Energy Efficiency Best Practice in Housing

Using whole life costing as a basis for investments in energy efficiency - guidance

Energy Efficiency
SAVE ENERGY MONEY ENVIRONMENT

Energy Saving Trust

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Background to whole life costing

Home energy use is responsible for 28 per cent of UK carbon dioxide emissions which contribute to climate change. By following Best Practice standards, new build and refurbished housing will be more energy efficient and will reduce these emissions, saving energy, money and the environment.

There is a lot happening in the area of whole life costs. Pressure is building from the highest levels of government for public sector procurement to move to a whole life cost based approach. Better Public Buildings[1], produced by the Commission for Architecture and the Built Environment for the Department of Culture, Media and Sport, sets the tone. In his foreword, the Prime Minister wrote:

> Integrating design and construction delivers better value for money as well as better buildings, particularly when attention is paid to the full costs of a building over its whole lifetime.

The Office of Government Commerce has been overhauling its procurement guidance, and Procurement Guide 07[2] gives advice to public sector procurers on whole life costing. It states:

> The advice contained in this guidance should be applied to all new projects and to all existing projects where invitations to tender have not yet been issued for the main construction contract. The principles should also be applied, wherever possible, to existing acilities.

HM Treasury's Green Book[3] states that when valuing the costs and benefits of options, they should normally be extended to cover the period of the useful lifetime of the assets being evaluated.

Meanwhile, in the private sector, clients are showing increasing interest in whole life costing. The subject is moving quickly into mainstream construction practice.

The Construction Round Table and the Construction Clients Forum (CCF) first called for the use of whole life costing in Agenda for Change[4] and Constructing Improvement[5], followed by Re-thinking Construction[6]. The CCF then produced Whole Life Costing: A Client's Guide[7] in 1999. It gives practical guidance to clients on the benefits, scope and implementation of whole life costing on buildings and other structures.

Whole life costing has often been dismissed because of the lack of clear methodology and absence of data. A 1999[8] survey found that these were the reasons why only 25 per cent of clients used whole life costing. To meet the need for owners, operators, designers, assemblers and users of buildings to plan for the whole of the service life, an international standard has been published. Part 5[9] of the standard is now published as a Draft International Standard on whole life costing, obtainable from BSI.

The Energy White Paper 2003[10] states that the UK is using far more energy than it needs. Around half the total carbon savings required by 2020 could come from energy efficiency. Households could account for half of these savings.

The Government is pushing for local authorities to give energy issues priority at a strategic level, for example through community plans and transport and housing strategies.

This guide will help move decisions on investments, particularly in energy efficiency, away from first cost – and provide a basis for decisions based on best value over the life of the building or individual component. It will allow local authorities, housing associations and house builders to prioritise investment by comparing relative benefits of investments in renewables, CHP (combined heat and power) or efficiency measures.

Who should read this guide?

This guide will help anyone responsible for investment decisions on buildings, whether new build or refurbishment. It will be particularly relevant to investment managers in housing associations and local authorities liable for ongoing maintenance of housing. Construction companies will also find it useful when competing on the basis of best value.

How the guide works

Whole life costing is introduced at component level and at whole building level. You may be more interested at component level – boilers, windows etc. However, you will need to understand the fundamentals of whole life costing at building level to appreciate the importance of whole building issues, such as energy consumption. We provide case studies to illustrate how whole life costing has been used.

Introduction to the principles of whole life costing – what, when, how much?

What work needs doing to a building or component over its life?

When, during the life of the building or component, should the work be done?

How much will it cost when you do the work?

The Office of Government Commerce Procurement Guide 07[11] defines the principles of whole life costs as:

> The whole life cost of a facility (often referred to as through life costs) are the costs of acquiring it (including consultancy, design, and construction costs, and equipment), the costs of operating it and the costs of maintaining it over its whole life through to its disposal – that is, the total ownership costs.
>
> These costs include internal resources and departmental overheads, where relevant. They also include risk allowance as required, flexibility (predicted alterations for known change in business requirements, for example), refurbishment costs and costs relating to sustainability and health and safety aspects.

Whole life costing is defined in the International Standard ISO 15686 as:

> The economic assessment considering all agreed projected significant and relevant cost flows over a period of analysis expressed in monetary value. The projected costs are those needed to achieve defined levels of performance, including reliability, safety and availability.

The Whole Life Cost Forum definition is:

> The analysis of all relevant and identifiable financial cashflows regarding the acquisition and use of an asset.

Although these definitions capture a number of essential issues in whole life costing, neither of these definitions reflect the fact that whole life costing is a tool to assist in making decisions between different options, with different costs that may occur at different times over a period of time. In other words, a forward planning tool to anticipate:

- what needs doing to the building or component;
- when it should be done;
- how much it will cost.

Whole life costing is relevant when considering whole estates, whole facilities, individual buildings or components. It can be used to compare alternative scenarios such as:

- whether to retain, refurbish, demolish or sell;
- alternative design decisions – whether to adopt natural ventilation or air conditioning;
- alternative specifications – metal or timber windows, and conventional, condensing or combination boilers.

Why use whole life costing?

The benefits include:

- optimising the total cost of ownership / occupation by balancing initial capital and running costs;
- providing data on actual performance and operation compared with predicted performance, for use in future planning and benchmarking;
- promoting realistic budgeting for operation, maintenance and repair;
- encouraging discussion and recording of decisions about the durability of materials and components at the outset of the project;
- encouraging analysis of business needs and communication of these to the project team;
- ensuring risk and cost analysis of loss of functional performance due to failure or inadequate maintenance.

What activities need consideration at component level?

At individual component level, the whole life cost is its initial installation cost, either as new or as a replacement, plus the costs of inspecting, operating and maintaining it and its replacement cost when it wears out (see Figure 1).

For a timber window, the maintenance cost would include repainting inside and out, replacing defective gaskets or putty, replacing defective double glazed units, lubricating the ironmongery and its occasional replacement – along with the cost of renewing the whole window at the end of its working life. Disposal costs may also need to be considered for any parts that are replaced during the life of the main component, for example, double-glazed units that last less than the life of the window frame. Access costs such as scaffolding need to be included for most of these activities.

In the case of a boiler, the same approach will apply. The initial installation cost is added to the inspection, maintenance, and parts replacements over its expected life. It needs to be checked and maintained in accordance with the Heating and Ventilation Contractors' Association guidance and its parts replaced on a regular basis. When the costs of these activities are becoming excessive, the unit is replaced, preferably before a complete breakdown, if it is vital to the function of the building.

It is important to capture all the activities associated with the ownership of a component if it is to last its normal life expectancy. Maintenance is costly and is often delayed because of budget cuts. One consequence of putting it off is that accelerated wear can occur:

- bearings that are not lubricated may seize and require earlier replacement;
- unpainted timber will rot, incurring additional costs to rectify.

Figure 1: Whole life costs at component level

Costs

Construction	Facilities	Operations	Disposal
Install cost Commission	Inspection Maintenance Repair Replace Commission Refurbish (Energy) (Utilities) Management	Tax relief (income)	Dismantle Demolition Sale (income)
Capital cost of component	Revenue (running) costs		

The left-hand column of Figure 1 shows the costs of the initial installation or last replacement of a component. The three right-hand columns represent the running costs of a component. Facilities costs may be cyclical (inspection, maintenance and related management costs) and intermittent for reactive maintenance. You need to predict replacement cycles for a component in order to estimate its replacement cost. Some costs, such as capital allowances and sale, may be treated as income.

What activities need considering at whole building level?

At whole building level, the whole life cost is calculated by adding up the initial capital cost of a building, and inspection, operating and maintenance costs of all the individual components (windows, heating plant etc) over their useful lives. Plus the replacement cost at the end of life. These costs are usually presented at today's values by discounting the total sum (see Figure 2).

Capital cost generally refers to construction costs. Revenue costs generally refer to the cost associated with running an asset, and is funded by income, for instance rent.

Some of the components within the building will impact on others. For example, a highly thermally insulated wall may (but not necessarily) have a higher whole life cost than a standard wall. However, this may be compensated for by the reduced heating costs. The thermally insulated wall may also reduce the required boiler capacity, with further cost savings attributable to the lower capital and replacement costs.

This level of whole life costing is often referred to as hard FM (facilities management) whole life costs where the emphasis is on replacement costs. Sometimes under private finance initiative, it excludes the costs of inspections and maintenance. Soft FM includes inspections and maintenance activities and other costs such as energy, rates and management/security.

Figure 2: Whole life costs at whole building level

Costs/income

Construction	Facilities	Operations	Disposal
Site Design Construction Commission Fit out Profess. Fees In-house fees Stat. authorities Finance	Inspection Maintenance Repair Replace Commission Refurbish Energy Utilities Management	Rent Rates Sub-let Tax relief	Dismantle Demolition Sale
Capital cost of whole building	Revenue costs		

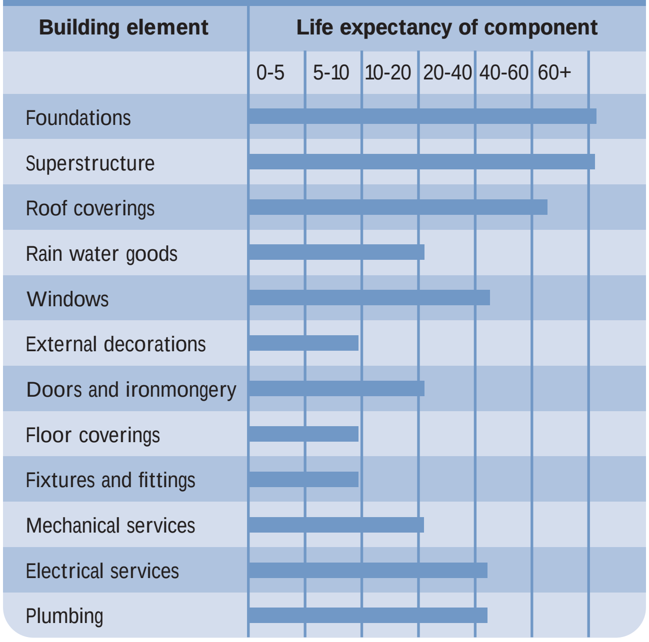
The left-hand column of Figure 2 covers the costs to be considered at construction stage. The three right-hand columns represent the running costs of the building, including a sum of the whole life costs of individual components. Facilities costs for all components may be cyclical (inspection, maintenance and related management costs) and intermittent for reactive maintenance. It is necessary to predict replacement cycles for each component in order to estimate their replacement costs. Some costs may be treated as income, such as capital allowances and sale.

Repairs and maintenance – when to do it

The design life of the building will influence the replacement frequency of those elements that will not last this period. In housing, it is usual to consider whole life costs over a study period of 60 years.

Some elements will be expected to last the life of the building, and will include those that are difficult to replace (foundations, under-building drainage and the main structure etc). On the other hand, windows, some roofing component fixtures, internal fixtures such as kitchen units, and mechanical and electrical services will need replacing several times as they reach the end of their working lives.

Figure 3: Life expectancies



A number of issues affect the life expectancy of a component, these include the amount of maintenance, excessive wear and tear, environmental conditions, its quality, and how well it was installed.

A number of sources provide basic information on life expectancies. Some levels of judgement, however, are needed to arrive at a reasonably accurate prediction of life expectancy based on in-use situations (see Appendix B).

These same issues will need to be taken into account when estimating the remaining or residual lives of components. In other words, how much longer will they last?

What costs are taken into account when undertaking whole life costing? How much will it cost?

Capital cost

The capital cost is needed for two purposes. It is included in the overall total whole life cost. It is also used as an estimate for the costs or component replacements at the end of their working lives. The costs of initial construction will vary, depending on whether the whole life cost is at whole building level or merely at component level.

At component level, the cost of installation and the purchase price is required, plus professional fees and the costs of statutory approvals if appropriate. At whole building or estate levels, the cost of the land, demolitions, the new construction or refurbishment costs plus professional fees and the costs of statutory approvals may be appropriate.

All cost levels being considered may attract in-house resource costs.

Finance costs

Finance costs include the costs of borrowing to fund the capital cost of purchasing the building or component.

Facilities costs

The following are costs that can be managed by careful planning and management.

Energy and utilities – These costs can be reduced by careful design such as:

- measures to avoid summer overheating;
- minimising the use of mechanical air handling and treatment;
- careful specification and selection of low energy heating and other mechanical equipment.

Straightforward payback calculations are possible to demonstrate the benefits of additional capital expenditure leading to energy reduction – spend to save.

Maintenance – The types of maintenance to be considered at whole building and component levels are: preventative, scheduled, corrective, condition based, reactive (emergency), predictive, and deferred. The following activities will be included:

- inspection;
- monitoring;
- testing;
- condition surveys;
- planning;
- repairs;
- replacements;
- refurbishments.

Related costs resulting from maintenance activities would include downtime, disruption of business, non-availability of the asset, temporary decant or rehousing costs and potential loss of income (eg rent) due to temporary loss of use.

Operations

These costs can rarely be influenced, although some organisations may benefit from capital allowances which may influence the choice of equipment.

Disposal

At whole building level, this could be income from selling the building, or the cost of demolition less any credit from recycled materials. At component level this would include the cost of disposal of the components being replaced.

Accuracy of costs

Values for the costs should be as accurate as possible. Greater effort may be required for the most significant cost variables. Values can be derived from:

- a direct estimation from known costs and components;
- historical data from typical applications;
- models based on expected performance;
- best guesses of future trends in technology.

How to present whole life costing

The format for reporting whole life costing is usually the net present value. This is a single figure representing all the future costs and incomes at their equivalent present value.

Annual equivalent costs may be more appropriate in some circumstances. This is a uniform annual amount equivalent to the project net costs, taking into account the time value of money throughout the period of analysis. This technique is used to compare the merits of competing investments where the natural replacement cycle is not an exact multiple of the period of analysis. The annual equivalent value is the regular annual cost that, when discounted, equals the net present value of the investment.

Other ratios can also be useful, such as payback periods. Payback is a calculation of the time period it takes to cover investment costs.

The costs should be expressed in current terms, as many financial or tax transactions are based on actual values at the time rather than the value in future (for instance, the current cost of a boiler should be used – not a projected future cost).

Recording whole life costing

ISO 15686-3[12] describes the audit trail and process of performance review for service life planning. For whole life costing analysis, records should be retained in accordance with the guidance in ISO 15686-3. These records should include:

- cost calculations;
- evidence of service life;
- sources of cost data;
- discussions on the scope of analysis;
- retained copies of software packages/ whole life costing models.

There are potential liabilities associated with providing assessments of whole life costing and / or service life planning. Record keeping (whether paper or electronic) should consider issues such as professional indemnity insurance retention, handover of relevant portions to other parties at later stages, insurance cover etc.

Changing from revenue to capital costs

Leasing and ESCO arrangements

An energy service company (ESCO) is a business that develops, installs and finances projects designed to improve energy efficiency and reduce operations and maintenance costs for its customers' facilities. ESCOs generally act as project developers for a wide range of tasks and assume the technical and performance risk associated with the project.

What sets ESCOs apart from other firms offering energy efficiency improvements is the concept of performance-based contracting. When an ESCO undertakes a project, the company's remuneration is often directly linked to the amount of energy that is actually saved.

Private finance initiative

Public private partnership is the umbrella name given to a range of initiatives that involve the private sector in the operation of public services. The private finance initiative (PFI) is the most frequently used initiative. The key difference between PFI and conventional ways of providing public services is that the public does not own the asset. The client authority makes annual payments, rather like a mortgage, to the PFI company, which provides the building and associated services.

A PFI contract will typically last 25 years, after which the ownership of the asset (school, hospital, district heating system etc) will revert to the client authority. PFIs are usually for projects of capital costs over £20 million.

Companies set up specifically to run the scheme will own the PFI project. These companies are usually consortia that would include a building firm, a facilities management company, a bank and other professional advisors. Whilst PFI projects can be structured in different ways, there are usually four key elements: design, finance, build and operate.

PFIs need not be for whole buildings or estates. They can, for example, be used for a boiler replacement programme.

Ideally the PFI contract would take on the costs of energy. This should encourage the consortium to take a holistic view of energy management.

Prime contracting

This approach uses a single (prime) contractor to take sole responsibility to the client for the management and delivery of a project on time, within budget and fit for the purpose for which it is intended. This includes demonstrating that operating costs can be met in accordance with a pre-agreed cost model over a proving period of a number of years.

Some quick wins

Reducing costs of access

A whole life cost for maintenance and replacement analysis enables designers to consider the possibility of reducing maintenance costs at no additional initial or capital cost. This can be achieved by improving the accessibility to various elements for foreseeable maintenance and replacement work, or removing the need for access altogether. The highest whole life cost savings can occur when:

- regular maintenance is completely avoided by redesign;
- entire cycles of maintenance at high levels are removed where scaffolding costs will often exceed the costs of the work to be carried out (more than half of all accidents in construction are as a result of falls from a height);
- consequential damage to adjacent surfaces is avoided by providing enough space and removable panels to access boilers, tanks and cisterns and plant.

Targeting the major elements of cost

The following breakdown of operational costs indicates the major areas where savings can be made. Average figures, provided by Building Maintenance Information*, indicate that occupants' spending falls into a number of categories for different building types.

* Building Maintenance Information is a service of the Building Cost Information Service a trading division of RICS Business Services Ltd (www.bcis.co.uk).

Figure 4: Cost of ownership by building type

Spending category	Residential	Commercial	Recreation	Educational
Utilities and energy	22%	35%	22%	32%
Overheads	13%	24%	19%	23%
Administration	20%	12%	29%	14%
Cleaning	25%	12%	13%	16%
Fabric maintenance	6%	9%	6%	5%
Services maintenance	6%	5%	7%	7%
Decorations	8%	3%	4%	3%
	100%	100%	100%	100%

Many savings are achieved by simple low-cost measures with short payback periods. The savings are even greater and capital costs less, if options are chosen at design stage and integrated with the main building work.

Figure 5: Examples of typical payback periods

Payback period	Boiler/heating system	Other
Free	• Reduce holiday heating • Check settings of controls / thermostats	• Reduce hot water temperatures • Replace 38 millimetre tubes with more efficient 26 millimetre tubes at failure • Replace tungsten lamps with compact fluorescents • Clean windows, rooflights and light fittings • Make good use of curtains and blinds
Short (< 2 yrs)	• Regularly check boiler / air fuel ratio • Repair leaks on distribution mains • Fit / repair / replace thermostats • Lag boilers, cylinders, pipework and valves • Install thermostatic valves in spaces which are subject to overheating • Install closures to external doors	• Seal unused chimneys / stacks • Fit foil behind radiators • Replace tungsten lighting with compact fluorescent lamps • Draught strip • Install automatic controls on external lighting
Medium (2-5 yrs)	• Replace boiler with more efficient boiler when worn out • Replace electric heating systems	• Install cavity insulation • Install top up roof insulation

Summary

The key issues of whole life costing may be summarised as follows.

- The earlier that whole life costing is considered, the greater the potential benefits.
- Lower capital costs, reflecting a more efficient design, can result in lower whole life costs.
- A building with in-built low running costs will have a lower impact on the profitability of the owner's or occupier's business.
- Buildings whose performance can be readily and economically maintained will benefit the occupants and improve their productivity.
- When specifying a better but more expensive product, look for an improved payback period. This is also important when replacing existing products.
- Whole life costing should not be the only deciding factor when selecting products. Think of 'softer', less easily quantifiable issues such as occupant satisfaction and comfort.

Case study 1 – energy efficient lamps

A simple example of whole life cost at component level can be used to support the selection of a replacement lamp for a single light fitting in a dwelling.

The choice of lamps is generally restricted to two options: compact fluorescent lamps and tungsten filament bulbs. In this example, the whole life costs include the purchase price of the lamp and any subsequent replacements; and the cost of electricity used by the lamp during its operation. Maintenance costs attributable to replacing the lamps are assumed to be negligible.

The following table illustrates the difference in costs[2] for each of these options over the life of a typical compact fluorescent bulb.

	Compact fluorescent bulbs			**Tungsten filament bulbs**		
	replacement	**electricity**	**total**	**replacement**	**electricity**	**total**
year 1	£10.00	£2.60	£12.60	£1.00	£13.00	£14.00
year 2	£0.00	£2.60	£2.60	£1.00	£13.00	£14.00
year 3	£0.00	£2.60	£2.60	£1.00	£13.00	£14.00
year 4	£0.00	£2.60	£2.60	£1.00	£13.00	£14.00
year 5	£0.00	£2.60	£2.60	£1.00	£13.00	£14.00
whole life cost			£23.00			£70.00

This simple example demonstrates that the whole life cost for tungsten bulbs are approximately three times as expensive as those for compact fluorescent lamps, despite their significantly lower cost price.

Case study 1 assumptions:
100 W GLS, cost £0.50, operating life 1,000 hours
20 W CFL, cost £10, operating life 10,000 hours
lamp use = 2,000 hours p.a., electricity price = 6.5p/kWh

Case study 2 – community heating

Aberdeen City Council used whole life costing when making improvements to heating systems, building fabric and thermal insulation in some of their high-rise properties.

The Council was exploring options for providing a community heating scheme (taking advantage of available grant funding), and had undertaken a feasibility study for the Seaton area of the city. This area was chosen because of the density of buildings, and the existing services, which were nearing the end of their economic life.

A cluster of buildings had been identified which comprised 288 electrically heated flats in four multi-storey blocks. Council tenants formed 98 per cent of residents and 70 per cent were estimated to be fuel poor.

Aberdeen City Council undertook a survey to establish an understanding of repair, maintenance and replacement costs over a period of 30 years. This exercise underpinned a whole life cost exercise to evaluate potential options for the upgrade of these buildings. The options evaluated are summarised in the table below.

Option	Capital cost	Whole life cost (25 years)	Weekly running cost per flat
Existing heating systems	n/a	n/a	£5.23
Upgrading electrical heaters	£780,000	£2,680,000	£5.23
Upgrading electrical heaters and applying cladding	£1,570,000	£3,317,745	£4.47
Centralising boiler plant	£935,000	£2,275,589	£4.15
Centralising boiler plant and applying cladding	£1,630,000	£2,932,540	£3.93
CHP scheme	£1,530,000	£1,896,956	£3.20
CHP scheme and applying cladding	£2,250,000	£2,658,854	£2.75

This exercise highlighted a CHP (combined heat and power) scheme with over-cladding of the buildings. However, the capital cost of applying the cladding was prohibitive (and potentially disruptive) and so the Council opted for the CHP scheme only.

Of the 288 tenants potentially affected by the work, only 21 did not want the community heating system, and retained electrically heated services. However, community heating will be available to new tenants as the flats become void.

The whole life cost analysis indicated that the scheme would reduce tenants' heating costs by 40 per cent, with similar reduction in carbon emissions.

For more information on this scheme see Community Heating – Aberdeen City Council case study (CE65).

Further reading

Energy efficiency best practice in housing

The following Energy Efficiency Best Practice in Housing publications are available free by telephoning the Helpline on **0845 120 7799** or by visiting the website at **www.est.org.uk/bestpractice.**

Community Heating – Aberdeen City Council Case Study (CE65)
Community Heating Case Study – Pimlico (CE125)

Further help and useful sources

Whole life costing – a client's guide

A short guide intended for clients and their supply chains, produced by the Construction Clients Forum (http://www.clientsuccess.org.uk/).

ISO DIS 15686-5 Buildings and Constructed Assets Service Life Planning Part 5 – whole life costing, BSI 2004

This multi-part standard provides guidance on how to estimate the service life of buildings and components. Part 1 is the most appropriate for a general audience. It contains general principles and guidance. Part 2 will be particularly relevant to manufacturers who need to predict service life using accelerated test data. Part 3 relates to checking whether service life issues have been taken into account throughout the process. Part 5 on whole life costing has been issued as a Draft International Standard (http://www.bsi-global.com).

20 steps to encourage the use of whole life costing

This report, intended for housing organisations in particular, will help clients and others to take the first steps in adopting a structured management approach to efficient long-term investment in housing (http://www.constructingexcellence.org.uk/sectors/housingforum).

Information on Energy Use and Cost Effective Improvements

Energy efficiency best practice in housing. Training, tools and support for the housing profession. Visit http://www.est.org.uk/bestpractice/ and http://www.est.org.uk/bestpractice/publications/all.jsp?start=6 for more information.

Energy Saving Trust – financing community energy schemes

The Community Energy programme offers information, advice and grant funding to support the installation of new, refurbishment or expansion of existing community heating schemes across the UK.

The programme is funded by the Government and jointly managed by the Energy Saving Trust and the Carbon Trust. It offers:

- handholding and guidance;
- training;
- development grants;
- capital grants.

Visit www.est.org.uk/communityenergy for more information.

Cost Data on Capital and Maintenance / Operational Costs

Building Cost Information Service and Building Maintenance Information are trading arms of the Royal Institution of Chartered Surveyors. They provide a subscription service and publications on a wide range of costs, including special reports on individual cost headings and building types (www.bcis.co.uk).

Procurement Guide 07

Whole life costing and cost management. Office of Government Commerce (www.ogc.gov.uk).

Housing Association Property Mutual – Component Life Manual

This publication provides life-span assessments for a wide range of building components used in housing, which are classified within the concept of quality specifications. It was developed as an insurance tool for UK social housing and offers indicative benchmarks against which new or differing specifications can be assessed. The approach is intended to be quick and easy to use, reflecting current knowledge.
Published by E & FN Spon 11 New Fetter Lane, London EC4P 4EE (http://www.sponpress.com/).

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5 Constructing Improvement, Construction Clients' Forum, 1998

6 Rethinking Construction, Sir John Egan, HMSO, 1998

7 Whole Life Costing: A Client's Guide, Construction Client's Forum, 2000

8 BRE Report 367, CRC Ltd 1999

9 ISO DIS 15686-5 Buildings and Constructed Assets Service Life Planning – Part 5 whole Life Costing BSI, 2004

10 Our Energy Future – creating a low carbon economy, DTI 2003 http://www.dti.gov.uk/energy/whitepaper/index.shtml

11 Procurement Guide 07 whole life costing and cost management. Office of Government Commerce

12 ISO DIS 15686-5 Buildings and Constructed Assets Service Life Planning – Part 3 p Aberdeen City performance audits and reviews BSI, 2002

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