CARBON TRUST

In depth guide

Energy surveys

A practical guide to identifying energy saving opportunities

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Contents

Introduction

Saving energy is one of the most effective ways of reducing your carbon footprint.

To find out how much you might be able to save, you'll need to review your current use of energy – this is the heart of the energy survey. This guide will prepare you to either undertake your own survey or to commission external assistance.

This guide is based on the experiences of the Carbon Trust's survey programme and is intended to help you and your organisation find practical opportunities to save energy. It provides a structured framework for a simple 'walk-through' energy survey, supported by guides to the more common processes and services.

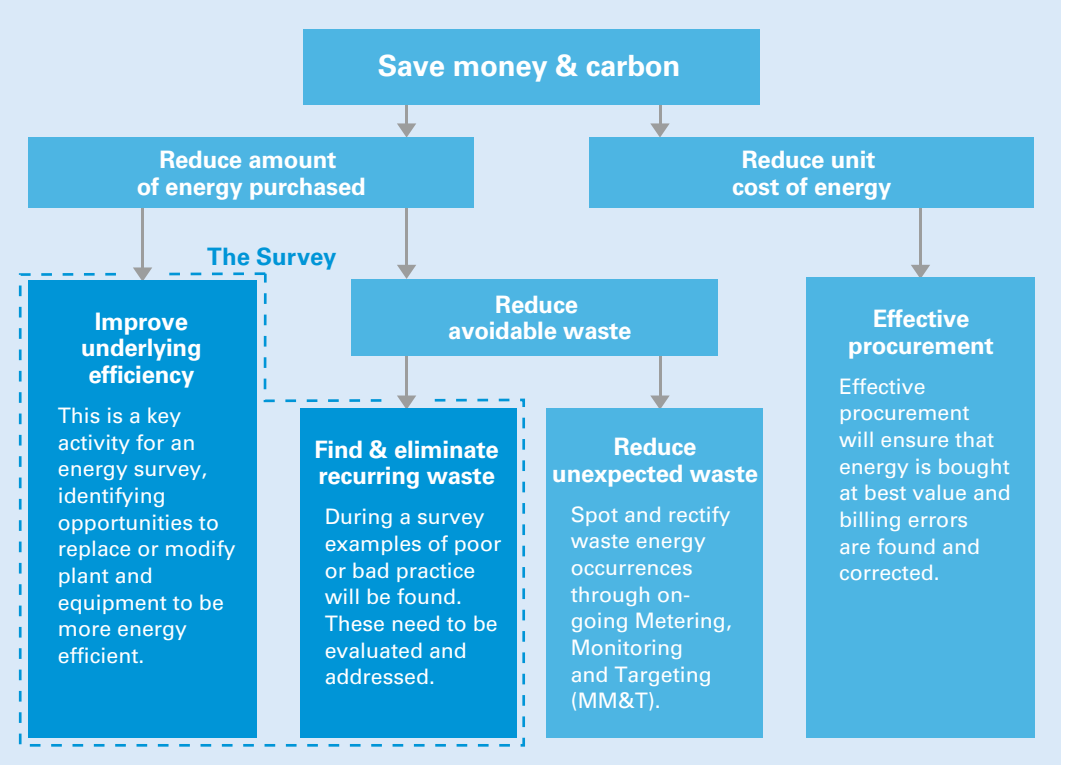
Any survey you carry out with the help of this guide will only be a first step on your journey to lower energy costs, improved environmental performance, and the benefits of active energy management. But it will be a start, and in the course of your survey you will probably make immediate savings by detecting and rectifying some obvious areas where money is being wasted.

Saving energy requires action.

A survey will result in a list of opportunities with associated costs and savings, from which you can determine your priorities. Some measures, such as resetting heating controls, will cost you nothing at all, while others will require investment. Once you have a list of possible opportunities, you will know where you need more information and advice.

Energy surveys are important because they identify how savings can be achieved. But there is more to energy management than surveys alone. Figure 1 (on the next page) shows the elements that lead to saving money and carbon, and how the energy survey fits in.

Figure 1 *How an energy survey contributes to saving money and carbon*



Who is this guide for?

This guide is for anyone with responsibility for reducing the energy use of their organisation. It will also help anyone who wants to know more about energy surveys. You don't need a technical background to read this guide, but you will need some level of technical skill if you want to undertake a complete energy survey on your own. That doesn't mean you need to be an engineer, but you do need to understand some basic engineering concepts.

This guide has been developed to help all sectors (industrial, commercial and public). It is based on the energy survey of a single site or building, but the techniques and advice can of course be extended to cover multiple sites.

This guide is not intended to be a comprehensive training guide. You'll need to refer to other guidance for full information on the opportunities identified by your survey.

What is an energy survey?

An energy survey is a systematic review of how energy is used within a building or industrial site. (It can include transport, but this is not covered in this

guide.) It includes a physical inspection of buildings and equipment, which can range from a simple visual inspection to a fully instrumented study.

There are three types of survey:

- walk-through
- detailed
- investment grade.

This guidance should enable you to undertake a walk-through survey. An investment grade survey will require an experienced professional.

For a formal definition, an energy survey is:

A technical investigation of the control and flow of energy in a:

- **site**
- **building**
- **process/manufacturing unit**
- **piece of equipment**

with the aim of identifying cost-effective energy saving measures.

A survey will normally cover:

- Energy conversion – for example: gas to heat in a boiler; electricity to cooling in a chiller.
- Energy distribution – how energy gets from one place to another.
- Energy end use – the equipment and people that use the energy.
- Management systems – how energy is managed and accounted for.

Recommendations are normally divided into three broad categories:

- No-cost measures – such as good housekeeping or changes in behaviour.
- Low-cost measures – often not requiring capital expenditure approval.
- High-cost measures – for which capital approval will be required.

An energy audit is defined as a study to determine the quantity and cost of each form of energy to a site, building, process/manufacturing unit or piece of equipment over a given period – usually a year.

In many ways an energy audit is similar to a financial audit. An energy audit can be part of an energy survey.

Do your own survey, or commission a specialist?

If your energy bills are low, you may not be able to justify the expense of a commercial energy survey. In this case it may be a good option to undertake your own survey and then look to equipment suppliers to help you in areas where you think that investment is required.

If your energy costs are higher there is still a case for conducting your own survey as it will give you an in-depth understanding of how your organisation uses energy. It also means you'll be starting from an informed position should you wish to commission a commercial survey.

For any organisation a good starting point is a walk-though inspection. This allows you to identify obvious opportunities and will help you to decide whether you need specialist support.

When to undertake a survey

A survey is a key element in any energy management programme. Ideally you should undertake your first survey as part of the development of your energy strategy, at the beginning of your energy saving journey. This means that you'll be able to set objectives based

on concrete knowledge of how energy is being used, rather than guesswork. Practices and technology change, so you should consider undertaking a full energy survey around every five years – or more frequently if there are significant changes in operations, equipment or plant configuration, or personnel.

Alternatively you may want to introduce a rolling programme looking at different parts of the organisation in stages. An effective energy survey will establish which areas will need regular attention and review through good continuing energy management. When planning the timing of energy surveys, take account of any asset condition surveys that are planned as the two can support each other.

How to use this guide

The Topic Guides in Section B of this guide will support different elements of your survey. Each deals with a generic service or process, such as lighting or boilers.

Each topic starts with Identifying opportunities. This describes what to look for, highlighting common sources of wasted energy, and how the opportunities can be realised.

Each topic guide then has a number of Consultant's tips –useful techniques often used by energy consultants.

Finally, each topic guide has a Signpost section for further information; in many cases it will be important to supplement this guide with more detailed information from other Carbon Trust publications.

To undertake your own survey, work out which parts of this guide are applicable and then treat those sections as your customised handbook.

This guide has been designed so that you can work within the limits of your own expertise. Once you need to go beyond those limits, or cannot devote the necessary time, the guide will equip you to better brief an outside expert. It will also help you to judge whether scope and fee quotes are reasonable.

Before you start

Before starting a survey it is important to gather as much data as you can on your energy use. Try to get at least 12 months of energy bills, and if possible half-hourly data on your electricity use.

Also make sure you have the support of the people whose help you'll need to make the survey work– for example, to gain access to plant rooms or other areas.

Gather information. The more information you can get hold of before you start, the more effective your survey will be. For example, has the site been surveyed before? If it has, the last survey report will be a great starting point. Are there asset registers or condition surveys that might help? Are there commissioning data and operation and maintenance (O&M) logs to hand?

And very importantly:

- Be fully aware of all health and safety requirements.
- Do not interfere with or change any equipment settings without authority.
- When in doubt, ask!

Section A: Survey Framework

Overview

It is important to have a structured approach to your energy survey to make the most of the opportunity. Before you start, think through what you want to achieve and how you plan to approach it.

The three key elements are:

- Review your energy usage
- Identify energy-saving opportunities
- Define practical 'next steps'

Review your energy usage

The starting point for this is the main points of supply: electricity meters, gas meters, oil tank, etc. By analysing your bills you can find out how much of each energy supply you use. You can then 'track' the energy from each point of supply to its point of end use.

Identify energy saving opportunities

While tracking the energy keep your eyes open for wastage – usually the easiest saving opportunity to spot. For example, you might not be sure if one type of light is more efficient than another, but it will be very clear if a light is on that does not need to be. Of course, if you find out that your boiler or lighting is 20 years old it would be fair to assume there are more efficient alternatives available. Use the topic guides to check how the advice provided applies to your plant and equipment.

Define practical next steps

A survey on its own will not save any energy. It is up to you to act on the findings. A good survey will result in a list of practical next steps, presented in a way that encourages action. For example, there will be little point in proposing a project with a 10-year payback if your organisation's limit is two years.

Commissioning a survey

You might require the services of an energy consultant if:

- in the course of your own survey, you identify energy-saving opportunities for which you need additional expert help
- after attempting a survey on your own, you decide it would be better to engage an outside specialist to do the job for you
- you only have time to undertake a limited survey yourself.

When an outside consultant undertakes an energy survey to identify areas for further investigation, they will usually cover the following:

- becoming familiar with the site and its activities
- gathering base data on monthly energy consumption and expenditure over the previous year
- becoming familiar with how energy is currently managed
- studying the main services facilities (boilers, compressed air, lighting, etc.) to look for energy saving opportunities
- reviewing opportunities for saving energy at the point of use
- estimating likely implementation costs, savings, and paybacks – typically from limited data
- writing a report in a standardised format and having it checked for accuracy.

The principal advantages of using a consultant are their depth of technical expertise, breadth of experience and freedom from site interruptions. The consultant can look at your site and its problems and opportunities with a fresh pair of eyes. An appropriately chosen consultant will have surveyed many sites and will know the likely sources of potential energy savings in your sector.

Selecting a consultant

If you don't already know a consultant, there are several ways to find one:

- recommendations from contacts in your sector, industry or your trade association
- registers maintained by independent bodies – for example the Energy Institute
- Carbon Trust Advice Line (0800 085 2005) can provide a list of accredited consultants.

When you're choosing your consultant, look for:

- Relevant experience: this doesn't necessarily have to be in your own sector, as many energy projects are generic.
- Relevant qualifications: are they properly qualified? Do they hold membership of a recognised professional body which has a code of conduct? Are they Carbon Trust Accredited?
- Independence: is the consultant/consultancy tied to any particular product or any given energy supply company? Do they receive commission for referrals to suppliers? Ask who owns them and what commercial partnerships they have.

- Professional indemnity insurance: all good consultants carry indemnity insurance. Ask for evidence of cover.
- Quality assurance: does the consultant/ consultancy perform work to a recognised quality standard?
- Value for money: most reputable consultants will quote a fixed fee, although some may quote on a 'shared-savings' basis. For shared-savings offers you should consider the following points:
  - How will savings be calculated and validated – is the methodology sufficiently robust to avoid the risk of disputes (which could be costly)?.
  - Is the consultant independent of equipment suppliers, or do they have a sales agenda?
  - Is the consultant only interested in opportunities where they can identify significant savings for relatively low effort?
  - If savings are much higher than initially estimated, will the fee still provide value for money?

When you've found one or more suitable candidates, discuss your needs and ask them about similar work they have done for other clients. If they are able to provide satisfactory answers, ask for references and follow them up.

Briefing and management

When you are ready to commission the work, fully brief the consultant. The survey must have clear objectives and deliverables. Avoid confusion about what is or is not included. An agreed scope of work is essential for a successful survey.

A successful survey also requires a good working relationship between you and the consultant – don't expect them to be able to work in isolation. When the survey has started, expect to spend time with the consultant: perhaps half a day for every day that they work on-site. Don't expect the consultant to be on-site for the whole duration of the survey – they will usually only need to be on-site for around one day in two or three of the total quoted days.

Using equipment suppliers

An increasing number of equipment suppliers are offering energy saving surveys. These are normally free of charge and look at a specific area – for example, motors or lighting. Such surveys can produce worthwhile results –the findings are always fully costed and typically only require an order for them to be implemented. However, they usually have a narrow focus – looking for cost-effective applications of the equipment they supply. This may not always be the best solution.

If you have a 'free survey' you need to apply similar checks to those you would use if you were paying for it. Is the company recognised and competent? You should also carefully check the assumptions made in their report – for example, annual working hours, cost of energy, etc. Having said this, using a supplier to follow up on an identified savings opportunity is an obvious next step. They know their equipment better than a consultant, and they may also have access to finance for the project.

Doing it yourself

Despite the advantages of using an external consultant, they will have limited time. A basic survey will involve just one day on-site and two days for analysis and reporting. Your ability to take your time, spreading the work over a longer period if you wish, is one advantage of undertaking the survey yourself – although you should aim to stick to a deadline. You also have other advantages:

- You will already be familiar with the site and its activities.
- You are free to come and go on-site, and won't need an escort.
- You know who has the information you need, and if you overlook something, you can go back at any time.
- You can ask others to help you, delegate parts of the survey to colleagues, or mobilise a 'task force'.
- If there are other surveys (for example on asset condition, safety, quality or environment), you may be able to join forces.
- If the base data you need is not immediately available, you can pull strings or even get into the source data yourself – or simply busy yourself with other aspects while the data works its way through the system.
- You are not obliged to write a formal report, although you should record your findings, calculations and recommendations for others to read later. You may also need a summary to obtain funds for investment in energy saving measures.
- You can more easily build on the work of others before you.
- You can choose to ignore certain aspects.
- You can improvise measurement techniques, even turning things on and off (within reason) to see their effect on energy use.
- You may be able to experiment with variations to operations and processes.

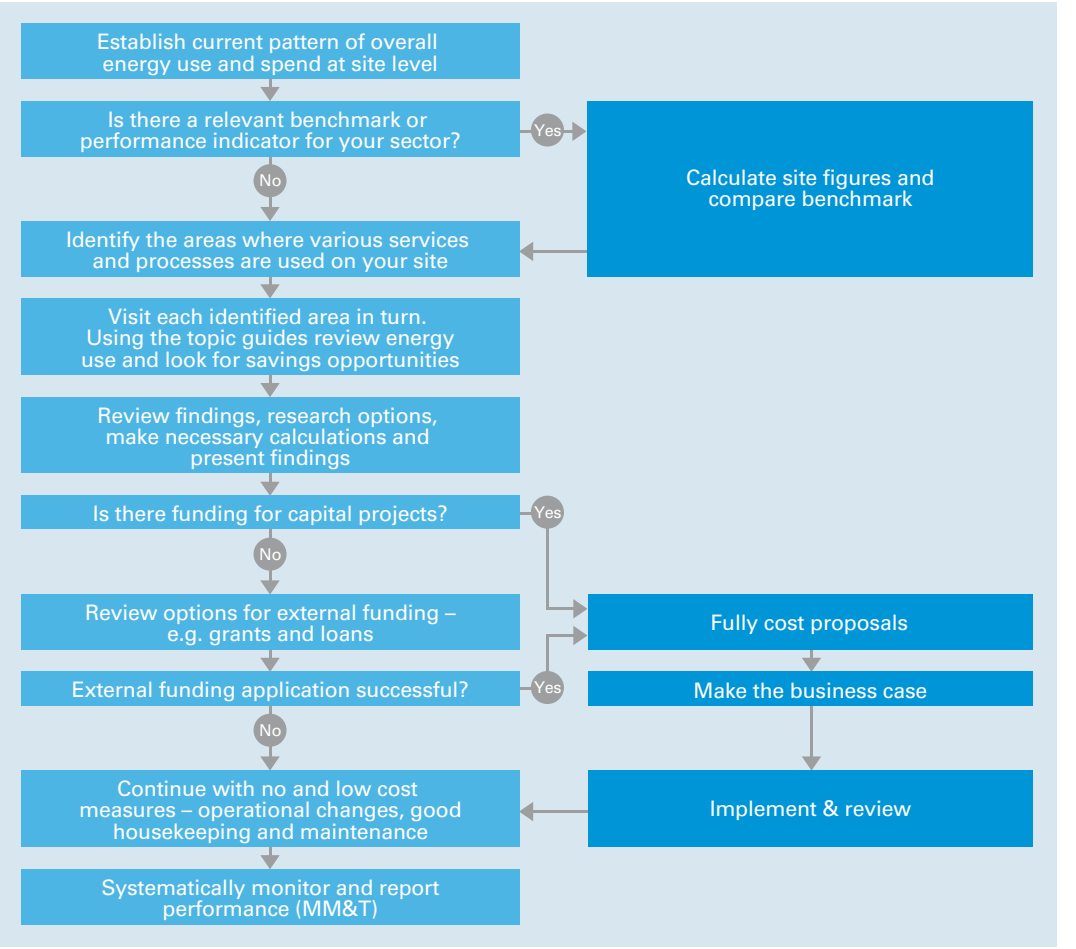
The work programme

- Establish current patterns of overall consumption and expenditure at site level.
- Do meaningful 'yardstick' energy ratios (performance indicators, benchmarks) exist for your sector?
- Calculate the figure(s) for your site. If your ratios are higher than those published this may indicate your savings potential.
- Tabulate where you have examples of particular services and processes, and use this to manage your on-site survey activity.
- Visit each area or department in turn. Using the relevant topic guides as a prompt, look for things which are obviously wrong and need to be corrected.
- Identify opportunities which may apply to your site in particular.
- If you are not sure what to look at first, start with the principal central services and the largest process users.

- By measurement, experiment, or inference, estimate the present energy use of particular systems and plant, and the likely potential savings in each case. Consult Carbon Trust guidance on the types of system in question.
- Discuss potential energy saving solutions with suppliers and obtain quotations.
- Calculate the financial viability of the projects you are proposing, and present recommendations to those who need to give approval.
- Report your findings, and put into action any low-cost and no-cost measures you have identified.
- Monitor performance systematically in order to track and verify subsequent savings. Systematic monitoring against targets can save money in itself, by revealing any unexpected waste as it begins.

Figure 2 to the right shows an example programme of work if you're undertaking your own survey. You can tailor this to suit your size of organisation.

Figure 2 ***Survey flowchart***



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Doing it yourself

Reporting

It's a good idea to record your survey findings in a formal report. It doesn't need to be long – it just needs to clearly explain to others what you have found and how you arrived at your conclusions. It will also help to remind you of these things when you return to the survey later.

The report records what the survey has found but more importantly it should provide the motivation to take the next steps. A key element will be an **action plan**, which should list the identified opportunities in a clear format. Typically they'll be listed in payback order – with the quick payback, or essential items first. Alternatively you might want to list projects in order of implementation cost, or in order of savings.

In many action plans savings from one measure may be affected by other recommendations. For example, you might have one recommendation to install lighting controls and another to replace the lights with more efficient units. Assuming that on their own the lighting controls would yield a 20 per cent saving compared with the current situation and the replacement of lights would give saving of 30 per cent, then if implemented together the total saving would be 44 per cent rather than 50 per cent.

If you are looking for approval to spend money on projects, it is essential to present clear, well-explained recommendations. Try to avoid giving the reader complex information or multiple options to choose between – but where this is necessary provide clear guidance. Always support your recommendations with calculations, estimates and costings.

The Carbon Trust management guide Making the business case for a carbon reduction project (CTV039) provides useful advice on presenting a convincing proposal for funding.

The Report

A report should normally contain the following sections, although for an in-house survey some may not be necessary:

Summary

- A brief narrative introducing the survey, its findings and recommendations.
- The action plan.

Introduction

- Background to the site and its operations (not usually necessary for an in-house report).

Energy use and expenditure statistics – possibly carbon figures as well (see table 1 on page 13 for an example)

- If appropriate and available, the trend in energy performance indicator(s) or benchmark(s) (and comparison with published values).
- Any special considerations supporting subsequent recommendations.

Survey findings

- Detailed discussion of findings, presented either by area, or by technology theme (eg lighting).

Recommendations

- measures to be taken (see table 2 on page 14 for an example)
- expected costs
- grants and incentives that have been identified
- estimated savings
- non-energy benefits
- implementation risks and risk mitigation
- payback periods and possibly internal rates of return
- next steps.

Appendices

- Energy prices and energy data not included in the main body of report.
- Charts and diagrams that support the report.
- Data gathered during the survey. (May be links to the data or spreadsheets, rather than actual data.)
- Detailed calculations of savings and costs – if needed.
- Any other relevant information.

Table 1 ***Example of an energy use and cost table***

	Energy Consumption		Cost		CO2 Emissions
	(kWh/Year)	(%)	(£/Year)	(%)	(tonnes/year)
Electricity	8,289,083	36%	£560,060	58%	4,509
Gas	14,589,563	63%	£389,979	41%	2,685
Oil	275,100	1%	£11,266	1%	76
Total	23,153,746	100%	£961,305	100%	7,270

Table 2 ***Example Action Plan***

The recommendations listed below are prioritised, according to cost, but with energy management recommendations as the first priorities.

Item	Recommendations	Estimated Annual Savings			Estimated cost (£)	Payback period (years)	Timescale forImplementation
		(£)	CO2 (tonnes)	(kWh)			
1	Implement a staff awareness programme	2,060	15.0	27,500	1,000	0.5	3 - 6 months
2	Implement Monitoring and Targeting (M&T)	5,160	37.4	68,800	10,000	0.9	6 - 12 months
3	Upgrade heating controls in offices	690	14.1	25,900	3,000	4.3	12 - 18 months
4	Lighting changes - T8 to T5 fluorescent tubes	8,090	58.7	108,000	15,000	1.9	6 - 12 months
Totals		16,000	125.2	230,200	£29,000	1.8	

*For simplicity's sake, simple payback is used here but you may need to provide a Net Present Value or Internal Rate of Return (IRR) to get approval for the projects. See also Making the business case for a carbon reduction project (CTV039)

Making the savings

The survey report listing the savings opportunities is the beginning, rather than the end, of your move towards greater efficiency, and your next step is to implement the recommendations. If the survey has been a walk-through you may want to undertake a fuller investigation of specific opportunities. For example, the survey might have suggested the use of a variable speed drive on a fan. You would therefore need to arrange for a supplier (or suppliers) to review the fan and put forward a costed proposal. In the case of 'improved housekeeping' you might be able to move straight on and take action.

A good quality external survey will clearly state the next steps to be taken.

Section B: Practical Survey Notes

The following notes outline what you should look for in each technical topic area. These notes are not exhaustive, and we strongly recommend you also read the more detailed advice available from the Carbon Trust – follow the link provided at the end of each topic.

Energy management

While a survey typically focuses on 'hardware', energy management is a critical aspect of any organisation's ability to reduce its energy use. Many survey reports have sat on the shelf as the organisations concerned have not had the management frameworks in place to implement the findings.

For an understanding of how energy management can help you save energy, download the Carbon Trust guide Energy Management (CTG054). We strongly recommend that you read this alongside this survey guide.

Energy information is key to energy management. Do you have a formal system for recording and analysing energy use and costs? If so, information from this will be the foundation of your survey. If you have fully implemented Metering, Monitoring and Targeting (MM&T) this could provide the focus of your survey activity.

The starting point for your survey should be to undertake an energy management assessment of your organisation using the Carbon Trust's Energy management self-assessment tool

As an alternative to the above link, this tool can be found under the attachments tab to the left.

The findings from this should be included in your survey report. Without effective energy management, your organisation won't be able realise the full potential of the energy saving opportunities. It is possible the self-assessment tools will identify opportunities to be implemented in parallel with the survey. In some cases it might be better to address any energy management issues before beginning your survey.

Energy Supply and Metering

The energy supply points are a link between the management aspects and technical topics. The first site activity should be the inspection of all the energy supply points. This will provide opportunities for improving energy data, rather than for directly saving energy.

Identifying opportunities

- Identify and physically inspect all the supply points to your site – these are the points at which you are billed.
- Look for opportunities to upgrade supply metering to provide automatic meter reading (AMR).
- For bulk fuels (oil, coal, LPG and biomass), make a note of the condition of the storage, the quantity that can be held, and if applicable, the method of measurement. For bulk fuels (oil and LPG), consider fitting metering if there is none in place, or where only tank contents are currently being measured. Where there are storage tanks, review these against current environmental and safety guidelines.
- If the main supply is shared between different users, check whether there is appropriate submetering. If there isn't, determine how costs are allocated. Identify significant energy users where additional submetering would be of value.
- Obtain copies of energy invoices for a minimum of 12 months – ideally 24 months. Enter data on a spreadsheet to determine the quantity and cost of supply – this will form the first part of an energy audit. Over a 24-month period there may be some billing errors – try to resolve these if possible. If you have an effective MM&T system this work should have already been undertaken.

Consultant's tips

- Mark up metering points and fuel tanks on a site plan.
- Identify physical meters and 'link' them to energy bills.
- If meters are in a cabinet you'll probably need a meter key – there are one or two types of standard key that are readily available.
- If meters are in a high-voltage area you may need the help of a qualified or competent person to gain access.
- If you have multi-rate electricity meters you'll need to find out what the different registers refer to – you may need to contact your supplier for guidance.
- Gas meters may be fitted with temperature and pressure correction – make sure you look at the right register when comparing readings with gas bills.
- It can be useful to take a digital photograph of a meter with a date, as well as noting the details on paper.
- Take manual meter readings at regular intervals during your survey – unless you have access to real-time data.

Signpost

The Carbon Trust has more detailed guidance on MM&T at www.carbontrust.co.uk/mmandt

Monitoring and targeting – In-depth management guide (CTG008)

Metering technology overview (CTV027)

Lighting

On average 25 per cent of an organisation's electricity costs come from lighting. Energy efficient lighting measures can reduce these costs by at least 30 per cent, and up to 60 per cent in many cases.

Consultant's tips

- Estimate the lighting load by running a controlled test while the building is unoccupied: read the electricity meter at, say, 10-minute intervals, first with the lights off, then with the lights on.
- If the building has a half-hourly meter, analyse the load profile versus the estimated lighting load to determine whether it is part of the base load.
- Make a point of examining areas whose use has changed.
- Subject to safety considerations, turn off some lights and see if anyone notices.
- Walk the site out of hours to see what lights are left on.
- An inexpensive light meter (£30-£50) will be accurate enough to see if lighting is in line with recommended levels.
- Use time-lapse video recording (CCTV) to study intermittently-occupied spaces.

Signpost

www.carbontrust.co.uk/lighting

Note: Certain lighting technologies may be eligible for tax relief through the Enhanced Capital Allowances scheme
www.carbontrust.co.uk/eca

Table 3 ***Identifying lighting opportunities***

People not knowing where the light switches are, or how the lights are controlled	Education and information via a staff awareness and motivation campaign Improve labelling of switches
A lack of labels on switches controlling shared workspaces	Brief staff, security personnel and cleaners to turn off lights when leaving unoccupied areas
Empty areas lit unnecessarily	Introduce occupancy controls, especially in infrequently occupied rooms
Large banks of lights controlled by a single switch	Fit more switches per bank of lights, if wiring permits. Also consider switching lights parallel to windows. However this can be very expensive and difficult to implement Consider introducing local controls in conjunction with a lighting control system
Tungsten filament lamps	Unless these are specialist lamps, these should be changed to energy efficient types
Older 'switch start' and larger diameter tube (T12 and T8) fluorescent lighting	Replacing fixtures with more efficient equivalents using T5 lamps and high-frequency electronic control gear. Consider the use of LED lighting
Excessive light levels for the type of work being done See Appendix B of Carbon Trust Lighting Technology Overview (CTV021) for recommended lighting levels	Reduce lamp ratings Remove or safely disconnect 'redundant' lights Redesign and replace lighting
'Redundant' lights, ie fittings that were originally installed, but don't now serve a purpose – for example, over a false ceiling or the tops of cupboards	Remove or safely disconnect 'redundant' lights
Artificial lighting in areas with sufficient daylight	Daylight sensors, or photocells, can be used for external lighting or for internal areas with good access to daylight. Also consider the use of timers – either discrete units or making use of a Building Management System (BMS)
Outside lights on manual control	
Dirty or discoloured diffusers, reflectors and shades	Introduce adequate lighting maintenance and cleaning regimes
Other evidence of poor maintenance	
Dirty windows, roof-lights or other opportunities to use more daylight	Cleaning lights and windows – maximise the use of daylight. Effective use of blinds can help

Heating and Hot Water

Heating and hot water can account for as much as 60 per cent of your total energy costs. And because it's possible to reduce your heating costs by up to a third, the potential savings are substantial.

Also see: building fabric (see page 40); building controls (see page 34); boilers and heat distribution (see page 24)

Consultant's tips

- Check that monthly fuel demand varies in accordance with changing weather (as recorded in published degree day figures). See Degree days for energy management (CTG004) for more information.
- A 1°C drop in average space temperature can cut heating energy consumption by about eight per cent.
- Temporary data logging can provide valuable evidence. As a minimum, aim to record the inside and outside air temperatures at 10-minute intervals. For 'wet' systems, record the boiler casing or flue temperature to detect when the system starts and stops, and the circulation temperature to check that heat distribution is appropriately controlled.
- You can estimate the rate of heat loss from a building from the rate of temperature decay when the heating, lights and equipment are turned off at the end of the day.
- Establish the number of full-time-equivalent occupants and how they use hot water to estimate their requirements.

Signpost

www.carbontrust.co.uk/heating

Note: Certain heating technologies may be eligible for tax relief through the Enhanced Capital Allowances scheme www.carbontrust.co.uk/eca

Table 4 ***Identifying heating and hot water opportunities***

What to look for	Potential opportunities
Heating outside working hours (whether deliberate or accidental)	Adjust existing timers and other controls Fit seven-day programmable controllers. Where there is occasional out-of-hours working, provide an extension timer to avoid having to reset the main time control Consider optimum start/stop control
Excessive space temperatures (even if only in localised areas)	Consider rebalancing the heating system to prevent some areas having to be overheated in order to satisfy others Fit improved heating system controls including possibly zone isolation and thermostatic radiator valves (TRVs) Consider external temperature compensation control
Unauthorised supplementary electric heating	Educate users and investigate why the area in question is cold
Mechanical ventilation running (or able to run) when building is unoccupied	Fit seven-day programmable controllers if circumstances warrant it Consider controlling ventilation fans on indoor air quality (eg CO_2 sensing)
Mechanically ventilated buildings	Investigate the possibility of increased recirculation Consider ventilation heat recovery
Frost protection thermostats set too high	Reset to appropriate level
Heating and cooling being used simultaneously	Investigate 'dead-band' settings
Anything which restricts heat output, including blocked grilles, obstructed radiators, clogged air filters, and missing air filters which have allowed convector tubes to become fouled	Introduce improved maintenance regimes

Table continued on page 23

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What to look for	Potential opportunities
Vehicle access doors which may be left open for long periods	Consider interlocking loading-bay doors with heating Fit fast-acting roller shutter doors, or secondary doors to create an air lock Use docking seals around vehicles during loading/unloading
Summer immersion heaters running simultaneously with boilers, or at risk of doing so	Install interlocks Fit point-of-use water heaters with time control to dispense with central storage and long distribution runs
Multiple storage cylinders where demand is low relative to stored volumes	Rationalise storage Consider point-of-use water heaters with time control
Excessive temperatures at hot taps (unless essential for control of legionella)	Adjust set points
High-bay buildings	Fitting de-stratification fans to prevent warm air pooling at high levels Replace convective 'blown air' heaters with radiant tube or plaque heaters

Boilers and Heat Distribution (Including Steam)

In a typical building, heating and industrial operations can account for as much as 60 per cent of the total energy bill. However, it's possible to cut heating costs by up to 30 per cent by implementing some simple energy saving measures.

Also see: heating and hot water on page 21

Consultant's tips

- For space heating systems, you may be able to spot a significant water leak if the feed and expansion tank is continually filling, or in the case of a pressurised system if the pump is running regularly.
- To assess whether idle (non-firing) boilers are dumping heat up the flue, check for air flow through the boiler. If it is confirmed, measure the stack temperature to see if it is elevated. However, this technique is not always practical.
- Check water temperature in offline boilers to confirm they are isolated. If they're feeding a common header, relate common flow temperate to individual boiler flow temperatures to estimate the flow through the idle boilers.
- Question the boiler operator(s) about the frequency and quality of maintenance.
- Check the temperature of condensate pipework after each trap. If it's significantly below 100°C, the trap is not working.

If the ground dries unusually quickly after rain, or frost clears sooner than usual, this may suggest that the insulation in your underground ducts is ineffective.

Signpost

www.carbontrust.co.uk/boilers

Note: Certain technologies may be eligible for tax relief through the Enhanced Capital Allowances scheme www.carbontrust.co.uk/eca

Table 5 ***Identifying boilers and heat distribution (including steam) opportunities***

What to look for	Potential opportunities
Irregular boiler and heating system maintenance regime	Regular annual service of boilers and heating systems can save 10 per cent (or more) of heating costs
Multiple boilers sharing loads when fewer units could meet the demand	Install boiler sequence control, or rectify faults in existing sequence control
Ageing boiler plant	If boilers are over 15 years old consider replacing them with more efficient types
Damaged, wet or insufficient insulation on boilers, storage vessels and associated pipe-work, valves or flanges	Repair and insulate as appropriate
Flooding in pipe ducts	Check duct drainage is effective
Check that boiler time clock settings are correct	Reset as necessary
Could boilers be running when there is no demand other than their own standing losses?	Improving control so that boilers are only enabled when there is demand from one or more of the circuits served
Check for water losses by assessing the water make-up rate	Investigate for leaks and repair

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What to look for	Potential opportunities
	Steam systems
Steam leaks	Repair
Steam traps passing steam or not passing condensate	Eliminating bypass valves on steam traps and if necessary fitting better-matched traps
Manual temperature control of process items	Fitting automatic temperature controls in place of manual valves
Manual control of dissolved solids	Implementing automatic TDS (Total Dissolved Solids) control on boilers Increasing feed water temperature to aid oxygen removal, reduce dosing requirements and resultant blowdown Recovering heat from boiler blowdown
Dead lengths of pipework, or long runs of pipework with very small demands at the end	Rationalising pipe-work to reduce distances travelled (and reduce diameters where feasible) and remove dead pipe runs Making alternative provision for small loads at the ends of long dedicated pipe runs (or relocating them)
Condensate running to waste	Investigating possibilities for recovery
Flash steam being lost from receivers	Finding a use for flash steam (eg sparging it into the feedwater tank or cascading to lower-pressure users) or using condensate coolers on calorifiers and heater batteries where feasible

Ventilation

Good ventilation is essential – it provides fresh air and also helps protect your building against damp and condensation. It is also needed to remove fumes and pollution from occupied areas. By taking just a few simple measures, you can significantly reduce the energy required for ventilation while maintaining performance.

Also see: motors and drives (page 32)

Consultant's tips

- If you can't see or hear the fans, check air movement by hanging thin strips of tissue paper near extract grilles.
- Pay special attention to areas whose use has changed and where the original ventilation requirements were more demanding.
- Compare the performance of identical duty and standby units.
- If nothing suggests otherwise, assume the air handling plant was designed to prevailing design codes for the type of use.

Signpost

www.carbontrust.co.uk/ventilation

Note: Certain technologies may be eligible for tax relief through the Enhanced Capital Allowances scheme www.carbontrust.co.uk/eca

Table 6 ***Identifying ventilation opportunities***

What to look for	Potential opportunities
Local extract ventilation running when not required	Adjust timer settings where installed Install time controls where appropriate Interlock local extract ventilation to occupancy and/or activity
Clogged or obstructed grilles or filters	Implement proper maintenance and cleaning schedules
Excessive system resistance, for example because of dirty filters, stuck dampers, or dropped fire shutters	
Eroded or fouled fan blades	
Inadequate use of existing air-recirculation facilities	Investigate and increase air-recirculation to suitable levels, balancing energy conservation against air quality Consider control on CO_2 concentrations
No heat recovery from exhaust air	Investigate the viability of introducing heat recovery from exhaust air to incoming fresh air
Dampers being used to control air flow rates	Consider Variable Speed Drive (VSD) control of the fans instead
Old inefficient fans and poor efficiency motors	Fit higher efficiency fans and motors – for existing fans this normally only makes sense when the motor fails. For all new equipment, higher efficiency fans should be specified with higher efficiency motors
Air conditioned buildings	In hot weather, consider using the ventilation system at night to pre-cool the building and so reduce air conditioning requirements during the day

Air Conditioning

Air conditioning can use a huge amount of energy – enough to increase a building's energy consumption and associated carbon emissions by up to 100%.

Also see: refrigeration (see page 37); ventilation (see page 27) and building controls (see page 34)

Consultant's tips

- Keep a log of when the chiller is running to spot whether it's being used during cool weather.
- Observe the operating patterns of air conditioning chillers, cooling towers, etc, relative to outside conditions. Look for excessive running or frequent on/off cycling.
- Compare refrigerant suction/discharge temperatures and condenser water temperatures on similar plant items. Significant differences may suggest physical problems or incorrect settings.

Signpost

www.carbontrust.co.uk/airconditioning

Note: Certain refrigeration technologies may be eligible for tax relief through the Enhanced Capital Allowances scheme www.carbontrust.co.uk/eca

Table 7 ***Identifying air conditioning opportunities***

What to look for	Potential opportunities
Excessively low cooling set points – air conditioning should not operate below temperatures of 24°C, unless there is a specific process requirement	Adjust temperature set points and investigate 'dead-band' settings to avoid simultaneous heating and cooling
Heating and cooling being used simultaneously	
Lack of time control, excessive hours of operation or risk of time-schedule being overridden	Implement appropriate time control to avoid unnecessary cooling Make sure controls can't be adjusted by unauthorised people
Air-recirculation potential not exploited or very low	Investigate and increase air-recirculation to suitable levels, balancing energy conservation against air quality Consider controlling on CO_2 concentrations
Portable electric heaters being used while air conditioning is active	Get rid of portable heaters and investigate reasons for their use
Electrical appliances (eg computer monitors) and lighting running unnecessarily	Manage other heat gains: if equipment is left on in an air conditioned space you are using energy both to run it and to remove the heat generated

Table continued on page 31

What to look for	Potential opportunities
Overheating of occupied space due to solar heat gain	Consider using blinds and/or solar film to reduce heat gain in summer – use types that will allow effective day-lighting to avoid using artificial light Consider solar shading for air conditioned buildings/areas
Air exchange with non-conditioned spaces	Improve isolation of conditioned from non-conditioned spaces; eg add doors, fit door closers, etc
Doors and windows being left open, gaps in building structure, or other infiltration routes	Repair gaps Fit door closers as appropriate Educate building occupants via awareness campaign Lock windows, subject to fire and health & safety considerations
Excessively tight control of relative humidity (e.g.±5%) where not essential	Adjust settings Discontinue control of relative humidity where possible
Blocked filters Fouled evaporator or condenser coils	Implement proper maintenance and cleaning regimes
Zones where cooling is required all year round rather than just in summer	Consider providing 'spot cooling' systems for zones with year-round cooling requirements, so that the main central system just needs to be operated seasonally

Motors and Drives

Running motors and drives uses almost two thirds of the electricity consumed by UK industry. In fact the cost of running a motor for a year can be 10 times what it cost to buy in the first place. The efficiency of your motor operation is therefore critically important if you're aiming to lower your carbon footprint and reduce your energy bills.

Consultant's tips

- Start with the largest motors and longest running hours.
- Thermal imaging equipment can help you pinpoint frictional transmission losses, poor electrical connections and other problems.
- The temperature of a motor can indicate the load it is working under.
- Three-phase motor power can be calculated from an ammeter reading by the following formula, where the rated figures will come from the motor's rating plate:

  Power (kW) = Rated power (kW) x
  Measured current (Amps)
  divided by Full-load current (Amps)

This formula provides a reasonable estimate down to around 50% of full load.

Signpost

www.carbontrust.co.uk/motors

Note: Certain motor and drive technologies may be eligible for tax relief through the Enhanced Capital Allowances scheme www.carbontrust.co.uk/eca

Table 8 ***Identifying motors and drives opportunities***

Driven equipment not doing a useful job	Isolate/decommission
Oversized motors: check whether motors are appropriately sized for their duty	If permanently lightly-loaded, compare efficiency figures with smaller high efficiency motors to see whether replacement will be cost effective (usually only on motor failure). Consider switching to permanent star connection (caution advised).
Motors in poor condition	Fit high-efficiency motors when replacements are necessary
Risk of unnecessary running	Improve machinery operator control and education Introduce time switching, or control via other sensors or BMS Fit automatic stop/start control (this might include motor load sensing)
Worn or slack V-belts Misaligned pulleys or couplings	Replace worn belts or pulleys. Re-tension slack belts. When V-belt pulleys need replacing consider conversion to wedge belts (two per cent improvement) or synchronous, flat, or ribbed belts (five per cent to six per cent improvement) Realign/repair misalignments
Individual belts broken on multi-belt drives	Replace as soon as possible as the performance of the other belts will deteriorate
Worn bearings in motors, driven equipment, or intermediate drive train Unusually hot or noisy gearboxes	Repair and maintain to reduce losses and risk of failure Use high-performance lubricants
Voltage imbalance, low or high voltages, harmonic distortion or poor power factor You'll need electrical instruments to measure this	Correct to optimise efficiency
Fixed speed motors used for variable load applications	Consider VSDs – best savings are with fans, pumps and air compressors.

Building Controls

Building controls can adapt a building's heating, ventilation, cooling and lighting according to changing requirements. Your organisation could significantly reduce its energy costs by simply installing controls and making sure they are set, operated and maintained correctly.

Consultant's tips

- If you have a Building Management System (BMS) look through the alert and alarm logs – also look at whether settings are being changed without authority.
- Compare time settings against actual occupancy and activity.
- Check time clocks when the clocks change in spring and autumn.
- If temperature settings are high, is it because of a fault with the heating system or building, such as excessive draughts?
- Find out whether occupants understand the controls that they have access to – eg thermostatic radiator valves (TRVs).

Note: Certain control technologies may be eligible for tax relief through the Enhanced Capital Allowances scheme
www.carbontrust.co.uk/eca

Signpost

www.carbontrust.co.uk/buildingcontrol

Table 9 ***Identifying building controls opportunities***

What to look for	Potential opportunities
That time clocks are a) set at the correct time of day and b) on/off cycles are correct	Retro or continuous commissioning of controls
Identify the required settings of all thermostats and then compare these to the actual settings	Adjust as necessary
Where occupancy controls are installed, check their sensitivity and run time	Adjust as necessary
Sensors located in the wrong position or of the wrong type (eg thermostats in direct sunlight, conventional thermostats in areas served by radiant heaters rather than black-bulb types)	Relocate/replace as appropriate
Exposed controls that shouldn't be adjusted by building occupants	Make such controls tamper-proof
Older electromechanical controls	Replace with electronic controls for improved accuracy and consistency
Limited in-house understanding of the Building Management system (where fitted) and/or infrequent checks on settings	Ensure that enough people are fully trained on the system – don't rely on occasional visits from the controls engineer Even for a new building, don't assume that the BMS has been properly commissioned Undertake a regular review of settings
Multiple unlinked control systems	Consider upgrading to or addition of an integrated Building Management System (BMS).

Office Equipment

From PCs to vending machines, office equipment of some kind is used by almost all UK organisations, and accounts for around 15 per cent of all the electrical energy used in UK offices. It's an area where huge savings can be made, as effective management of equipment can reduce its energy consumption by up to 70 per cent.

Consultant's tips

- Walk around offices at lunch time and the end of the day.
- Look for 'unofficial' kettles and heaters – typically these will not carry a Portable Appliance Testing (PAT) label.
- Talk to staff to find out how they use equipment and if they know about any energy saving options.

Signpost

www.carbontrust.co.uk/offices

Table 10 ***Identifying office based business opportunities***

What to look for	Potential opportunities
Equipment left on out of working hours	Providing education and information via a staff awareness and motivation campaign Using the network to turn off unwanted PCs Fitting seven-day timers to vending machines and similar where appropriate
Equipment left on during working hours, but when not required	Providing education and information via a staff awareness and motivation campaign Using the in-built energy saving features of equipment – these are often not enabled or set up correctly
Energy saving options not enabled	
Old, inefficient equipment	Using multi-function devices instead of separate printers, photocopiers and fax machines Replacing old CRT monitors with flat screen models Consider the use of laptops instead of desktop computers – laptops use only around 10 per cent of the energy of desktop models (Ergonomics and health & safety concerns may not allow laptops for extended daily use) Specify energy efficient (eg Energy Star rated) replacement equipment

Refrigeration

A lot of companies spend far more than they think on refrigeration, including HVAC, retail and process applications. For some retail and specialist companies, it can represent more than 50 per cent of their energy bill.

Consultant's tips

- Look for misuse of display cabinets and cold stores, for example, overloading and stocking with 'warm' goods – this occurs quite often in practice.
- Where food and drink are involved link to food safety issues.
- Measure refrigerant liquid temperature both upstream and downstream of the strainer. A high differential implies clogging.
- If the temperature rise is lower than you expected, there may be an excessive cooling water flow rate.

Signpost

www.carbontrust.co.uk/refrigeration

Note: Certain refrigeration technologies may be eligible for tax relief through the Enhanced Capital Allowances scheme www.carbontrust.co.uk/eca

Table 11 ***Identifying refrigeration opportunities***

What to look for	Potential opportunities
Cold stores or display units running at too low a temperature – determine what the right settings should be before the survey	Only cooling to the temperature needed – every 1°C reduction in cooling temperature could save two per cent of energy use
Cold storage and cabinet doors being left open	Keeping doors closed as much as possible Good housekeeping and door management need to be enforced constantly Fitting automatic or rapid-closing doors to cold stores if frequent access is required
Over-filled retail display cabinets Return air grilles of cabinets blocked due to poor product loading or over-stocking	Introducing working procedures and awareness training for relevant staff
Poor cleaning of display cabinets	Using a good cleaning and maintenance schedule to maintain efficiency and good temperature control
Retail display cabinets without night blinds or covers	Using well-fitting night blinds or covers on all open cabinets to reduce the load during non-trading hours Using a glass riser ("weir plate") at the front of the cabinet to save around three per cent of energy costs

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What to look for	Potential opportunities
Inadequate or damaged insulation on pipework and fittings	Installing new insulation Pipework in sub-zero temperatures requires special care to stop moisture freezing inside the insulation Low-temperature insulation has to be air-tight as well as thermally sound, or the insulation will break down
No heat recovery employed	Investigating opportunities for heat recovery
Duty being shared by diverse chillers	Optimising chiller scheduling by letting the best take the lead
Fouled coils, air filters, air inlet screens or cooling tower spray nozzles	Cleaning and ensuring suitable maintenance regimes are put in place
Evaporator icing up	Making sure defrosting is well controlled; avoid timed defrost and using defrost on demand where possible
Condenser control (head pressure control) systems programmed to run all year round at a condensing temperature designed for summer conditions	Adjusting the control to allow the condensing temperature to reduce in cooler weather to lower temperature lift
Conventional thermostatic expansion valves	By replacing conventional thermostatic expansion valves with electronic expansion valves you may be able to reduce the head pressure setting, since they can operate reliably with a lower pressure drop (equivalent to the temperature lift)
Refrigerant leaks Leaks can't always be spotted by simple observation, but maintenance records may highlight excessive top-ups of refrigerant In larger systems bubbles in the sight glass are indicative of leakage.	Finding and repairing leaks Work with your contractor to set up a leak test regime and fix leaks as they appear You'll need to recheck leaks about a month after the repair to ensure they are sound Making sure the plant is maintained in good condition and all valves are sealed

Building Fabric

About 60 per cent of heat in most offices is lost through the building fabric. The remainder is lost through air infiltration and ventilation. This means your office could be wasting a lot of money.

Consultant's tips

- You can detect unwanted air movement using a bubble-maker or smoke generator.
- An infra-red camera can be used on cold nights to detect hot spots (from outside) or cold spots (from inside).
- The characteristics of your building's heat loss can be estimated from the rate of temperature decay at the end of the working day, taking outside temperature into account.

Signpost

www.carbontrust.co.uk/buildingfabric

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Table 12 ***Identifying building fabric opportunities***

What to look for	Potential opportunities
Poorly utilised space	Rationalising occupied space and isolating empty zones for heating, ventilation and air-conditioning
Doors and windows which require draught proofing or repair	Repairing and/or replacing Applying draught-proofing
Broken windows and roof-lights	Repairing damaged fabric – gaps, holes and broken windows
Gaps in walls or roof, through which warm air can escape	
Dirty windows and roof-lights	Cleaning windows and roof-lights to maximise daylight where possible
Substandard or damaged insulation in roof spaces and suspended ground floor spaces	Improving/adding insulation in roof spaces, suspended floors, cavity walls, solid walls, etc
Determine whether cavity walls have insulation	
Damp which may have compromised existing insulation	Identifying and eradicating the cause of the damp, repair fabric and replacing damaged insulation
Doors left open causing loss of heat or cooling	Fitting door closers For loading bay doors: • Consider interlocking doors with heating • Fit fast-acting roller shutter doors, or secondary doors to create an air lock • Use docking seals around vehicles during loading/unloading
Doors fitted with door closers that are not working or wedged open – this may also be a fire regulation issue	Repairing door closers Educating occupants not to wedge open doors that are fitted with closers
Overheating of occupied space due to solar heat gain	Consider blinds and/or solar film to reduce heat gain in summer – use types that will allow daylight in to avoid using artificial light. Consider solar shading for air conditioned buildings/areas

Compressed Air

Compressed air is one of the most energy hungry ways of delivering useful work. Minimising waste is therefore vital; the right approach can save over 30 per cent of the energy used.

Also see: motors and drives (see page 32) and heat recovery (see page 44)

Consultant's tips

- Look and listen. Are air pressure safety valves operating? If so, control is inadequate. Can you hear air escaping during meal breaks and after hours? Are compressors starting and stopping frequently?
- If the compressors have hours-run meters, read them at intervals through the day to see whether you have more units running than necessary.
- Compare on-load hours against total run hours to check for idle running.
- If the air supply is metered, take readings regularly through the day to establish patterns of use relative to production activity. Look for unexplained idle losses.
- Air meters can be unreliable. If a meter provides a chart recording, look for symptoms such as the trace being unexpectedly smooth, clipped off at maximum, or never returning to zero.
- After hours, either shut off the compressors and record the rate at which pressure subsequently falls or with the compressors on time the load/unload periods – the load periods will be serving only leaks assuming there are no real demands for air.
- A 10 per cent air loss might be considered acceptable – losses in excess of 35 per cent from leakage are not uncommon.
- Power delivered to air tools is 10 times the cost of electricity to do the same job.
- Reducing air inlet temperature by 6°C reduces energy consumption by around two per cent.
- Ask how often the filters are replaced. Blocked filters cause a drop in pressure.

Signpost

www.carbontrust.co.uk/compressedair

Note: Certain technologies may be eligible for tax relief through the Enhanced Capital Allowances scheme www.carbontrust.co.uk/eca

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Table 13 ***Identifying compressed air opportunities***

What to look for	Potential opportunities
Air leaks; particularly on connectors, flanges, and flexible hoses	Repairing leaks and introducing an ongoing leak reduction maintenance programme
Compressors running when there's no demand for air	Fitting improved control of central compressors, including computerised sequence controls for multiple compressor installations, which can reduce compressor run hours and prevent air loss and wasted power
Air intakes drawing in warmer air than necessary	Using the coldest possible air source to maximise compressor efficiency
Inappropriate uses, such as low-grade duties (like swarf blowing, or agitating liquids in tanks) which don't warrant clean, dry, air from the central system	Using low-pressure blowers for applications such as air knives, air lances, air agitation, blow guns, product ejection, powder transfer, etc Substituting alternatives for air tools
Excessive distribution pressure Higher pressure means greater losses through leaks and higher power requirement for the same delivered air volume	Regulating the air pressure to that required by the end-use devices can also result in excellent savings. Look at the manufacturer's stated requirements and compare these with the actual pressure at which devices are operating
Dead distribution pipework runs, which create a risk of leaks	Removing and capping-off
Manual condensate drains valves left open	Improving operational practices Replacing manual condensate drain valves with zero-loss electronic condensate traps
No heat recovery employed	Investigating opportunities for heat recovery, such as: • space heating for an adjacent building • domestic hot water heating • pre-heating boiler feedwater • producing warm air to keep product and packing materials dry.
Opportunities for zoning and selective isolation of zones	Fitting zone-isolation valves These can be under time control, or interlocked to the packing/production line served, to enable parts of the site to operate out of hours without air going to the whole works If combined with a pressure gauge, local leakage tests are possible

Heat Recovery

Heat recovery is the collection and re-use of heat lost from a process or building. This can help reduce the energy consumption of the process itself, or to provide heat for other processes. Like all systems, if you have a heat recovery systems in place it will need to be reviewed to make sure it's operating effectively.

Consultant's tips

- Before recovering heat look at the process that is generating it. Improving the efficiency of this process may reduce the amount of heat that can be recovered.
- For existing systems:
  - Check temperature differentials against the manufacturer's specification or original design intent.
  - Compare temperature efficiencies of similar units.
  - Note the temperature and heat content of the high-temperature stream at outlet, in case there is potential for further heat recovery.

Signpost

www.carbontrust.co.uk/heatrecovery

Note: Certain technologies may be eligible for tax relief through the Enhanced Capital Allowances scheme www.carbontrust.co.uk/eca

Table 14 ***Identifying heat recovery opportunities***

What to look for	Potential opportunities
Significant waste heat that occurs at the same time as a need for heat Although the heat can be stored or transferred over reasonable distances, the best opportunities are those where the heat supply and demand are at the same time and close by Possible candidates include air compressors, refrigeration plants, high-temperature processes and exhaust air	Exhaust air from buildings and processes Flue gas from boilers and furnaces Air compressors and refrigeration plant Steam condensate Hot waste streams
Where heat recovery is already installed, look for: – fouled heat exchangers – fans fouled, worn or even stopped – poor operation of control dampers in air re-circulation systems – incorrect configuration or control of batch heat reclaim – lost fluid or failed pumps in run-around coil system – dumping of heat because of mismatched sources and loads.	Introduce improved maintenance processes and regularly check configuration and control settings. Using thermal storage to improve utilisation where heat is being dumped because of mismatched supply and demand profiles

Industrial Processes

Since industrial processes are varied they are not covered in this guide. You should refer to Carbon Trust guidance relevant to your sector, which you can find at: www.carbontrust.co.uk/sector

A walk-around checklist can be found for each sector, which you can employ in undertaking your energy survey.

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Appendices

Instruments and tools

You can undertake a survey with minimal equipment, but you'll find it useful to have a few basics.

For energy surveys, you don't usually need traceable calibrated instruments as approximate measures are sufficient.

Some of the more expensive equipment can be hired. Before hiring look at the purchase price and decide whether hiring is cost effective. A basic kit would contain:

- A digital camera – an inexpensive compact model is adequate, but a powerful flash is recommended.
- A video camera – this can be very useful and an inexpensive PC-connectible camera can be used in many instances, as can many digital cameras.
- Digital voice recorder – useful for taking notes and recording interviews.
- Torch.
- Stopwatch.
- Pocket tape measure – a laser measure can also be useful.
- Meter cabinet keys.
- Walkie-talkie radios or mobile telephones to coordinate 'drop-tests' when one party is reading meters while another starts and stops equipment.
- A light meter – an inexpensive unit will suffice, capable of working over the 100lux-2,000lux range. Note that these meters will not be able to accurately measure LED lighting levels. Photographic light meters are not suitable.
- Smoke generator to detect air leaks and visualise air movement -alternatively, improvise with tissue paper or a child's bubble maker.
- A sling hygrometer allows you to make a spot check on wet and dry bulb air temperatures. Alternatively, use a digital relative humidity probe, especially if you need to measure the moisture contents of product.

- Non-contact thermometers can be useful to give approximate temperatures of inaccessible surfaces, or to scan for hot spots. You can hire an infra-red camera if you need to assess large areas in detail. Results of infra-red thermography must be interpreted with caution.
- Digital thermometers with type K thermocouple probes. You will need one instrument operating in the range –50°C to 200°C, ideally with 0.1°C resolution, and another for 0°C -500°C with 1°C precision. For high-temperature applications you'll need a robust probe. For lower-temperature work, a 'band' probe designed for surface measurements makes a good general-purpose instrument capable also of measuring air temperatures. Even a bare thermocouple junction can be used. Thermocouples can be left in place and read manually by connecting the instrument when required. Compensating extension cable is necessary if the probe will need to be used at a distance (on the end of a pole), for instance.
- A clip-on power meter is useful for checking lighting circuits, motor consumption and small power loads
- A portable electricity data logger can be used to measure voltage, current and power and log readings over time. They are useful in providing a check on existing metering and also to temporarily log individual areas of electricity demand that are not submetered.

  See the Carbon Trust guide Choosing a portable electricity data logger (CTV041)

  Some equipment may qualify for Enhanced Capital Allowances. See www.carbontrust.co.uk/eca for more information.
- Miniature data loggers which record temperature, relative humidity, voltage or pulses may be useful for extended tests. Pulses can be logged from a variety of sources including PIR (passive infra-red) sensors (logging occupancy levels) or even improvised temporary contacts on valve linkages and other moving equipment.
- Anemometer to measure air velocities, especially in supply and extract ducts.
- Combustion analysis kit – one instrument which ought to be calibrated against a traceable standard. Although relatively expensive, this is a good long-term investment because it enables you to detect poor combustion through regular checks. Always choose one with carbon monoxide measurement. If you're using oil or solid fuel, you will also need a smoke pump.
- Permanent metering shouldn't be overlooked as a source of data. Manually read at frequent intervals, it can provide useful profile information. Don't forget that on equipment with fixed power demands, an elapsed-hours counter will provide a rough estimate of demand.

Energy data and conversion factors

For conversion factors, refer to www.carbontrust.co.uk/conversionfactors

Related publications and tools

The Carbon Trust has a wealth of publications and online tools that can give you more help.

Factsheets

Assessing the energy use at your industrial site (CTL002)

Assessing the energy use in your building (CTL003)

Various sector-specific walk-around checklists: www.carbontrust.co.uk/sector

Automatic Meter Reading (CTL083)

Guides

An introduction to energy management (CTV045)

Energy Management (CTG054)

Making the business case for a carbon reduction project (CTV039)

Creating an awareness campaign (CTG056)

Monitoring and targeting (CTG008)

Better business guide to energy saving (CTV034)

Metering technology overview (CTV027)

Choosing a portable electricity data logger (CTV041)

Degree days for energy management (CTG004)

Tools

Energy management self-assessment tool
As an alternative to the above link, this tool can be found under the attachments tab to the left.

Project planning tool

Action plan tool

Energy analyser tool

Technology Topics

Visit www.carbontrust.co.uk/topic

Other relevant guidance

CIBSE Guide F: Energy efficiency in buildings

Guide F includes a section on energy audits and surveys, together with a model brief for a concise energy audit and survey and a model brief for a comprehensive energy audit and survey.

Visit: www.cibse.org

Example brief for an energy survey

If you're briefing a consultant to do a general energy survey the following example brief can be adapted to suit your circumstances. (It is based on the CIBSE Guide AM5 Energy Audits and Surveys, now incorporated into CIBSE Guide F)

1. Objectives

The objectives of a concise energy audit and survey are:

- to identify opportunities for reducing energy costs
- to estimate the potential savings and, where applicable, implementation costs
- to provide an audit for the site on the basis of the previous 12 months' invoiced accounts.

Methods of achieving these objectives are:

- by observations and, where applicable, analysis of how efficiently energy-consuming equipment is being used
- by considering possible improvements to energy management control.

2. Report format

A short report shall be written to outline the findings and recommendations arising from the survey. The report shall include a management summary outlining the potential energy savings available at the site. These will primarily be of the good housekeeping and low-cost type but will also indicate where further opportunities may exist. The body of the report shall contain the following sections:

- site information
- energy audit
- energy use
- energy management.

3. Scope of survey and report

The following shall be covered:

- site information
- the site, its functions and services, shall be described
- energy audit
- energy use
- energy management.

Based on data obtained from the previous 12 months' fuel invoices, a table showing annual fuel consumptions and costs shall be compiled of the site. Performance indicators against published benchmarks shall be determined and commented on.

4. Energy use

Boiler plant

Combustion efficiency, based on waste gas analyses, shall be assessed for the main boiler plant under operating conditions as found. The general condition of the boiler plant and associated pipework insulation shall be checked. Recommendations for improved energy efficiencies within the boiler house shall be based on the above analysis and observations.

Process/manufacturing equipment

Observations on:

- factors affecting consumption
- product quantity/quality
- controls
- operation.

Compressed air
Observations on:

- generation
- treatment
- distribution
- end use
- controls.

Electrical power and lighting
Observations of power and lighting systems shall be carried out to determine the following:

- the condition of lighting equipment
- any unnecessary use of lighting
- the type of existing luminaires and possible replacement by higher-efficiency lighting
- use of electric heating and its control
- the operation and loading of refrigerators and air compressors
- efficient use of large electric motors.

Recommendations to reduce energy costs shall be made on the basis of the above observations.

Ventilation/air conditioning
The settings of existing time and capacity controls shall be obtained and included in the report, together with comments on control, operation and potential energy savings.

Space heating and domestic hot water
The heating and hot water systems shall be assessed and recommendations made on:

- the heating period compared with occupancy periods
- the condition, settings and siting of existing controllers and sensors
- instantaneous temperature measurement taken during occupancy periods
- the condition of insulation on pipework, valves and flanges
- the condition and siting of heat emitters and any obstruction
- HWS temperature.

Building fabric
Observations shall be made of:

- insulation standards
- excessive air leakage into buildings due to badly fitting doors and windows.

Recommendations shall be based on the above observations.

5. Energy management

Existing energy management procedures shall be assessed, and outline recommendations shall be made for any improvements that can be made to the existing system. Consideration should be given to:

- energy policy and strategy
- management structure/responsibilities
- regulatory requirements
- training of key staff
- management information systems (MM&T)
- awareness/motivation of employees and communications
- investment strategy
- energy purchasing/procurement.

Go online to get more

The Carbon Trust provides a range of tools, services and information to help you implement energy and carbon saving measures, no matter what your level of experience.

Call us on 0800 085 2005

Our experts offer independent, authoritative advice. Lines open 8.30am-5.30pm, Monday to Friday.

Website

Visit us at www.carbontrust.co.uk for our full range of advice and services.

Publications

We have a library of publications detailing energy saving techniques for a range of sectors and technologies. www.carbontrust.co.uk/publications

Energy Saving Plan

The Carbon Trust Advice Line can work with you to highlight areas for review within your organisation and can then provide you with a structured Energy Saving Plan. Call today on 0800 0852005 and ask one of our advisors how an Energy Saving Plan could help your business save money and cut carbon.

Cut Carbon, Cut Costs

This tool gives you an introduction to energy saving and helps you create a personalised action plan for your site, estimating the cost and carbon savings you could make in your workplace. www.carbontrust.co.uk/onlinetraining

Case studies

Our case studies show that it's often easier and less expensive than you might think to bring about real change. www.carbontrust.co.uk/casestudies

Energy Efficiency Financing

Investing in energy efficient equipment makes sound business and environmental sense, especially with the easy, affordable and flexible Energy Efficiency Financing scheme brought to you by Carbon Trust Implementation and Siemens Financial Services. To find out more visit www.energyefficiencyfinancing.co.uk

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The Carbon Trust is a not-for-profit company with the mission to accelerate the move to a low carbon economy. We provide specialist support to business and the public sector to help cut carbon emissions, save energy and commercialise low carbon technologies. By stimulating low carbon action we contribute to key UK goals of lower carbon emissions, the development of low carbon businesses, increased energy security and associated jobs.

We help to cut carbon emissions now by:

- providing specialist advice and finance to help organisations cut carbon
- setting standards for carbon reduction.

We reduce potential future carbon emissions by:

- opening markets for low carbon technologies
- leading industry collaborations to commercialise technologies
- investing in early-stage low carbon companies.

www.carbontrust.co.uk
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