GPG348

Good Practice Guide

Building log books – a user's guide

"Better information for better buildings"

Guidance for facilities managers

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Contents

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Investors in FM Excellence

This guide was written by Phil Jones of Building Energy Solutions under a project managed for Action Energy by BRESEC and the Chartered Institution of Building Services Engineers (CIBSE). It is supported by CIBSE and the British Institute of Facilities Managers (BIFM).

The contributions of all those who commented on the guide is gratefully acknowledged.

Overview

Introduction

The Building Regulations* now require building log books. They will improve access to information for Facilities Managers (FMs) or others responsible for managing buildings, enabling them to improve the operation of their buildings. Specifically, they provide a place to record ongoing building energy performance, which should help improve energy efficiency.

Using log books should improve the understanding, management and operation of buildings resulting in lower running costs and reduced carbon dioxide (CO_2) emissions to the atmosphere. This should also contribute to improved occupant comfort, satisfaction and productivity.

Log books are intended to provide the building owner or occupier:

"with details of installed building services, plant and controls, their method of operation and maintenance, and other details that collectively enable energy consumption to be monitored and controlled"

The Building Regulations ADL2 (2002 Edition)

ADL2 applies to new and refurbished non domestic buildings in England & Wales

The requirements of Part L will also begin to penetrate the existing building sector as they apply when plant and equipment are upgraded/replaced

* These only apply in England & Wales, regulations will differ in Scotland and Northern Ireland

Purpose of this guide

This guide provides advice on using building log books for Facilities Managers, Building Operators and Energy Managers. It will also help maintenance staff, consultants and contractors who work in a range of buildings.

This guide describes:

- what is a log book?
- the benefits of using a log book
- how to use a log book on a day-to-day basis
- how to conduct an annual review as part of the organisation's Quality Assurance (QA) procedures
- a simple worked example of how to log energy performance compared with benchmarks
- a detailed worked example assessing the performance of each energy end-use in a large air conditioned office (see Appendix).

If you have any comments on this guide, or TM31, then Action Energy and CIBSE would welcome these.

Developing Building Log Books

This guide complements CIBSE TM31 *Building Log Books – An authors guide and standard template for non domestic buildings* which provides guidance and tools for developing log books. It comes with a template in Microsoft® Word that can be completed by the designer/author to produce a finished log book. The three example log books included with TM31 show the potential range, style and size of log books.

TM31 also includes:

- a 'small business template' for buildings less than about 200m^2
- example log books for:
  - a large air conditioned office
  - a small naturally ventilated school
  - a very small office based business using the small business log book template
- spreadsheets of the building performance tables and a meter reading pro-forma in Microsoft® Excel.

Generally, log books will be written by designers or specialist authors e.g. of Operation and Maintenance (O&M) manuals, often working in contracting organisations. Where possible, the FM should work with the author to develop a log book that specifically meets their particular needs.

Why you need a log book

Log books are a legal requirement in new buildings and in existing buildings where services are changed.

For many years, cars have been provided with user handbooks yet most buildings lack a simple and easy to understand summary of how they are meant to work. Building log books are intended to give Facilities Managers a clear and concise summary of their building, its services and intended operation. There are a number of reasons why all Facilities Managers need a log book.

The commissioning and handover stages of a contract seldom receive the time and attention they deserve, which means the FM seldom becomes conversant with the building before it is occupied.

The O&M manuals, usually a set of large documents, provide much detailed information but little on the overall design and management philosophy, leaving the FM "flying blind". To run the building effectively and efficiently the FM has to know how the building is intended to work and what maintenance requirements there are without having to assimilate all the detailed information contained in O&M manuals.

New FMs, consultants and contractors are also "flying blind" when they come in to unfamiliar buildings. The lack of a logged history often leads to decisions contrary to the original design intent. There is currently no single document where alterations to the building can be logged. Equally, there is no single document where building performance can be recorded, allowing possible excessive consumption to go unnoticed.

The building log book seeks to address these problems so that buildings, which are valuable and complex assets, can be managed more effectively and efficiently.

Benefits of using a log book

Keeping the log book up to date will provide a range of ongoing benefits:

- It will make managing the building easier
- Logging alterations to the building and plant ensures a current picture of the design philosophy is always available
- New FM's, their staff or external contractors will be fully aware of how the building is meant to work
- Improving the FM's understanding of the building will enhance building management and operation
- Building an historical record of alterations and performance should aid future management
- It will help FMs avoid inappropriate alterations that go against the design intent
- Logging energy performance against design estimates and typical benchmarks will help identify energy problems
- It provides a single place to keep key information about the building
- It links documents and information that might otherwise be dispersed elsewhere e.g. O&M manuals, record drawings etc.
- It should enhance occupant comfort, satisfaction and productivity.

The small business approach

The approach used in a very small business, (less than roughly 200m^2 floor area with say 10-15 occupants), will be similar in principle to that for larger buildings. The main difference is that the log book will be based on the small business template resulting in a much less detailed document (usually 5-10 pages). Updating the log book will require the same approach but less detail. In small businesses, logging energy performance only requires annual meter readings to give a simple performance assessment, but quarterly or monthly readings will help to identify excessive consumption quickly. This approach would apply to small offices and retail outlets typical of the local high street but can also be used in small tenancies in a much larger building.

Log books for existing buildings

Log books are a legal requirement for new and refurbished buildings and for existing buildings where significant changes have been made. When significant work is carried out on existing non domestic buildings, Part L states:

"a log book should be prepared or updated as necessary to provide the appropriate details of the replacement controlled service or fitting."

For example, where boiler replacement is undertaken then a log book would need to be prepared covering the new plant and heating system. See, 'Developing Building Log Books' on page 5. Where a log book already exists then it would simply need to be updated.

Although not required by Part L, all existing buildings would benefit from the preparation and use of a comprehensive building log book. Preparing the log book should help develop a better understanding of the design intent, improving building management. Ongoing use of the log book provides a means of recording building performance, which in turn gives the basis for action to improve energy consumption and reduce CO_2 emissions to the atmosphere.

What is a log book?

The log book should give FMs ready access to information on the design, commissioning and energy consumption of their own building. It will enable fine tuning of the building with consequent improvements in energy efficiency. The log book will also provide explicit information about the metering strategy implemented in the building, and on the scope for monitoring and benchmarking energy consumption.

As suggested earlier, the closest analogy to a building log book is the car handbook. Drivers need an easily understood overview of the car that is always readily to hand in the glove compartment. Facilities Managers need the same thing. Although buildings are more complex devices, there has never been a simple "user's handbook" to help drive the building. The building log book actually goes much further than the car handbook as it records energy performance and changes to the building, but the underlying principle is the same. The closest analogy to the O&M manual might be the detailed car workshop manual.

The log book should be an easily accessible focal-point of current information for all those working in the building. It has four main functions:

Summary of building – it is a summary of all the key information about the building including the original design, commissioning and handover details and information on its management and performance. One of the main things it will provide is a strategic understanding of how the building is meant to work i.e. the design intent. In being a summary it does not duplicate or replace the O&M manuals.

Key reference point – it is *the* single document in which key building energy information is logged and kept. It could be regarded as the hub document linking many other relevant documents. The log book should provide key references to the detail held in less accessible O&M manuals, BMS manuals and commissioning records.

Source of information/training – it provides a key source of information for anyone involved in the daily management or operation of the building and to anyone carrying out work on the building and its services. It will be relevant to new staff and external contractors/consultants and should play a role in training and induction.

Dynamic document – it is a place to log changes to the building and its operation. It is also used to log building energy performance and the results of continual fine-tuning commissioning. It is essential that it is kept up to date. Alterations should only be made with the approval of the FM and should be signed and dated by that person.

Golden rules for log books

- Keep the contents list and distinctive CIBSE style reasonably similar to the original TM31 template so it is easily recognisable to anyone working in the industry
- Keep it easy to read and use with simple explanations with minimum jargon, utilising diagrams where possible
- At handover, the log book should be between 20 and 50 pages (5-10 pages for premises less than 200m^2) in order to make it a useful and easily accessible summary
- The FM should sign the log book at handover as a recognition of taking over responsibility for the log book
- Keep the log book up to date by doing an annual review as part of the quality assurance system, particularly energy performance, maintenance and alterations to the building
- Keep the log book in a designated location, not to be removed without the FM's approval.

What should a log book look like?

The log book should be a summary document written in an easily understood style for facilities managers, building operators and non technical readers. It should not be a detailed technical document but a management tool for running the building.

Style

Retaining the distinctive CIBSE style and structure (see Developing Log Books earlier) will make it easily recognisable to anyone working in the building industry. Keeping this common 'look and feel' to the log book will ensure that any pages photocopied from it can be easily recognised. A typical contents list is shown below.

Log books should generally be ring bound or in a loose leaf binder to allow the FM to update the document easily. It is preferable to use a well labelled distinctive ring binder to make this stand out in a busy building operations room or in a small business environment.

How big should the log book be?

The size of a log book should reflect the size and complexity of the building in order to keep it a useful and easily accessible summary, see table. In all but very small premises, less than 20 pages is unlikely to include all the necessary information. Log books greater than 50 pages are unlikely to function as an easily accessible management summary. Log books will grow as updates and annual reviews are included but they should not be vastly different to these guidelines.

Links between documents

Clearly, there are direct links between the energy log book and O&M manuals, record drawings etc. The best way to view these links is to see the log book as a summary of key information from all the other relevant manuals etc. The log book should have clear references to key parts of the O&M manuals and any key record drawings.

Some building services equipment manufacturers (e.g. boilers) include 'equipment' log books when supplying their products. These equipment log books may be regarded as a sub set of the overall building log book with clear references between the two. The building log book may show a list of equipment log books and their location, where they exist.

Typical contents list of a log book

1. Updates and annual reviews
2. Purpose & responsibilities
3. Links to other key documents
4. Main contacts
5. Commissioning, handover & compliance
6. Overall building design
7. Summary of areas/occupancy
8. Summary of main building services plant
9. Overview of controls/BMS
10. Occupant information
11. Metering, monitoring & targeting strategy
12. Building energy performance records
13. Maintenance review
14. Major alterations
15. Results of in-use investigations

APPENDIX – Relevant certificates/tests

Building size (Floor areas are rough guides)	**Likely size of log book (at handover)**
Very small business/tenancy <200m² (roughly 15-20 occupants)	5-10 pages
Small to medium/simple building 200 – 2,000m²	20-35 pages
Large/complex building >2,000m²	35-50 pages

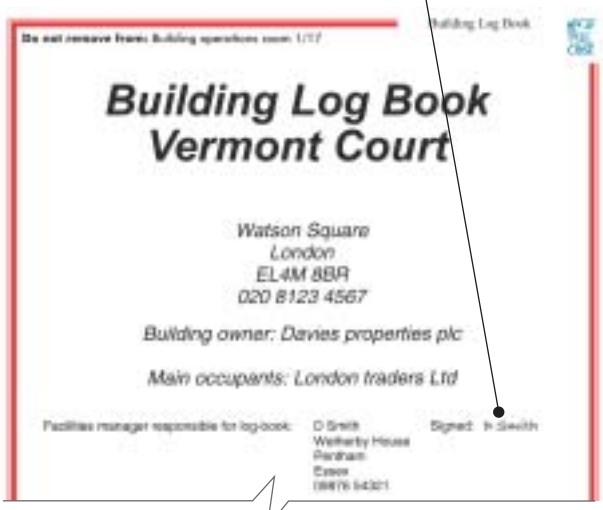
Using your log book

At handover

The log book should be a key document provided to the FM at building handover. Where changes are made to the building or its services during the defects liability period then the log book should be updated, see page 16. Updating the log book during this period would usually be the designer's responsibility although this will depend on the specific contractual arrangements. Prior to handover, the FM should be trained by the design team and contractor in how to use the building log book to:

- educate the FM staff and consultants/contractors as to how the building is meant to operate
- run and manage the building to its maximum potential
- log significant changes made to the building/plant
- use the metering strategy to monitor energy performance
- educate the building occupants on how to use their space and the reasons for not leaving windows open etc.

The Facilities Manager signs the log book at initial handover or when taking over from a predecessor



Log book front cover

Taking responsibility

At handover, the FM should take responsibility for the log book and should sign it in recognition of this. A change in FM should result in a formal handover, the log book being signed by the new incumbent.

In a tenanted building, the landlord is ultimately responsible for the log book. However, under the lease agreement the landlord may assign this to the tenant or managing agent. This will depend upon the terms of the lease e.g. whether the landlord is running central plant or not. In multi tenanted buildings, sub log books will be required for each significant tenancy, see page 12. Again, keeping the log book up to date could be written in to the tenancy agreement.

Key FM responsibilities for log books

1. To ensure that the log book is correct and up to date at handover or when passing it on to any successor
2. To ensure that the log book is kept up to date on an ongoing basis including any changes to the building fabric, services, operation or management
3. To ensure that building maintenance and energy performance is logged
4. To ensure that all those working in the building are made aware of relevant information contained in the log book
5. To ensure that the log book is kept in its designated location at all times.

Who has access?

Clearly, all building operations staff should have reasonably direct access to the log book. There may also be other staff in the building that need sight of the information. However, for reasons of security, not everybody should be allowed direct access to the log book. The FM should be the ultimate authority as to who can have access. The FM should always ensure that they know who is accessing the information and why.

Only the FM should be allowed to formally maintain, alter and update the log book. Each change should be signed and dated by the FM to ensure a clear historical record of the building. The FM may decide to ask others to provide the information e.g. develop diagrams or energy figures, but there must be an authorising signature before this goes into the log book.

How many copies?

The FM should keep one single paper copy for rapid access. This would act as the day-to-day master for easy reference and minor updating etc. However, it is anticipated that most organisations will also keep an electronic version that can be easily updated, see 'Keeping it up to date' later. Each new version of the electronic copy of the log book should be clearly dated and kept in a designated folder on the FM's PC or server. It is essential that an electronic back-up copy is kept in a separate place for recovery in the event of emergencies.

Where should the log book be kept?

The master paper copy of the log book should always be kept in a designated location, preferably on the FM's desk in the building operations room. The designated location should be identified and highlighted with a clear sign. This should indicate that it is not to be removed without the authority of the FM.

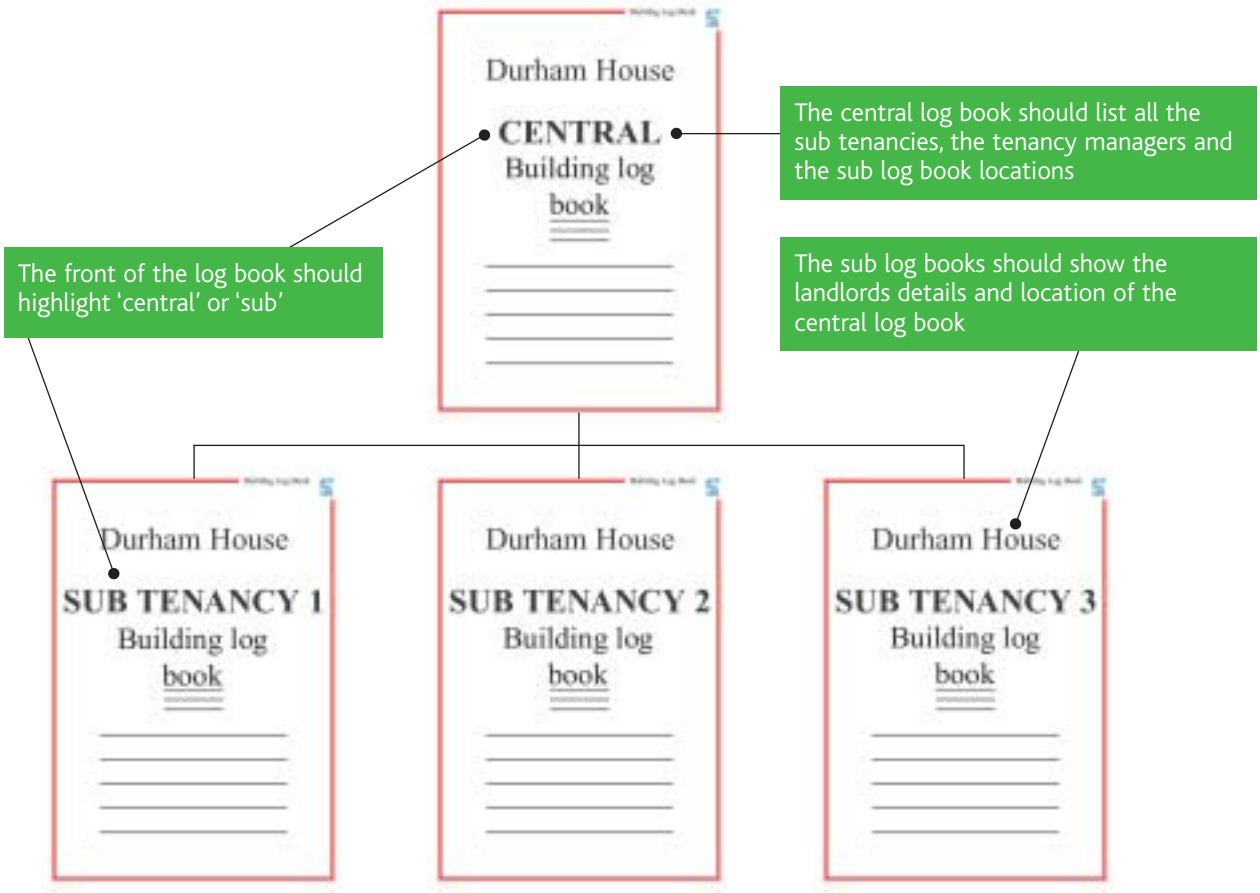
LOCATION
This log book is to be kept at all times in:
Room name/No & designated location in that room

Log book front cover

ELECTRONIC COPY
An electronic copy is kept at:
Server/PC, directory name & file name

Use in multiple tenancies

A multi tenanted building may well need a central log book to be kept by the landlord or the agent responsible for landlord services with 'sub' log books for each tenancy. The tenants should be responsible for their individual sub log books as they need to log their energy performance etc. The management responsibilities of the landlord and tenants should be clearly set out in the tenancy agreements and in both the central and sub log books. Where tenancies are relatively small (e.g. less than 200m^2) then the log books can be relatively simple, based on the small business template.



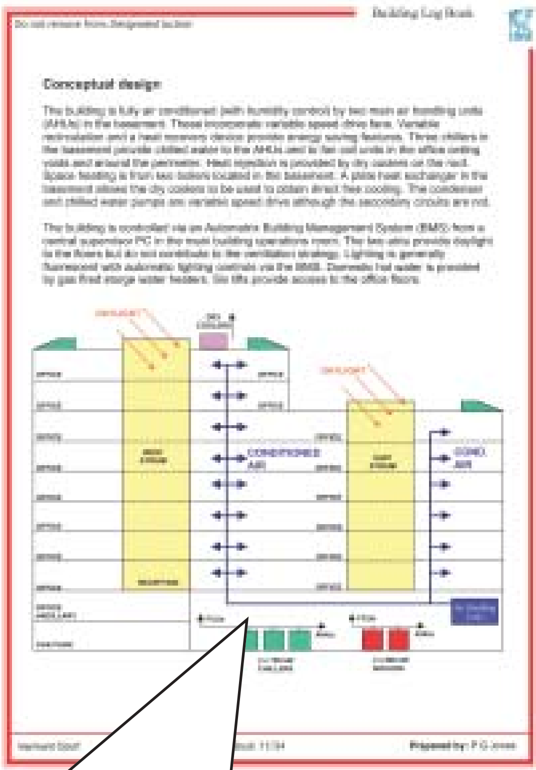

Multiple log books
for mulitple tenancies

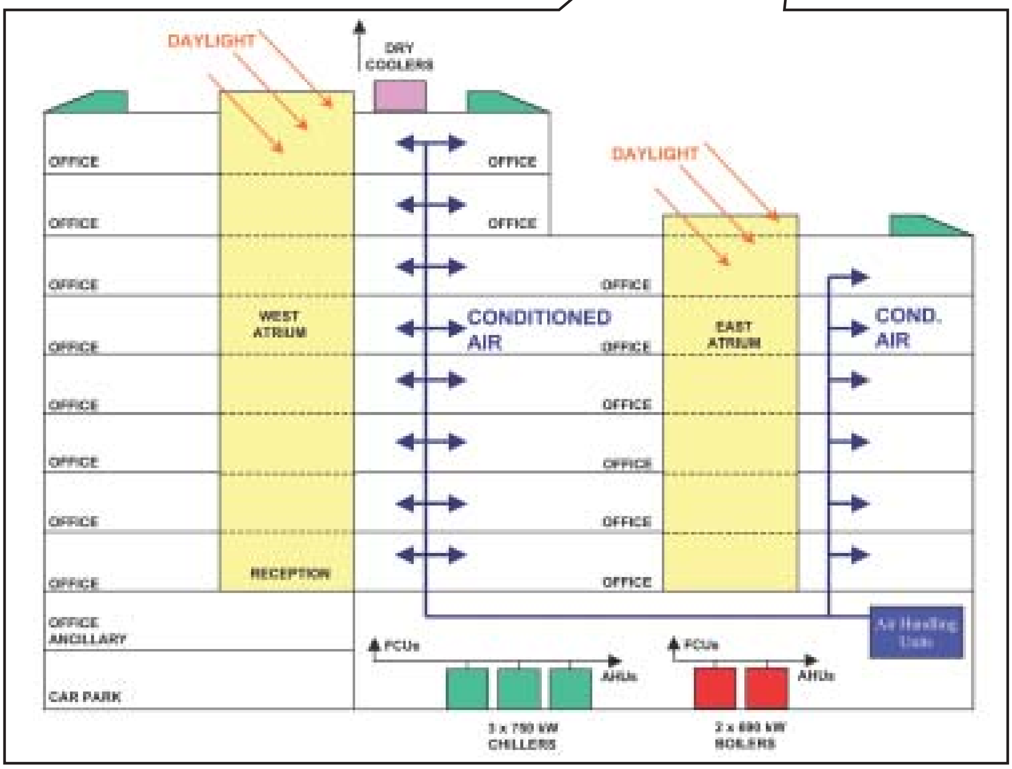
Using the information in log books

Understanding the building

A key aspect of using the log book is to ensure that everybody working in the building understands the basic design philosophy. This is usually expressed in one or two diagrams plus some brief explanatory text, as shown opposite (example based on the building described in the appendix). It is immediately obvious that it is an 8 storey air conditioned office with central boilers/chillers in the basement and daylight contributed via two atria. A full example log book for this building is provided with CIBSE TM31.

This section of the log book should also show any special design features, energy saving features, key interactions between services and any limitations to the design. The FM has a key role in passing on this strategic understanding to operational and maintenance staff in the building. This should avoid inappropriate changes being made to the building or plant that may contradict the design intent.





Overall Building Design

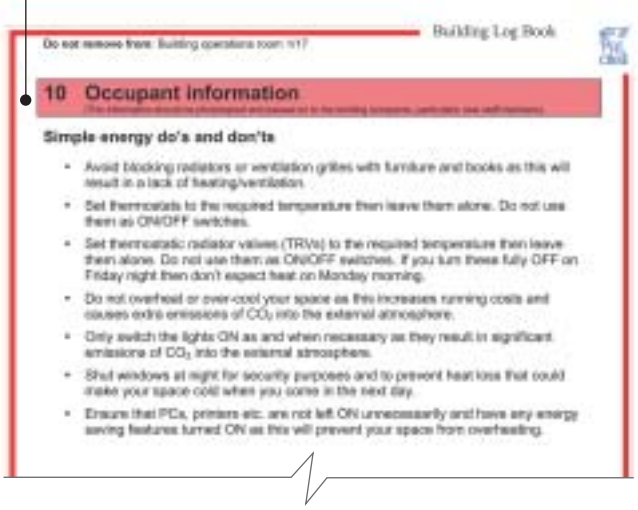
This building overview is followed by more detailed information showing:

- an overview of occupancy and activities in each different zone
- a breakdown of floor areas by each different type of area/activity
- a list of separately managed areas e.g. restaurants, conference suites or leisure facilities
- simple floor plans indicating key areas, plant rooms and incoming meters
- a list of the largest energy using plant in the building
- 'System Sheets' that provide a simple overview of each main system in the building e.g. electricity distribution, space heating, cooling, ventilation etc.
- an overview of the main control systems, in particular the Building Management System (BMS) showing what the system covers and how to navigate around it.

The FM should use this information to ensure that the building is operating to its maximum potential.

Occupant information

The FM should pass this information to the building occupants to explain how to use and control their own space


Building Log Book

10 Occupant information

Simple energy do's and don'ts

- Avoid blocking radiators or ventilation grilles with furniture and books as this will result in a lack of heating/ventilation.
- Set thermostats to the required temperature then leave them alone. Do not use them as ON/OFF switches.
- Set thermostatic radiator valves (TRVs) to the required temperature then leave them alone. Do not use them as ON/OFF switches. If you turn these fully OFF on Friday night then don't expect heat on Monday morning.
- Do not overheat or over-cool your space as this increases running costs and causes extra emissions of CO_2 into the external atmosphere.
- Only switch the lights ON as and when necessary as they result in significant emissions of CO_2 into the external atmosphere.
- Shut windows at night for security purposes and to prevent heat loss that could make your space cold when you come in the next day.
- Ensure that PCs, printers etc. are not left ON unnecessarily and have any energy saving features turned ON as this will prevent your space from overheating.

***Section 10** of the Log Book – occupant information*

ENSURE STAFF AWARENESS

- display occupant information in separately managed areas e.g. restaurants, kitchens, conference suites etc.
- display occupant information in areas atypical of the main building e.g. leisure/swimming facilities in hotels

ENSURE PUBLIC AWARENESS

- display occupant information in public areas e.g. hotel bedrooms, meeting rooms

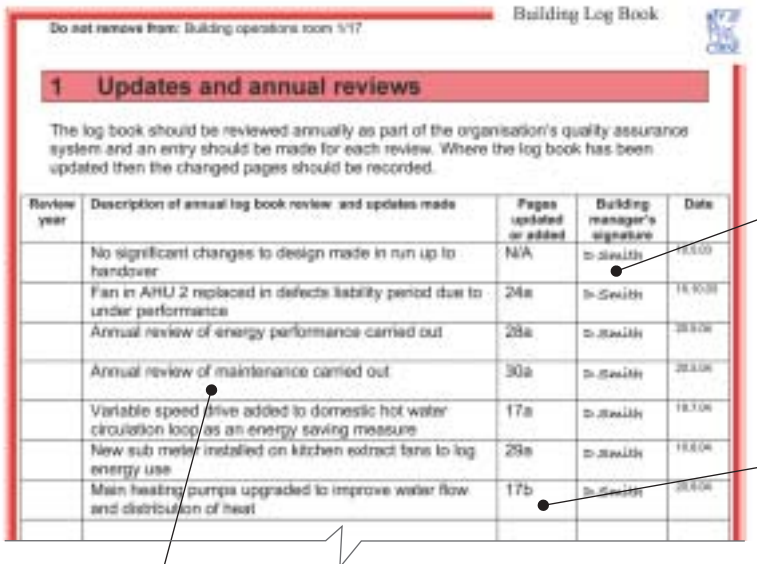
Keeping it up to date – the annual review

Although there is no legal requirement to use log books, to get the full benefit from them they should be reviewed annually by the FM as part of the organisation's QA procedures. This annual review should act as a trigger to ensure that the log book is fully up to date and that the annual energy assessment has been carried out. The QA procedures should ensure that annotations made to the paper log book get transferred into the electronic version.

The review should consider all aspects of the building:

- architectural
- building services controls
- occupancy and use
- building management
- maintenance
- energy performance.

Where necessary, the log book should be updated using the electronic copy and the FM should record these changes in the review summary in section 1 of the document, as shown below. Energy and maintenance performance pages will need to be added annually, see later for examples. Where a page has been updated/added then this should be numbered 13a, 15a etc. FMs should retain paper and electronic copies of those pages that have been updated in order to keep a clear building history. Old pages should be marked "SUPERSEDED".



Building Log Book

Do not remove from: Building operations room 1/17

1 Updates and annual reviews

The log book should be reviewed annually as part of the organisation's quality assurance system and an entry should be made for each review. Where the log book has been updated then the changed pages should be recorded.

Review year	Description of annual log book review and updates made	Pages updated or added	Building manager's signature	Date
	No significant changes to design made in run up to handover	N/A	D Smith	
	Fan in AHU 2 replaced in defects liability period due to under performance	24a	D Smith	
	Annual review of energy performance carried out	28a	D Smith	
	Annual review of maintenance carried out	30a	D Smith	
	Variable speed drive added to domestic hot water circulation loop as an energy saving measure	17a	D Smith	
	New sub meter installed on kitchen extract fans to log energy use	29a	D Smith	
	Main heating pumps upgraded to improve water flow and distribution of heat	17b	D Smith	

The Facilities Manager (FM) must approve any changes made to the log book

Updated pages must have a new separate number to show a progressive history

Any changes to the log book must be logged including annual reviews of energy and maintenance

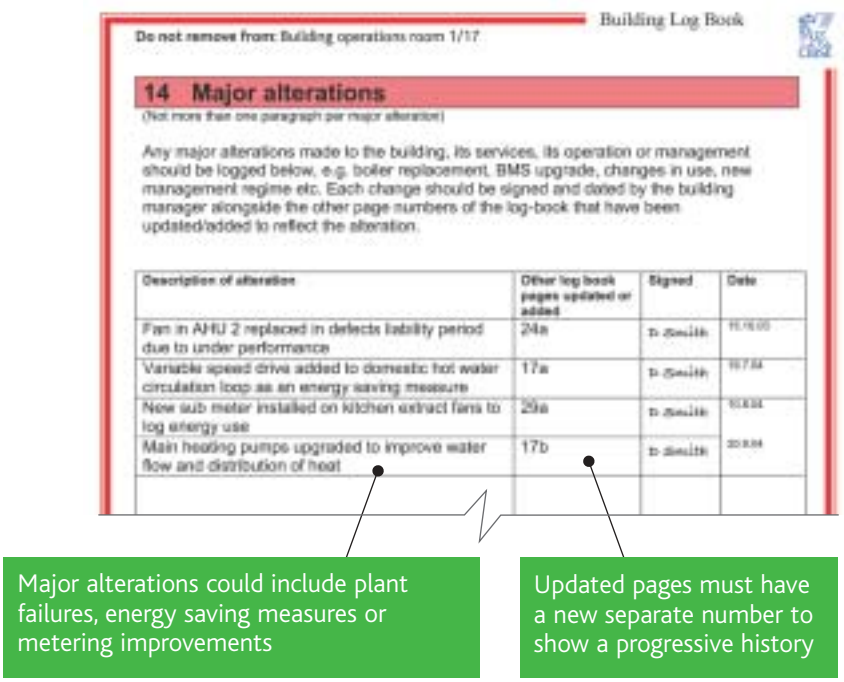
***Section 1** of the Log Book – updating the log book*

Updating for building/ plant alterations

When the building has undergone significant alterations then this should be recorded in section 14 of the log book. Changes might be physical alterations to the building fabric or building services but should also include changes to controls, occupancy, building use, building management and maintenance. This ensures that the log book holds a current picture of all aspects that affect the operation of the building, particularly energy consumption.

In multi tenanted buildings, information should be exchanged between the tenants and landlord about any significant changes to the building, its services or to individual tenancies. The annual quality assurance review(s) carried out by the landlord and tenants should trigger this exchange of information.

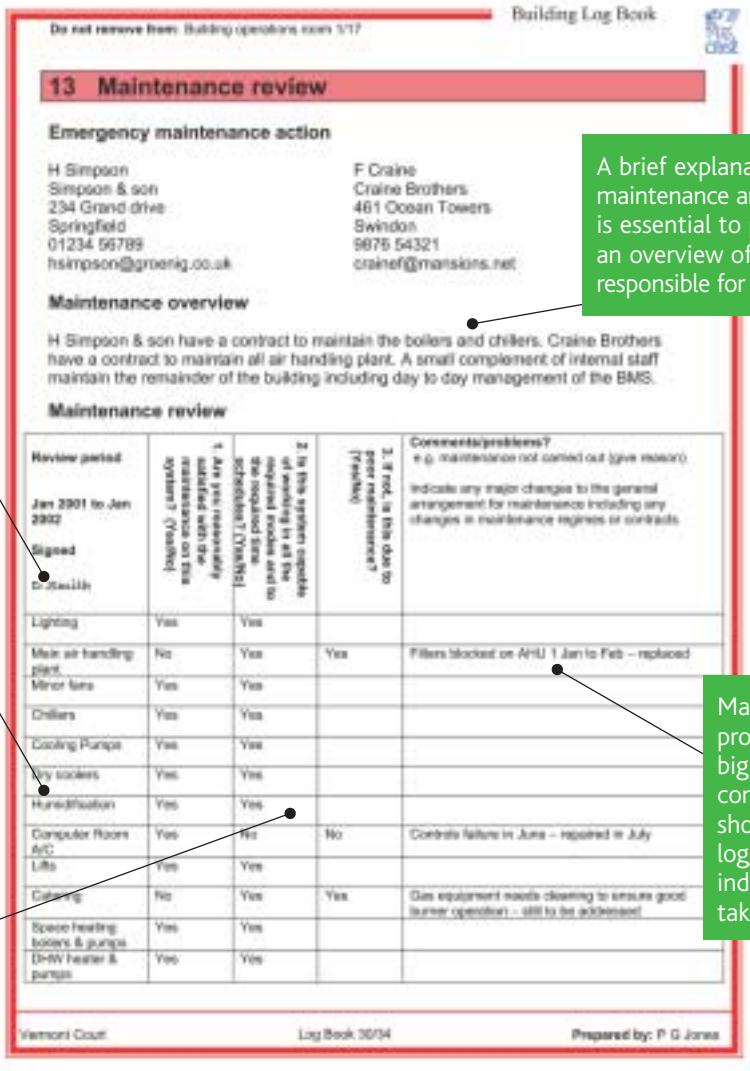
Where staff movement (office churn) has a significant effect on the operation and management of the building then a summary of this might be recorded as a change to the building in section 14 of the log book.



***Section 14** of the Log Book – major alterations*

Logging maintenance

High energy consumption is often a result of maintenance problems. A review of maintenance should therefore be carried out at least annually, and preferably quarterly, with a view to highlighting problems. Even problems that have already been actioned throughout the period should be logged as a record of maintenance difficulties so that these can be compared to energy demands i.e. to show how fan consumption increased when filters were blocked, then fell again once the correct maintenance regime was in place.



Building Log Book

13 Maintenance review

Emergency maintenance action

H Simpson
Simpson & son
234 Grand drive
Springfield
01234 56789
hsimpson@groenig.co.uk

F Craine
Craine Brothers
461 Ocean Towers
Swindon
9876 54321
crainef@mansions.net

Maintenance overview

H Simpson & son have a contract to maintain the boilers and chillers. Craine Brothers have a contract to maintain all air handling plant. A small complement of internal staff maintain the remainder of the building including day to day management of the BMS.

Maintenance review

Review period Jan 2001 to Jan 2002 Signed D Smith	1. Are you reasonably satisfied with the maintenance on this system? (Yes/No)	2. Is this system capable of working in all the required modes and to the required time schedules? (Yes/No)	3. If not, is this due to poor maintenance? (Yes/No)	Comments/problems? e.g. maintenance not carried out (give reason) Indicate any major changes to the general arrangement for maintenance including any changes in maintenance regimes or contracts
Lighting	Yes	Yes		
Main air handling plant	No	Yes	Yes	Filters blocked on AHU 1 Jan to Feb – replaced
Minor fans	Yes	Yes		
Chillers	Yes	Yes		
Cooling Pumps	Yes	Yes		
Dry coolers	Yes	Yes		
Humidification	Yes	Yes		
Computer Room A/C	Yes	No	No	Controls failure in June – repaired in July
Lifts	Yes	Yes		
Catering	No	Yes	Yes	Gas equipment needs cleaning to ensure good burner operation – still to be addressed
Space heating boilers & pumps	Yes	Yes		
DHW heater & pumps	Yes	Yes		

Vermont Court | Log Book 30/04 | Prepared by: P G Jones

A brief explanation of maintenance arrangements is essential to provide an overview of who is responsible for what plant

The annual maintenance review should be signed by the Facilities Manager to indicate satisfaction and problems

All the main energy using plant should be listed here whether it is on a maintenance contract or not

Maintenance problems can have a big effect on energy consumption and should therefore be logged with an indication of action taken

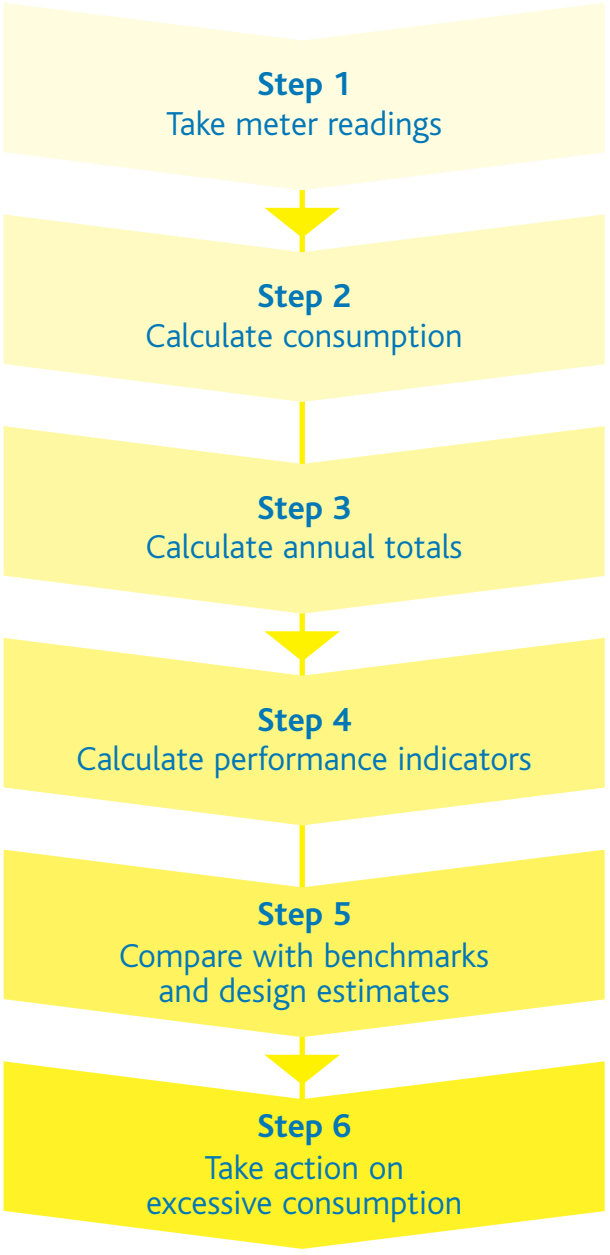
This review should be part of the organisation's quality assurance scheme. Senior management may assess the entries if there are continuous problems

***Section 13** of the Log Book – maintenance review*

Logging overall energy performance

As part of the annual review, the FM should ensure that energy performance is recorded and compared with good practice benchmarks and the designers estimates of what the building should consume. Regular main and sub meter readings should be recorded on the meter reading pro-forma set up by the log book author, see examples later. This allows consumption in kilowatt hours (kWh) to be calculated and totalled to give the energy consumptions of the main end-uses. Overall performance and end-use performance can then be plotted over time, compared to benchmarks and design estimates.

The FM should follow the basic step-by-step approach shown here. This can be followed in the examples shown later in this guide. The first (see next page) shows how to assess overall building performance (in kg $CO_2/m^2/yr$) of a relatively simple building. The second is a very detailed example showing how to use the sub metering required by Part L to assess the energy performance of each end-use e.g. lighting, fans etc.



"If you can't measure it then you can't manage it!"

CIBSE Guide F – Energy Efficiency In Buildings

Step by step approach

Step 1: Take meter readings

The procedures for monitoring building energy performance are underpinned by setting up an easy to use meter reading pro-forma. Once the metering strategy and schedule have been determined, the building designer should provide a meter reading pro-forma, as shown below and in the appendix. All the meters in the metering strategy should be included with the meter name and code at the top of two columns for meter readings and consumption in kWh. A template version of the meter reading pro-forma is provided on the CD ROM associated with TM31.

This tailored meter reading pro-forma allows regular main and sub meter readings to be recorded and kept in a separate file (not in the log book). Check that your meters read kilowatt hours (kWh), otherwise use an appropiate conversion factor to get kWh, see CIBSE Guide F or look on your utility invoice for factors. Monthly readings may be appropriate in many larger buildings whereas quarterly readings may be acceptable in smaller buildings. It may be possible to automatically download this information from a BMS or automatic meter reading system.

Consumption in kWh can then be calculated and totalled to reach the main consumptions. The consumptions can then be compared to typical and good practice benchmarks available from Action Energy or CIBSE Guide F.

STEP 1 – Take meter readings
Try and take readings over regular periods to allow comparisons e.g. monthly, quarterly etc.

STEP 2 – Calculate consumptions
Subtract previous meter reading to get kWh consumption over that period

Indicate the meter code e.g. EM_1 GM_1 etc. and what is being measured

Year	2003	EM_1 Main electricty meter		GM_1 Main gas meter	
Date	Time	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)
4.1.02	15:30	102,356		476,890	
4.2.02	11:00	136,876	34,520	630,790	15,3900
4.3.02	10:30	169,096	32,220	775,490	144,700
5.4.02	13:30	196,186	27,090	862,810	87,320
4.5.02	15:00	235,166	38,980	936,710	73,900
4.6.02	16:00	262,486	27,320	988,810	52,100
3.7.02	9:40	291,476	28,990	1,022,210	33,400
4.8.02	10:15	315,526	24,050	1,048,110	25,900
4.9.02	12:30	338,746	23,220	1,096,810	48,700
4.10.02	15:45	365,526	26,780	1,178,150	81,340
5.11.02	16:15	398,286	32,760	1,283,850	105,700
4.12.02	7:12	433,606	35,320	1,417,450	133,600
4.1.03	9:00	471,596	37,990	1,580,850	163,400
		ANNUAL TOTAL	369,240		1,103,960

Make a pro-rata adjustment if the beginning/end of year readings do not cover a 12 month period

STEP 3 – Calculate annual totals
Calculate the total annual consumption in kWh

Keep electricity and fossil fuel consumption separate as they have different costs and CO_2 emissions

Step 2: Calculate consumptions

Subtract the previous meter reading from the present reading to get kWh consumption over that period. Taking readings over regular periods will allow monthly or quarterly comparisons.

Where there are 'virtual meters' involved then additional calculations will be necessary and these should be specified on the metering strategy, as shown in the detailed example in the appendix.

Step 3: Calculate annual totals

Ensure that actual consumption figures on main incoming meters do not include estimated bills and ensure consumption relates to a full exact 12 month period (If not then record actual and adjust by the number of days missing/extra).

Step 4: Calculate performance indicators

Divide consumption by the building floor area to reach a simple performance indicator in kWh/m²/yr. Use the total internal gross floor area shown in section 7 of the log book. It is possible to use treated or net lettable floor area but ensure that a consistent approach is used throughout.

Step 5: Compare with benchmarks and design estimates

Make a direct comparison with the benchmarks and design estimates included in the metering strategy by the designer. Any excessive consumption should be investigated immediately. Information on benchmarks for different building types and guidance on their use is available from Action Energy (see page 22). The example shows a building worse than the overall benchmarks and the design estimates. It is poor on both electricity and gas consumption so both lighting and space heating need to be investigated although electricity is worse than gas.

Step 6: Take action on excessive consumption

The above procedure will not save energy, it is the action taken as a result of identifying excessive consumption that saves energy. Action should be rapid in order to stem energy wastage.

Log the annual consumption in kWh

Multiply by CO_2 factor This shows how many kilograms of CO_2 are emitted when one kWh of each fuel is used

Divide by floor area

Compare with benchmarks Actual performance indicators versus those estimated by the designers versus good practice benchmarks, where available

Building energy performance for period from Jan 2001 to Jan 2002

Based on a gross floor area of 2,000m²

Fuel	KWh (A)	CO_2 ratio kg CO_2/kWh (B)	kg CO_2 (C)	Actual kg CO_2/m² (D)	Design estimates kg CO_2/m² (E)	Good practice benchmark kg CO_2/m² (F)
Electricity	369,240	0.43*	158,773	79.4	61.2	55.3
Gas	1,103,960	0.19	209,752	104.9	89.0	85.7
Total				**184.3**	**150.2**	**141**

Keep electricity and fossil fuel separate as it helps identify where the energy problems might lie. In this case, electricity is 30% above the designers estimates, possibly indicating excessive consumption by lighting or small power

If you want one single indicator of performance then use kg CO_2/m²

Multiply column (A) by column (B) to get (C) then divide by total gross internal floor area to get (D) for comparison with benchmarks in columns (E & F). One overall performance indicator can be established by totalling column (D). Avoid adding column (A) as the fuels have different costs and CO_2 factors. The designer/author should have completed column (E & F). It is important to use the correct conversion factors in column (B) in relation to the fuels used. These will be shown in the log book but electricity factors (*) do change due to alterations in the mix of generation plant. Where appropriate, the log book should take account of any CHP and list any renewable sources and the effect they have.

Other sources of information

Further reading

Building Log Books – An authors guide and standard template for non domestic buildings CIBSE Technical Memorandum TM31 (CIBSE) (2003)

The Building Regulations Part L: Conservation of Fuel and Power Approved Document ADL2 (London: Stationery Office) (2002)

Energy Efficiency In Buildings, CIBSE Guide F (CIBSE) (2003)

Royal Commission on Environmental Pollution, Twenty Second Report, Energy – the changing climate (June 2000)

Energy White Paper – Our energy future – creating a low carbon economy (HMSO) (2003)

Special Issue on Post Occupancy Evaluation, Building Research and Information 29(2) (March – April 2001)

Bordass W T, Flying Blind – Everything you always wanted to know about energy in commercial buildings but were afraid to ask (Association for the Conservation of Energy) (2001)

The CDM Regulations Health & Safety File, BSRIA AG 7/97 (Building Services Research and Information Association) (1997)

Pearson C, Feedback from facilities management BSRIA TR 2/2003 (Building Services Research and Information Association) (2003)

Energy Assessments and Reporting Methodology – Office Assessment Method CIBSE TM22 (CIBSE) (1999)

Action Energy publications

For information on benchmarking, energy management, metering etc. visit the Action Energy website at www.actionenergy.org.uk or call the helpline on 0800 58 57 94. Relevant publications include:

ECG019 – Energy use in offices

GPG310 – Degree days for energy management – a practical introduction

GIL065 – Metering energy use in new non domestic buildings

Useful websites

Action Energy
www.actionenergy.org.uk

Chartered Institution of Building Services Engineers (CIBSE)
www.cibse.org

The Energy Saving Trust (EST)
www.est.org.uk

Enhanced Capital Allowances Scheme
www.eca.gov.uk

Carbon Trust
www.thecarbontrust.co.uk

British Institute of Facilities Managers (BIFM)
www.bifm.org.uk

Energy Systems Trade Association (ESTA)
www.esta.org.uk

Building Regulations (Approved Documents and FAQs)
www.safety.odpm.gov.uk/bregs

Health and Safety Executive
www.hse.gov.uk

Appendix – Logging energy performance in more detail

Appendix – Logging energy performance in more detail

The following example is based on a large air conditioned office, the same building shown in the example log books that come with CIBSE TM31. This example takes the reader through the whole process of end-use benchmarking based on sub metered energy consumptions. This allows the FM to determine where/how the energy is being used in the building and what main end-uses are excessively high. CIBSE TM22 gives further guidance and benchmarks for assessing building energy performance.

The example building

Vermont Court is an 8 storey prestige air conditioned office with a steel framework lightweight concrete structure with stone cladding. Two atria on the west and east sides of a central office space provide daylight to the floors.

There are three service cores running up the building. Core 2 contains a bank of 6 passenger lifts. The building has two basement levels, the lower provides service area for the offices, plant rooms, storage areas and car parking for 20 cars. The building is fully air conditioned (with humidity control) by two main air handling units (AHUs) in the basement. Three chillers in the basement provide chilled water to the AHUs and to fan coil units in the offices. Heat rejection is provided by dry coolers on the roof. Space heating is provided by boilers in the basement and domestic hot water is via separate gas fired storage water heaters. The main energy consuming plant is shown below in an extract from the log book.


Building Log Book

8 Summary of main building services plant

Main plant	Location	Input (kW)	Output (kW)
VENTILATION			
AHU1 Supply Fan	Basement Plantroom	55	
AHU1 Extract Fan	Basement Plantroom	30	
AHU2 Supply Fan	Basement Plantroom	55	
AHU2 Extract Fan	Basement Plantroom	30	
Smoke Extract Fans F 13 & 14	Level 6 Roof	0.5	
Smoke Extract Fans F 15 & 16	Level 6 Roof	0.5	
Smoke Extract Fans F 17 & 18	Level 6 Roof	0.5	
Smoke Extract Fans F 19 & 20	Level 8 Roof	0.5	
AHU3 Supply Fan	Basement South East	5	
Basement Extract Fans F 11&12	Basement Plantroom	5	
AHU4 Supply Fan	Basement South East	3	
Basement Extract Fans F 23&24	Basement Plantroom	3	
Atrium Smoke Extract Fans SF 01 & 02	Level 8 Roof Plant Area	22	
Atrium Smoke Extract Fans SF 03 & 04	Level 6 Roof Plant Area	22	
Atrium Extract Fan F 21	Level 6 Roof Plant Area	3	
Atrium Extract Fan F 22	Level 6 Roof Plant Area	3	
Plantroom Extract Fans F 02&03	AHU1,2 Basement Plantroom	3	
Toilet Extract Fan F 10	Level 8 Roof	5	
Car Park/Loading Bay Extract Fans F 08 & 09	Basement	30	
COOLING			
Water Cooled Chillers	Basement Chiller Room	3 x 258	3 x 758
Packaged Dry Coolers Fans 01 to 06	Roof Level	5 kW x 10	
Condenser Water Pump (P 05 & 06)	Basement Pump Room	2 x 45 (N&S)	
Chilled Water Primary Pumps (P01 & 02)	Basement Pump Room	2 x 20 (N&S)	
Chilled Water Secondary Pumps (P 03 & 04)	Basement Pump Room	2 x 33 (N&S)	
LTHW SPACE HEATING			
LTHW Boilers B1 & B2	Basement Boiler Room		2 x 680
LTHW Pumps LTHW P-1A & 1B	Basement Pump Room	7	
LTHW Pumps LTHW P-2A & 2B	Basement Pump Room	7	
LIFTS			
6 passenger lift motors	Lift Motor Rooms A & B	6 x 10	
Goods lift motor	Goods Lift Motor Room	8	

Vermont Court | Log Book 15/04 | Prepared by: P G Jones

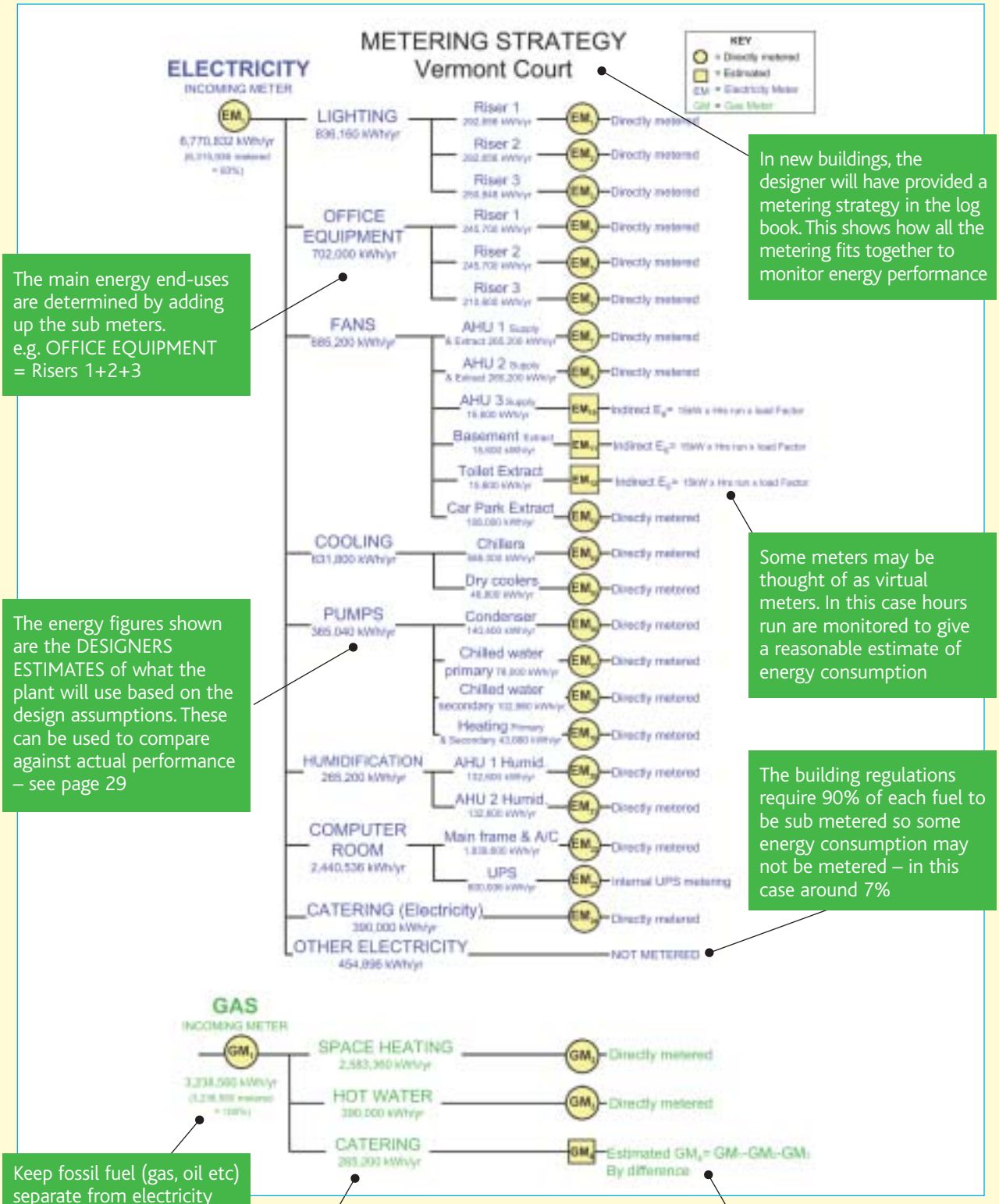
The plant summary shows all the main energy using equipment above a certain size - in this case 3 kW

The designer has used these values to estimate what the building energy consumption will be

***Section 8** of the Log Book – the plant schedule*

The metering strategy

The following metering strategy is taken from the log book and shows how all the sub meters fit together to allow performance to be monitored. The energy figures are the designer's estimates of what the plant is likely to use.



In new buildings, the designer will have provided a metering strategy in the log book. This shows how all the metering fits together to monitor energy performance

The main energy end-uses are determined by adding up the sub meters. e.g. OFFICE EQUIPMENT = Risers 1+2+3

Some meters may be thought of as virtual meters. In this case hours run are monitored to give a reasonable estimate of energy consumption

The energy figures shown are the DESIGNERS ESTIMATES of what the plant will use based on the design assumptions. These can be used to compare against actual performance – see page 29

The building regulations require 90% of each fuel to be sub metered so some energy consumption may not be metered – in this case around 7%

Keep fossil fuel (gas, oil etc) separate from electricity

In this case all three main gas end-uses are essentially sub metered

Some meters may be thought of as virtual meters. In this case catering gas is estimated by difference. Be careful about the accuracy of this approach

Meter readings

The step-by-step approach shown earlier can also be used to assess end-use performance. This begins by taking sub meter readings and determining annual consumption through each meter. The tailored meter reading pro-formas shown below were provided with the log book by the designer/author and show all 23 electricity sub meters in the building. Check that your meters read kWh, otherwise use an appropriate conversion factor to get kWh, see CIBSE Guide F or look on your utility invoice for factors.

STEP 1 – Take meter readings
Try and take readings over regular periods to allow comparisons e.g. monthly, quarterly etc.

STEP 2 – Calculate consumptions
Subtract previous meter reading to get kWh consumption over that period

ELECTRICITY METER READINGS

Year	2002	EM_1 Main electricity meter		EM_2 Lighting Riser 1		EM_3 Lighting Riser 2		EM_4 Lighting Riser 3	
Date	Time	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)
4.1.02	15:30	2,635,572		226,724		373,345		132,525	
4.2.02	11:00	3,256,147	620,576	258,323	31,599	408,888	35,543	163,987	31,462
4.3.02	10:30	3,870,326	614,178	287,049	28,727	441,200	32,312	192,588	28,602
5.11.02	16:15	9,084,442	614,178	511,691	26,428	693,881	29,727	416,253	26,314
4.12.02	8:15	9,705,018	620,576	540,418	28,727	726,194	32,312	444,855	28,602
4.1.03	9:00	10,312,799	607,780	571,443	31,025	761,091	34,897	475,745	30,890
ANNUAL TOTAL			7,677,227		344,719		387,746		343,220

Electricity meter readings continued on next page

STEP 3 – Calculate annual totals
Calculate the total annual consumption in kWh for each sub meter

There are 23 sub meters measuring electricity in this building, each has a unique code and name describing what is measured

Space heating falls to zero in summer whereas hot water and catering are more steady demands

There are three physical gas meters in this building, one is the main incoming gas meter

GM_4 (catering gas) can be thought of as a virtual meter – consumption is estimated by subtraction

GAS METER READINGS

Year	2002	GM_1 Main Das Meter		GM_2 Space Heating Boilers		GM_3 Domestic Hot Water		GM_4 Estimated Catering Gas = GM_1-GM_2-GM_3
Date	Time	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Consumption (KWh)
4.1.02	15:30	2,155,378		2,021,106		187,334		
4.2.02	11:00	2,723,986	568,608	2,526,416	505,310	226,450	39,116	24,181
4.3.02	10:30	3,113,228	389,242	2,854,867	328,452	264,018	37,567	23,223
5.4.02	13:30	3,400,781	287,554	3,082,257	227,390	301,198	37,180	22,984
4.5.02	15:00	3,614,418	213,637	3,233,850	151,593	339,539	38,342	23,702
4.6.02	16:00	3,754,766	140,347	3,309,646	75,797	379,430	39,891	24,660
3.7.02	9:45	3,817,437	62,671	3,309,646	0	418,160	38,729	23,942
4.8.02	10:15	3,883,241	65,804	3,309,646	0	458,825	40,666	25,139
4.9.02	12:30	3,947,792	64,551	3,309,646	0	498,716	39,891	24,660
4.10.02	15:45	4,202,295	254,503	3,499,138	189,491	538,995	40,278	24,733
5.11.02	16:15	4,618,682	416,388	3,852,855	353,717	577,724	38,729	23,942
4.12.02	8:15	5,158,891	540,209	4,332,899	480,045	614,904	37,180	22,984
4.1.03	9:00	5,939,288	780,397	5,052,966	720,067	652,084	37,180	23,150
ANNUAL TOTAL			3,783,910		3,031,860		464,750	287,300

Gas meter readings

Meter readings continued

ELECTRICITY METER READINGS

EM_5 Small Power Riser 1		EM_6 Small Power Riser 2		EM_7 Small Power Riser 3		EM_8 AHU 1 Supply & Extract Fans		EM_9 AHU 2 Supply & Extract Fans	
Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)
109,151		120,220		131,275		146,081		134,291	
134,201	25,050	148,306	28,086	154,048	22,773	172,046	25,965	158,401	24,110
357,829	22,773	399,041	25,533	357,346	20,703	427,835	25,708	395,920	23,871
382,424	24,595	426,617	27,576	379,705	22,359	454,571	26,736	420,746	24,826
	273,273		**306,397**		**248,430**		**308,490**		**286,455**

Electricity meter readings *continued below*

ELECTRICITY METER READINGS

EM_{10} AHU 3 Supply Fan		EM_{11} Basement Extract Fans		EM_{12} Toilet Extract Fan		EM_{13} Car Park Extract Fans		EM_{14} Chillers	
Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)
18,182		19,397		24,761		122,419		127,332	
19,851	1,669	20,819	1,422	26,616	1,855	128,950	6,531	155,217	27,885
36,295	1,653	34,827	1,408	44,887	1,836	196,817	6,531	939,483	27,885
38,014	1,719	36,291	1,464	46,796	1,910	203,214	6,396	963,882	24,399
	19,832		**16,894**		**22,035**		**80,795**		**836,550**

Electricity meter readings *continued below*

ELECTRICITY METER READINGS

EM_{15} Dry Coolers		EM_{16} Condenser Pumps		EM_{17} Chilled Water Primary Pumps		EM_{18} Chilled Water Secondary Pumps		EM_{19} Heating & DHW Pumps	
Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)
40,505		126,139		62,154		85,859		39,283	
42,758	2,253	138,434	12,295	68,984	6,830	94,875	9,016	45,198	5,915
106,133	2,253	265,564	12,295	139,612	6,830	188,104	9,016	80,491	7,098
108,105	1,972	278,239	12,675	146,654	7,042	197,399	9,295	86,603	6,112
	67,600		**152,100**		**84,500**		**111,540**		**47,320**

Electricity meter readings *continued below*

ELECTRICITY METER READINGS

EM_{20} Humidifier AHU 1		EM_{21} Humidifier AHU 2		EM_{22} Main Frame Computer		EM_{23} UPS		EM_{24} Catering (Electricity)	
Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)	Meter Reading	Consumption (kWh)
69,095		68,126		625,411		280,053		195,897	
73,846	4,752	72,951	4,825	772,579	147,168	334,996	54,943	229,497	33,600
207,487	4,752	208,654	4,825	2,311,711	148,701	909,605	55,515	580,897	33,950
211,645	4,158	212,876	4,222	2,465,011	153,300	966,837	57,232	615,897	35,000
	142,550		**144,750**		**1,839,600**		**686,784**		**420,000**

Calculating performance indicators

The metering strategy indicates what sub meters to add together to reach the main end-uses that are comparable with benchmarks. Dividing by the floor area provides a useful indicator of energy performance. Ensure that a common floor area is used, particularly for the benchmarks which are often based on treated floor area. In most cases it is easiest to use gross internal floor area. Follow the steps 4.1 to 4.5 for each fuel.

STEP 4.1
List the sub meters and their consumptions

STEP 4.2
Using the metering strategy, add up the sub meters to get each main end-use consumption

STEP 4.3
Add up the metered end-uses to get the total metered consumption

Sub meter	Sub meter consumption (kWh)	Main end-use	end-use Consumption (kWh)	End-use performnace Indicators (kWh/m²) Gross floor area = 27,531
ELECTRICITY				
Lighting Riser 1	344,719	LIGHTING	1,075,685	39.1
Lighting Riser 2	387,746			
Lighting Riser 3	343,220			
Small Power Riser 1	273,273	SMALL POWER	828,100	30.1
Small Power Riser 2	306,397			
Small Power Riser 3	248,430			
AHU1 Supply & Extract Fans	308,490	FANS	734,500	26.7
AHU 2 Supply & Extract Fans	286,455			
AHU 3 Supply Fan	19,832			
Basement Extract Fans	16,894			
Toilet Extract Fan	22,035			
Car Park Extract	80,795			
Chillers	836,550	COOLING	904,150	32.8
Dry cooler fans	67,600			
Condenser pump	152,100	PUMPS	395,460	14.4
Chilled water primary pump	84,500			
Chilled water secondary pump	111,540			
Heating pumps	47,320			
AHU 1 humidifer	142,550	HUMIDIFICATION	287,300	10.4
AHU 2 humidifier	144,750			
Main frame and A/c	1,839,600	COMPUTER ROOM	2,526,384	91.8
UPS	686,784			
Catering (Electricty)	420,000	CATERING	420,000	15.3
TOTAL METERED ELECTRICTY (A)			**7,171,579**	**260.5**
TOTAL FROM MAIN (B) INCOMING METER			**7,677,227**	**278.9**
OTHER (B-A) (UNMETERED) ELECTRICTY			**505,648**	**18.4**
% Unmetered =			**7%**	
GAS				
Basement Boiler Room	3,031,860	SPACE HTG	3,031,860	110.1
Basement Boiler Room	464,750	DHW	464,750	16.9
Kitchen	287,300	CATERING	287,300	10.4
TOTAL METERED GAS (C)			**3,783,910**	**137.4**
TOTAL FROM MAIN (D) INCOMING METER			**3,783,910**	**137.4**
OTHER (UNMETERED) GAS = C – D			**0**	**0.0**
% Unmetered =			**0%**	

Go through the same procedure for each fuel e.g. gas, oil etc

STEP 4.4
Divide by the gross floor area to get kWh/m²

STEP 4.5
Calculate the unmetered consumption. If this is greater than 10% then investigate what it could be

Comparing end-use performance

This table provides a comparison of end-uses and should be recorded in the log book. It shows where all the energy is being used and where a particular end-use is consuming more than it should e.g. lighting. This allows the Facilities Manager to take specific action to address particular problems. The designer's estimates are based on the design assumptions e.g. hours of use, service levels etc and will be exceeded if the actual operation is outside these assumptions. Good practice benchmarks indicate what a very good building will achieve. In this case, most of the end-uses are worse than design and good practice although humidification is better than good practice.

Record the floor area and ensure that the benchmarks and design estimates are based on the same floor area definition

The log book should include the designer's estimates of what consumption is likely to be

These benchmarks are based on a type 4 office from 'Energy use in offices ECG019' and converted to gross floor area. Other benchmarks are available from Action Energy and CIBSE Guide F

Building energy performance for period from 4.1.02 to 4.1.03			Based on gross floor area of 27,531 m²			
Fuel type	Main end-use	ACTUAL INCOMING METERED consumption (kWh/yr)	ACTUAL SUB METERED Main end-use energy consumption (kWh/yr)	ACTUAL SUB METERED Main end-use energy consumption (kWh/m²/yr)	DESIGN ESTIMATES Main end-use energy consumption (kWh/m²/yr)	GOOD PRACTICE BENCHMARKS Main end-use energy consumption (kWh/m²/yr)
ELECTRICITY	Lighting		1,075,685	39.1	30.4	24.7
	Office Equipment		828,100	30.1	25.5	19.6
	Fans		734,500	26.7	24.9	20.4
	Cooling		904,150	32.8	22.9	17.9
	Pumps		395,460	14.4	13.3	10.2
	Humidification		287,300	10.4	9.6	10.2
	Computer Room		2,526,384	91.8	88.6	74.0
	Catering (Electricity)		420,000	15.3	14.2	11.1
	TOTAL SUB METERED ELECTRICITY		7,171,579	260.5		
	TOTAL FROM MAIN INCOMING METER	7,677,227		278.9	245.9	198.9
	OTHER (UNMETERED) ELECTRICITY		505,648	18.4	16.5	11.1
	Percentage unmetered		6.6%			
GAS						
	Space Heating		3,031,860	110.1	117.6	80.8
	Domestic Hot Water		464,750	16.9	14.2	10.2
	Catering (Gas)		287,300	10.4	9.6	6.0
	TOTAL SUB METERED GAS		3,783,910	137.4		
	TOTAL FROM MAIN INCOMING METER	3,783,910		137.4	141.4	96.9
	OTHER (UNMETERED) GAS		0	0.0	0.0	0.0
	Percentage unmetered		0.0%			

Calculate the unmetered consumption. If this is greater than 10% then investigate what it could be

STEP 5 – Compare performance
Actual V Design Estimates V Benchmarks
Most of the end-uses in this particular building are significantly above the designers estimates which in turn are above the benchmarks

STEP 6 – Take action on excessive consumption

Comparing overall performance

Even when an end-use comparison has been carried out it is still important to assess overall performance and record this in the log book. If one single performance indicator is preferred then use kg CO_2/m^2 as shown below. In this case, gas and electricity performance is generally worse than design and good practice. However, it is noticeable from the previous table that space heating is performing better than the designer anticipated. This might be due to a warmer winter and therefore could be inconclusive. This comparison should be refined by adjusting for weather variations using a simple degree day method, as shown in GPG310. CIBSE TM22 provides software to help assess building energy performance that includes an option to adjust for weather variations.

Building energy performance for period from Jan 2001 to Jan 2002
Based on a gross floor area of 27,531m²

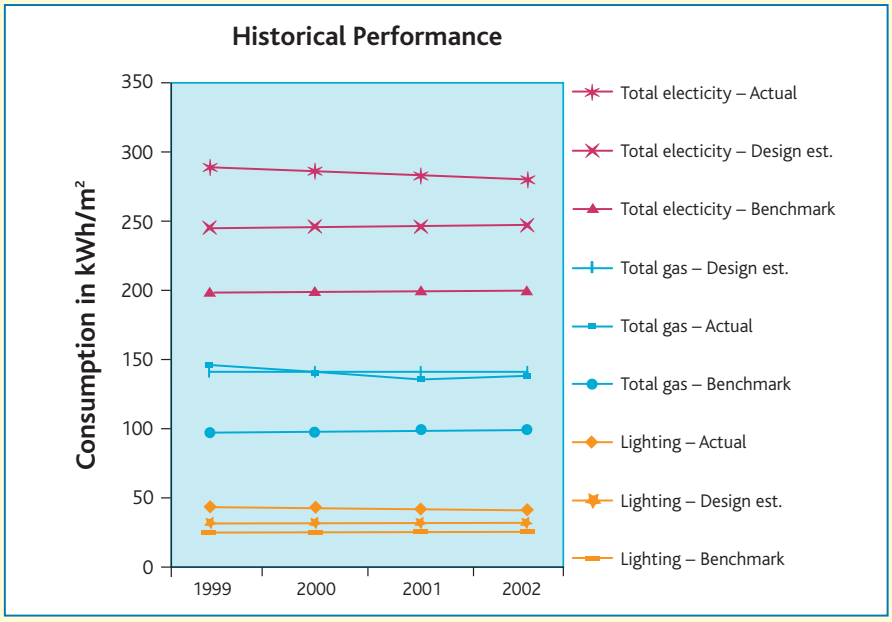
Fuel	KWh (A)	CO_2 ratio kg CO_2/kWh (B)	kg CO_2 (C)	Actual kg CO_2/m^2 (D)	Design kg CO_2/m^2 (E)	Good practice benchmark kg CO_2/m^2 (F)
Electricity	7,677,227	0.43*	3,301,208	119.9	105.7	85.5
Gas	3,783,910	0.19	718,943	26.1	26.9	18.4
Total				**146**	**132.6**	**103.9**

Multiply column (A) by column (B) to get (C) then divide by total gross internal floor area to get (D) for comparison with benchmarks in columns (E & F). One overall performance indicator can be established by totalling column (D). Avoid adding column (A) as the fuels have different costs and CO_2 factors. The designer/author should have completed column (E & F). It is important to use the correct conversion factors in column (B) in relation to the fuels used. These will be shown in the log book but electricity factors (*) do change due to alterations in the mix of generation plant. Where appropriate, the log book should take account of any CHP and list any renewable sources and the effect they have.

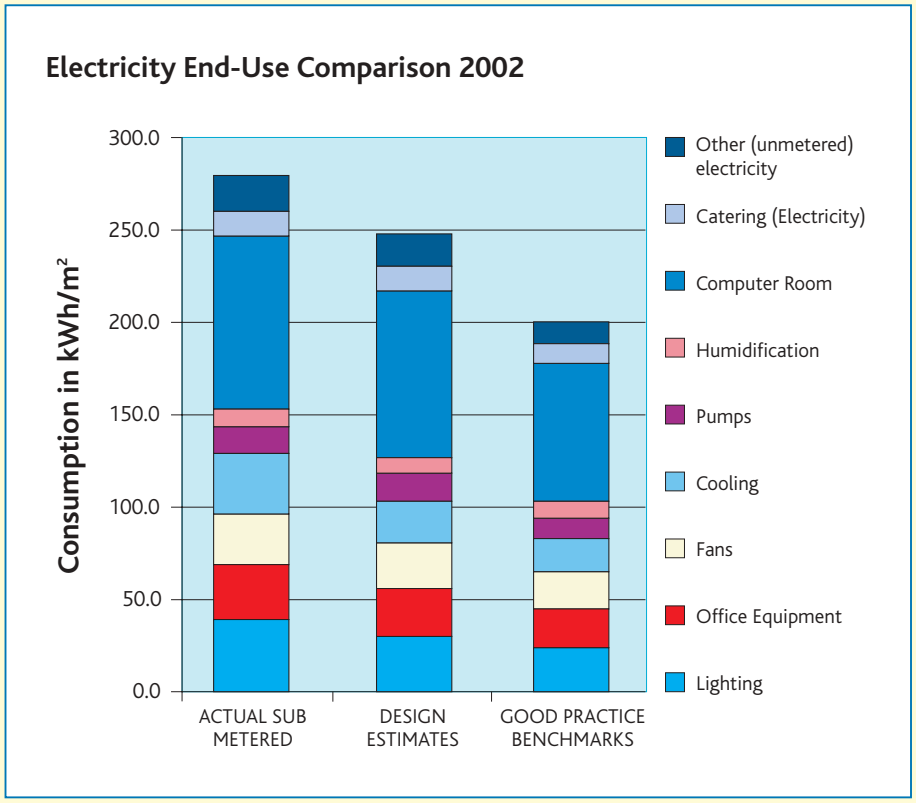
It is also valuable to graph the results to provide an even clearer comparison. This can be an annual comparison but may also include a historical view when there is enough data available.

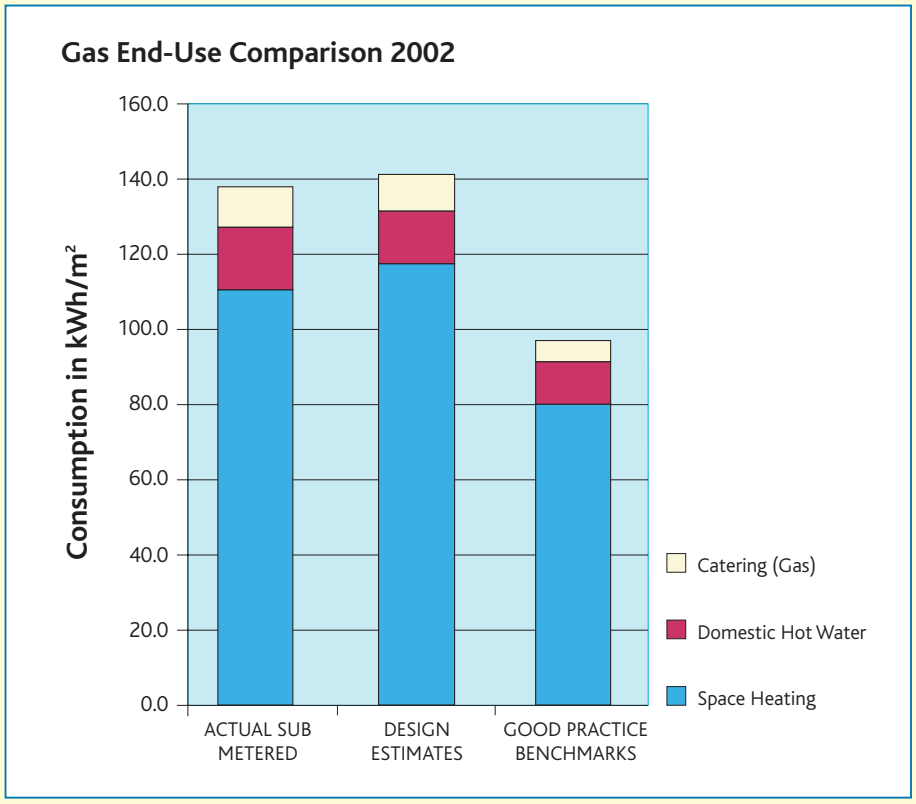
Historical performance

This historical performance chart shows that actual electricity consumption has been falling but is still well above the design estimates and good practice benchmarks. Actual gas consumption is close to the designers estimates but still above good practice which may suggest that this should still be investigated for potential savings. It is also possible to track end-use consumption over time, as shown by lighting, which does appear to be reducing.



Electricity and gas end-use comparison





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