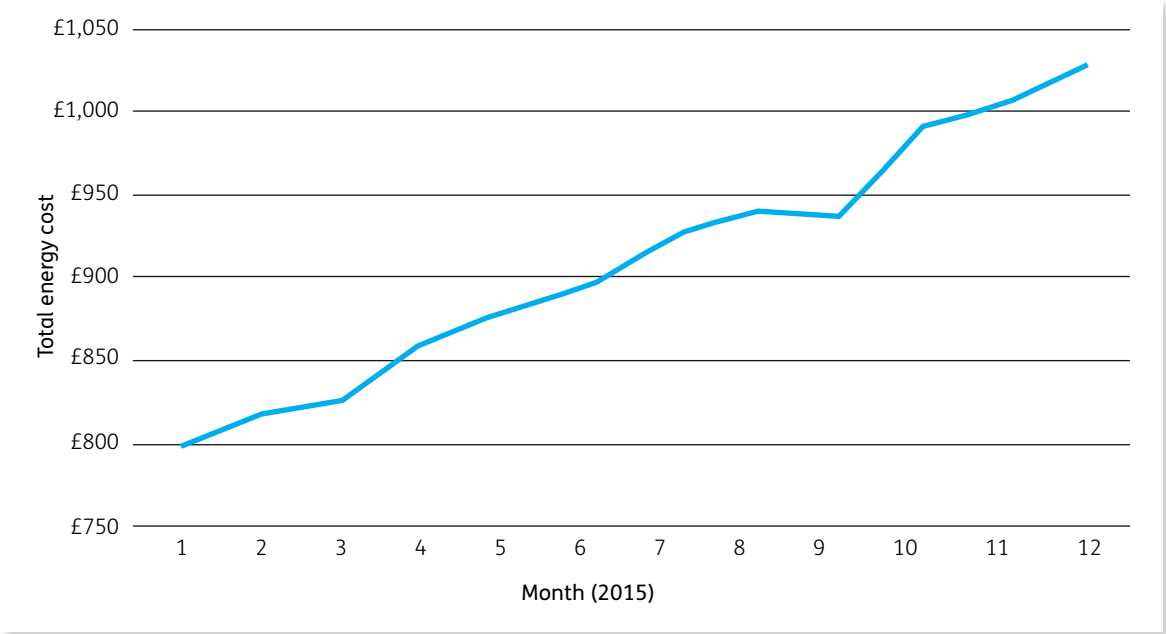
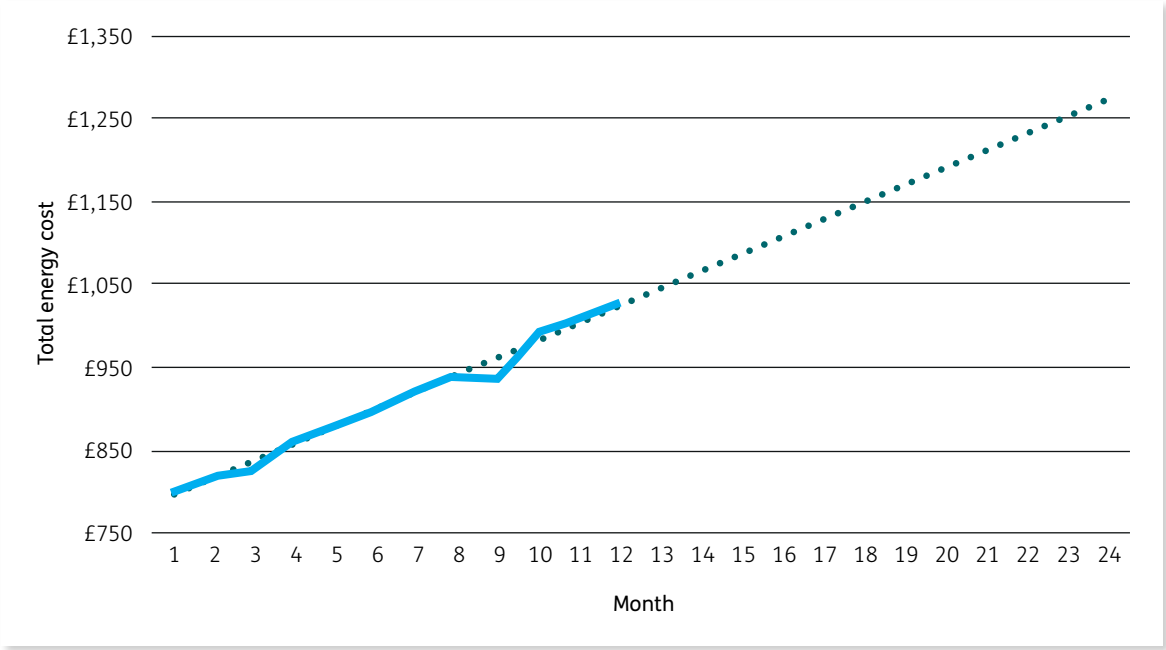


Figure 13 – Line graph showing total energy cost and forecasted energy cost over 24-month period



4.3 Using benchmarks

Benchmarking is a method of improving performance in a systematic and logical way by measuring and comparing your performance against that of others, and then using lessons learned from the best to make targeted improvements. It requires answering two questions – who is better and why are they better?

While not an essential part of a measuring and monitoring programme, many organisations have found that benchmarking is a valuable additional benefit that can be enjoyed by having a good understanding of their resource use. Benchmarking can be a gateway to big savings and large improvements in resource efficiency performance and competitiveness.

The key benefits of benchmarking include:

- focusing improvement efforts on issues critical to success;
- ensuring that improvement targets are based on what has been achieved in practice; and
- providing confidence that your organisation's performance compares favourably with best practice.

Benchmarking can be used to compare your resource with other similar businesses (external benchmarking) or to compare the performance of sites or similar processes within your own business (internal benchmarking).

4.3.1 Internal benchmarking

Internal benchmarking is an easy way of starting a benchmarking process, as it can be done fairly easily and quickly.

If you have more than one site in your business, internal benchmarking can be particularly valuable, especially when comparing resource use at sites that undertake similar production activities. Benchmarking between your sites will help you identify the sites that are implementing good resource efficiency practices and draw attention to areas where efficiency savings could be made, for instance repairing/replacing less efficient equipment.

It can also have the benefit of sharing good practices and innovation from one part of the organisation to another as there is likely to be less resistance to change compared to introducing new practices from outside the organisation.

However, one of the drawbacks to internal benchmarking is that over time, the various parts of your organisation will begin carrying out similar processes in much the same way. This may limit your long-term ability to learn about radically different approaches and opportunities for resource efficiency improvements.

Internal benchmarking	External benchmarking
Where an organisation compares resource use in a given building with other buildings (or between different departments, units, production lines), for example where a company has a number of buildings in different locations. The results can be used to: • compare resource use between buildings; • identify which building performs the best (or worst) and why; • identify which buildings have the greatest potential for improvement; • identify best practices and apply them to other buildings; and • increase the ability of the organisation as a whole to interpret and analyse resource data.	A comparison of an organisation with similar organisations in the same sector. Can also be used to show how an organisation performs against published industry benchmarks. The findings can be used to: • compare an organisation's performance with that of similar organisations in the sector. • determine the scope of resource efficiency savings; and • identify high-performing organisations for external recognition.

4.3.2 External benchmarking

There are two main types of external benchmarking, competitor benchmarking and sector benchmarking.

Competitor benchmarking

Competitive benchmarking involves looking outside your organisation to examine the resource efficiency performance levels of similar organisations and your potential for improvements.

A small retail shop would not gain much value in comparing itself to a large manufacturing company so the goal is to identify organisations that are a similar size and sector to gain a like-for-like comparison that provides useful insights.

Sector benchmarking

Accessing performance information on similar organisations, particularly competitors, may not always be practical. Sector information is an alternative source for your external benchmarks.

Sector benchmarking involves comparing your resource efficiency performance with what is considered to be an industry standard or best practice.

Published sector benchmarks exist in the UK for energy and water use, covering a range of different types of buildings (e.g. offices, retail premises, workshops, hotels). There are also more detailed benchmarks on services such as heating. However, there are no published sector benchmarks for waste.

Where sector benchmarks are used, you should pay particular attention to whether the benchmark is current, the type of business to which it applies and any assumptions made.

Energy sector benchmarks

Energy consumption benchmarks are published in Good Practice Guides for different buildings and some processes. The benchmarks are usually measured in kilowatt-hour per m^2 of floor space per year (kWh/m^2/per year). Sector comparative energy benchmarks are available from the Chartered Institution of Building Services Engineers (CIBSE).

Water sector benchmarks

While water use across different sizes and types of organisation varies significantly, water-use benchmarks may be available for your sector. For example, sector comparative water benchmarks for offices and hotels are available from the Construction Industry Research and Information Association (CIRIA).

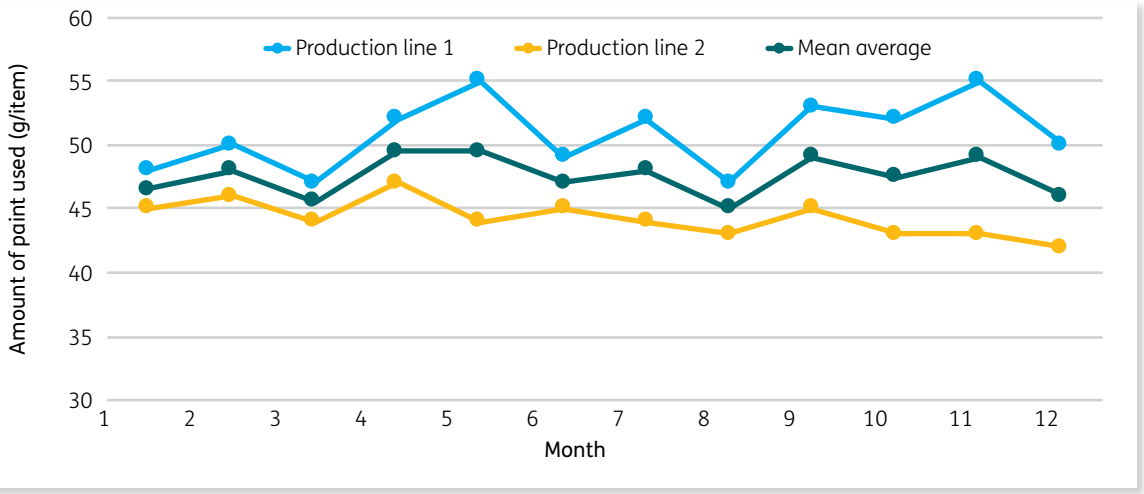
Analysing your selected benchmarks

You can also analyse the data based on your internal or external benchmarks. For example, a manufacturing organisation wants to compare the amount of paint used for coating a product for two different production lines. Figure 14, shows data for two production lines, together with the mean average.

In this example, just tracking the mean average would suggest that the process is reasonably under control (the amount of coating used is between 45g/item and 50g/item). However, the graph reveals that production line 2 shows little variation and coating use is gradually falling, while production line 1 shows considerable variation and coating use is increasing.

Further investigation is needed to understand why production line 1 is more efficient, for example is there good practice that can be applied or is production line 2 using less efficient equipment.

Figure 14 – Line graph comparing internal benchmarks



Case study
Crieff Hydro

Crieff Hydro is a four star luxury spa hotel in Perthshire, set in a 900-acre estate with 213 en-suite rooms and over 500 staff. Crieff Hydro has taken part in a food waste monitoring trial to actively measure and reduce food waste in its main Meikle restaurant.

By using a smart meter to measure food waste, the hotel identified the areas to focus on were the breakfast and lunch buffet. Subsequently the hotel reduced food waste through various measures such as reduced buffet container sizes; smart production planning and greater use of small batch preparation; and greater staff engagement in reaching weekly food waste reduction targets.

After 8 weeks in just one restaurant, Crieff Hydro reduced food waste by 31% in weight per cover, equivalent to savings of around 43%. This equates to an annual saving of around 11.5 tonnes of food and approximately £51,750 in costs.

Find out more on the Resource Efficient Scotland website

4.4 Asking questions about the information

Using your graphs, you are now in a position to assess your organisation's resource use and identify where you sit in terms of your KPIs. You can also assess your performance against your internal and external benchmarks.

Look critically at the graphs and ask questions such as:

- Are there any sudden fluctuations? What caused them?
- Has performance improved, declined or stayed constant? Where and why?
- Have there be any clear periods of inefficiency? If so, what could the causes be?
- Have there been periods of high efficiency? Can adjustments be made to always achieve this higher performance?
- Could other factors have had an impact on performance (e.g. a leaking pipe, severe weather)?
- What improvements could be made?
- Where have there been successes? Can these be replicated in other areas?
- How do similar time periods compare (e.g. the same period last year)?
- Is the KPI moving towards target? If not, why not? Do we need to prioritise some actions to meet the target?
- Does the value of the KPI vary much? If so, why?
- Is the KPI variation random or systematic? What might the causes be?
- How do other processes, departments and specific activities compare (e.g. internal benchmarking)?
- Are there any data discrepancies (e.g. incorrect data, unaccounted resource consumption)?

If it is still unclear what your information is showing, it could be useful to increase the frequency of your data collection to get greater clarity.

Step 5 – Identify improvements and take action

Having collected and analysed your data, you will be able to prepare a list of actions to address any opportunities that have been identified.

For ideas on potential resource efficiency improvement actions, download the free Resource Efficient Scotland guides, **How to save money and energy on space heating, How to save money and energy on lighting, Save money on waste and Save money on your water bill**.

5.1 Developing an action plan

Place your resource efficiency improvement actions in a costed action plan. This way your organisation can compare the cost/benefit of each action and assess its priority, and ultimately whether your business will implement them.

Your action plan should set out:

- proposed priority improvement measures;
- key implementation steps for each measure;
- the achievable technical, environmental or cost saving benefit;
- team roles and responsibilities;
- your timescale for completion; and
- timescales for action.

5.2 Implementing your action plan

Implementing the action plan will involve detailed teamwork. In some cases, you will need to produce detailed implementation plans for specific improvement projects within the overall action plan. It is important to get everyone involved in implementation and to keep people informed about progress. This is vital to maintain interest and motivation.

5.3 Regularly reviewing progress

As you begin to implement your action plan, it is important to regularly review your data. This will not only allow you to see the progress you have made and the results of actions employed, but it may also help you to obtain investment for future programmes or contribute towards a business case.

Some key facts to remember when conducting a progress review include:

- ensure all the relevant stakeholders are involved in your progress review (e.g. data owners, department managers, senior management);
- conduct a review regularly (ideally quarterly);
- make sure the data are presented in a useful and meaningful format;
- have clear criteria against which you are assessing the progress made; and
- identify why a project is (or is not) performing as expected.

The positive results achieved should be communicated back to senior management and staff to highlight the good work undertaken and the positive improvements made to date. You should use these 'good-news-stories' to further reinforce the message of how important improving resource efficiency is for your organisation and to help gain further resources to continue your improvement campaign.

Our 13 fun resource efficiency facts will help you share your successes with your colleagues in meaningful and attention-grabbing ways.

Further support
13 fun resource efficiency facts

Sharing information on the resource efficiency improvements you are making is a great way to acknowledge the effort your colleagues have put in. Sharing success can also help to gain the support of staff who have been resistant to change, by demonstrating the results people around them are achieving already.

When sharing your success it's important to make your messages attention grabbing and meaningful. After all, your colleagues are likely to be very busy people too, and they might not know just how much 'a tonne of CO_2' is.

Download our 13 fun facts and see how if they can spark some ideas on ways you can share your successes with your colleagues in new, meaningful and attention grabbing ways.

Improving your resource efficiency is not a one-time project. It should be viewed as being a process of continual improvement and the action plan should be used as a tool to drive efficiency across the organisation over the long term.

Case study
Scarf

Scarf is a social enterprise that operates in the North of Scotland with more than 60 staff members.

In 2013, Scarf formed GreenScarf, a staff forum with the goal of improving Scarf's environmental performance. The GreenScarf team quickly recognised that a measuring and monitoring system should be implemented. That decision has been rewarded in a number of ways.

On several occasions, GreenScarf has been able to quickly identify unexpected and otherwise hidden problems that had the potential to increase costs. This includes an instance where the automatic urinal flush system had reset itself during a power cut and caused urinals to flush out of hours (including overnight and at the weekends), wasting water.

They have also been able to gain a much better understanding of resource use, which has in turn helped them to find savings, such as a 42% saving on waste generation, by identifying patterns of wasteful behaviour.

Critically, as an ambassador for resource efficiency, measuring and monitoring has given Scarf accurate performance information that can be shared with colleagues and the local business community.

Find out more on the Resource Efficient Scotland website

Finding further savings

Resource Efficient Scotland's team of experienced advisors has helped hundreds of organisations across Scotland to save money and reduce their environmental impact.

We understand that it can take time and experience to implement the type of measuring and monitoring activity outlined in this guide. That is why we can provide you with specialist advice; access to funding and suppliers; and in-person, on-site support to help you take action and enjoy savings on your energy, water and raw materials.

If you would like help finding savings or implementing projects that you have already identified, please contact the team on 0808 808 2268 or email enquiries@resourceefficientscotland.com.

Further support
Using league tables

Communicating progress to senior management, staff and customers is vital for the success of any resource efficiency programme.

By comparing one area with another through internal benchmarking, you will be able to develop a league table. This will help you identify where best practice is occurring and encourage improvement in any areas that are not performing as well. Sharing the league tables internally is great way to help motivate staff to improve their performance.

Download our free article for more ideas on using rewards to engage staff

Save money on your organisation's energy, water and raw material costs

Resource Efficient Scotland is a programme from Zero Waste Scotland, funded by the Scottish Government. We help business, and public and third-sector organisations save money by using resources efficiently.

We can provide you with free specialist advice, training, access to funding and suppliers, and in-person on-site support to help you cut your energy, water and raw material costs.

Our **free** advice and support is available to every organisation in Scotland. **How much could you save by . . .**

- installing new, high-efficiency lighting
- upgrading your heating system
- encouraging staff to be resource efficient
- using less water
- insulating your premises
- improving processes
- using renewable energy

. . . call our team today to find out, for free.

0808 808 2268

Other popular guides from Resource Efficient Scotland that will help you save money on energy, water and raw materials. Download them for free today.

Implementation guides

Save money on waste	**Download here**
How to save money and energy on lighting	**Download here**
How to conduct an energy audit	**Download here**
Save money on your water bill	**Download here**
How to save money and energy on space heating	**Download here**

Procurement support guides

How to carry out a successful biomass heating project	**Download here**
How to carry out a successful lighting replacement project	**Download here**
How to get the best waste management solution	**Download here**

Finance guides

Sources of finance: How to fund your resource efficiency projects	**Download here**
Accessing finance: Developing a business case for your resource efficiency projects	**Download here**

Updated July 2016

RESOURCE EFFICIENT SCOTLAND

Growth that doesn't cost the earth

www.resourceefficientscotland.com | 0808 808 2268 | @ResourceScot

Zero Waste Scotland, Ground Floor, Moray House, Forthside Way, Stirling, FK8 1QZ

A programme from ZERO WASTE SCOTLAND

natural scotland SCOTTISH GOVERNMENT