Environmental profiling for the UK timber industry

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Executive Summary

This is the final report for project 'Environmental profiling for the UK timber industry' undertaken by BRE for the UK Forestry Commission, contract reference number: FG10/04.

Today, businesses are faced with ever stricter environmental controls and changing markets in which consumers are becoming increasingly aware of environmental matters. Various claims and counterclaims about 'environmental friendliness' cause a lot of confusion and they are meaningless unless they are supported by robust evidence. Life Cycle Assessment (LCA) identifies the material, energy and waste flows of a product over its entire life cycle so that the environmental impacts can be determined in a standardised way.

The UK timber industry companies must ascertain and demonstrate clear sustainability rationales to potential clients in order to improve their business and stimulate faster growth. By raising awareness within the industry of LCA principles and providing user-friendly information and tools to implement these, the forestry-wood chain will be prepared and well equipped to improve processes, satisfy clients' requirements, and thus secure and enhance their business and image.

Main findings:

The current sustainable construction agenda provides an excellent opportunity for all industries to improve their profiles.

The review of five robust LCA studies has shown that timber-based products have favourable environmental credentials, but further studies are necessary to support these findings in the long term.

The understanding of, and engagement in, LCA and the sustainable construction agenda has improved considerably across the UK industry. This project provided a valuable insight regarding practicalities of undertaking rigorous environmental assessments for timber manufacturing businesses.

The forestry-wood industries have gained significant motivation during this project. This presents a range of prospects to actively work on addressing a number of issues within the environmental assessment field.

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Introduction

The UK Government has set up a number of greening initiatives aiming to improve environmental performance in construction. The key messages are to focus on the whole life impact and use whole life costing[1]. Every industry must take responsibility for the sustainability of its products from components to the complete structure as well as its processes[2]. Leading contractors are including environmental criteria within their procurement practices and more are expected to follow. However, claims about the environmental performance of building products are easy to make, but difficult to substantiate without a universal measuring system. BRE's Environmental Profiles Methodology provides that measurement system. As well as underpinning claims of environmental performance, Environmental Profiles enable manufacturers to compare their products against others, to demonstrate improvements that have been made and to help raise general awareness of life cycle issues.

The focus of this project was twofold:

- To provide information on Life Cycle Assessment (LCA) & Environmental Profiling and their role in sustainable construction for the use of the industry (environmental assessment tools, e.g. the BREEAM family of assessment methods).
- To collect and process data for LCA and therefore secure up-to-date data for products and processes.

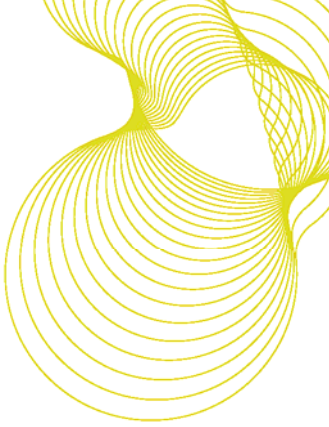
The project's aims were to assess the level of awareness of LCA within the industry (what it is and is not; how it is done; what one can and cannot use it for) and also to raise this level of awareness. The opportunities for practical application in the form of Environmental Profiling of the UK timber industry linked to the increasingly accepted and used EcoHomes (BRE's Environmental Assessment Method –BREEAM - for housing) as well as strategically monitoring any development of the Code for Sustainable Homes are presented and clearly demonstrated.

This project's main premise was to link product manufacturers with their ultimate users (specifiers and other customers). This link is necessary in order to utilise any potential to improve the image of the UK's forestry-wood product in the construction industry. In order to satisfy requirements of clients, manufacturers need to understand how to most effectively meet these prerequisites for business.

The UK timber industry must ascertain and demonstrate clear sustainability rational to potential clients in order to improve their business and stimulate growth. Furthermore, in the process of fulfilling clients' specification a number of improvement opportunities may be recognized. These improvements are usually closely linked to a full understanding of manufacturers' activities and all inputs and outputs relevant to their processes. LCA is a tool that has a user-friendly framework to quantify all identified impacts. In general, this project's purpose was to bring the subject of LCA a distinctly stronger market direction and to define a clear scope for any future efforts.

[1] HM Government (2001) *Better Public Building,* Department of culture, media and sport

[2] DTI, *Sustainable Construction Brief*, July 2003



This project was undertaken for the UK Forestry Commission, Contract Reference Number: FG10/04 as a two-year study from April 2004 to March 2006. A time extension was agreed.

Additional interest on behalf of the UK timber industry was sought from the following organisations:

- UK Timber Frame Association
- UK Forest Product Association
- Wood Panel Industry Federation
- British Woodworking Federation
- Timber Trade Federation

This project had the following deliverables:

1. A leaflet, *Life Cycle Assessment for Construction Products: an introductory guide for manufacturers and specifiers* was produced and widely distributed for the use of the industry/partners (Appendix 1).

2. A data gathering tool for companies to use to collect base data for an LCA study was developed (Appendix 7).

This is the final report for this project. It describes the project, methodology used, provides forestry-wood chain decision-makers with clear information on the use of LCA, its pros and cons, and reviews current situation in the field of sustainable construction.

Description of the project

This project employed BRE's expertise in the fields of environmental assessment and used data from previous projects. These projects were, namely, the project on 'LCA for the UK forestry, sawmilling and panel industry' funded by Forestry Commission, BRE Trust, and DTi; and BRE's 'TF 2000' study, 1995 (DETR, Century Homes, P J Steer Consulting Structural Engineer, Prestoplan, Stewart Milne Timber System, Walker System). Additionally, BRE's strong relationship with the industry ensured good penetration of this project's information as well as contributing to a number of deliverables.

Through a four-phase approach, the aims were achieved in a timely manner. These phases were as follows:

Phase 1: A compilation of a simple, user-friendly leaflet. Deliverable: A booklet *Life Cycle Assessment for Construction Products: an introductory guide for manufacturers and specifiers* (Appendix 1).

Phase 2: A data gathering tool for companies to use to collect base data for an LCA study. Deliverable: Access data gathering tool (Appendix 3 for detailed rationale explaining software choice)

Phase 3: Generic profiles assessing 'typical practice' within the forestry-wood chain industries (see Appendix 4 for detailed suggestions)

Phase 4: Specific profiles (certified Environmental Product Declaration for a particular product or process). A number of profiles are underway at various stages of progress (see below for details)

These phases are described in more detail later in this section.

Throughout the project the team engaged in discussions with the client and various manufacturers and representatives of professional associations and federations. This approach supported information flow and a wider understanding of LCA and therefore of this project. A number of presentations and seminars were run to ensure a close link with the industry. Lively debates enriched the course of this project and addressed uncertainties or misconceptions that might have precluded the success of this project or potential future work.

This approach allowed for a high level of dissemination and buy-in from all parties. Furthermore, it was possible to address a number of recommendations and suggestions. The following is the list of key meetings:

- Meeting and discussions with Pinewood (also involved in phase 4)
- Presentation at the Scottish Parliament Cross Party Working Group On Sustainable Forestry & Forest Products
- Presentation at FEG Annual conference

- Presentation and discussion with UKTFA Commercial committee
- Meeting with a member of UKTFA (Stuart Milne, also involved in phase 4)
- Discussions during meetings with BWF
- Meeting and a seminar for Finnforest (also involved in phase 4)
- Meeting and discussions with Palgrave Brown
- Meeting and discussions with UPM Kymmene
- Discussions on LCA with BWF
- And other presentations at various events organised by BRE

A diary of progress reports is summarised in Appendix 5.

In this project, timetable for alpha (internal) and beta (external) piloting of data gathering tool was adjusted to permit a meaningful assessment of the tool's design and functionality. With the timetable extension, it was possible to appreciate that any capture of data within companies relevant to LCA happens on two levels. These levels are:

- Basic – a generic, starting level. This level allows for capture of data necessary for LCA study at a generic, time defined level.
- Advanced – a complex, sophisticated level. This level allows for continuous data capture within the scope of LCA for internal purposes as well as any future update for other assessments, analysis or update. Additionally, this level enhances the purpose of the tool for use by ISO 14001, Environmental Management System (EMS) and other systems that focus on a 'time-free' improvement of systems and processes.

Furthermore, this contribution made possible a series of 'quick-wins' to boost manufacturer's awareness of their current practices based on real-life data. Moreover, opportunities for improvement became self-evident, which, in turn, contributed to a strong sense of endorsement and high motivation for addressing these in a structured way. This indication is an important element that can be built-upon in future work in the field of LCA within the timber industry.

Findings

Awareness

During the process of information dissemination it was found that the understanding of LCA varied from manufacturer to manufacturer. It was necessary to overcome the barrier of focusing solely on LCA as a tool. This was achieved by putting the project's aim in the context of the current sustainable construction agenda for the UK. A number of events have facilitated a good level of interest. These were:

- Leaflet on LCA distribution
- Presentations at various seminars
- Use of practical examples of LCA work in construction
- Growing use of EcoHomes as a requirement for delivering construction projects
- Sustainable Code for Housing being developed based on EcoHomes
- Addressing sustainable refurbishment as well as new build(EcoHomes XB)

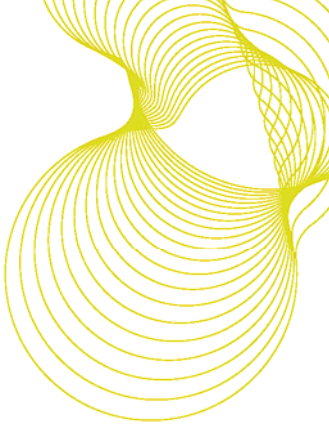
Awareness of LCA and its potential importance for the timber industry has been raised considerably as a direct result of this project.

Perception

The degree of acceptance of LCA's role as a useful tool was inherently linked to the level of awareness. The major important influencing factors were a perceived opportunity or hazard of using LCA or providing data. The significant features of interest in LCA were client's conditions (e.g. asking for environmental credentials contributing to EcoHomes or other BREEAM ratings) and achievements of competitors (both within the timber industry and in competing industries).

Data gathering tool – Format

During the design of the data gathering tool, the consultants found that the nature of manufacturing process (e.g. complexity) and the proliferation of various custom-built and in-house systems for data capture considerably hindered convergence with an existing format of data capture used by BRE (Appendix 2). To improve user-friendliness of this process an Access database was selected (see Appendix 3). A random sample of manufacturers were contacted regarding availability of Access software. As a large number of responses were negative, it was decided to include a developer's version of a 'running' package to allow viewing and use of the database in its final version. This final package improves accessibility and penetration in the market (Appendix 7).



Data gathering tool – Data availability

In the early stages of the design phase following the alpha testing of the tool, it became apparent that data flow in the supply chain is not coherent or focused on existing systems or concerns. Various business-related concerns were the continuity of supply, price, or Chain of Custody issues (CoC). It was unclear, whether information needed for the scope of a particular manufacturer's profile would influence or be influenced by their choice of supplier. Transport mode and distances were the focal points particularly with non-UK supply chains. It was noticeable that existence of CoC procedures improved the accessibility of relevant information.

Auxiliary data relevant to LCA, such as utilities (e.g. water use and discharge), were not initially considered or perceived as principal considerations. Often, substantial improvements were made by tackling these elements within the process, particularly at the 'incoming' gate point. For example, identifying a price-band for water use or considering a water meter. At the outgoing stage (i.e. out-of-gate), knowledge of and compliance with waste regulations and process-related savings had been more obvious. The energy use category brought to attention the nature as well as amounts of energy used. The Energy Savings Trust (EST) runs a useful service for business aimed at identifying any potential improvements or savings which can be realised.

These practical examples of opportunities offered by LCA considerably improved the status and perception of this tool.

Data gathering tool – Complexity

During the data gathering to populate the tool to achieve an LCA rating, the key issue was complexity and time-scale. This database was designed to help manufacturers to gather the data needed to look at the environmental profile of their products and processes. Once the data set is collected, manufacturers can use the tool to apply for a certificated environmental profile from BRE, or to produce environmental reporting information for submission to Defra on CO_2, waste and water.

Generally, a requirement of a reliable 12-month period data-set (or minimum of 3-month period) can be achieved at various time periods. This deliverable has the potential to be a very useful tool, particularly if input and output data are gathered throughout the year, as and when information becomes available to the company, as well as in one shot from whole year records. However, for future use there is a need for a two-level approach to the tool's design and development:

1. Basic – a generic, start level for one-time use
2. Advanced – a complex, sophisticated level, for continuous use

This project deliverable addresses the first level. It is hoped that future work could include and build upon this level of complexity. The momentum that was achieved in this project indicates that a high level of buy-in could be realized.

Conclusion and recommendations

This section provides a summary of the project's conclusions. This section also outlines suggestions for the way forward in future work regarding LCA use within the forest-timber industry in the UK.

The current sustainable construction agenda and commitment to delivery on environmental credentials provides a unique opportunity for the UK forest-timber industry to explore and engage in LCA work.

In order to make products 'greener', robust environmental, economic and social information must be available readily and in an understandable format. A life cycle approach presents a potentially powerful method for evaluating the environmental implications of products or services, and provides a good basis for making an evaluation of the economic and social impacts associated with those products and services, through the application of sustainable life cycle management.

The desk-based literature review revealed that a number of robust LCA studies demonstrate timber-based products to have favourable environmental profiles in comparison with alternative materials in a variety of products due to their beginning of life phase. However, up-to-date and specific and generic studies are necessary in order to support these assertions in the long-term. The developments in LCA and its use by a plethora of industries brings new challenges that need to be addressed in order to keep abreast with any inherent benefits or advanced modifications achieved by other industries. LCA work presents a positive opportunity for cross-sectoral progress.

Currently, manufacturers are more and more aware of various requirements for supply chains that must be addressed in order to continue a successful business activity (e.g. sustainable sourcing).

BRE's environmental assessment methods, such as BREEAM for housing called EcoHomes and the UK Government's work on the Code for Sustainable Homes offer frameworks to focus work in the provision of environmental information and labelling.

This project is complementary in its aims to the existing work on sustainable procurement of timber past responsible sourcing (i.e. sustainable forest management certification and Chain of Custody certification).

<u>Key deliverables:</u>

- Livesey, K; Mundy, J (2004) Life Cycle Assessment For Construction Products; An Introductory Guide For Manufacturers And Specifiers, Forestry Commission UK
- Data-gathering tool for the timber industry (2006) – CD ROM (Appendix 7 illustrates selection of screens from tool).

<u>Key impacts</u>

- Improved level of awareness and interest in LCA
- Improved understanding of manufacturing processes and possible improvements

- Improved motivation for participating in LCA
- A number of LCA studies in process or in final stages of negotiation
- An increased interest amongst manufacturers and professional associations in learning the practical use of LCA
- A high level of motivation in collaborating with BRE on generic LCA work (i.e. update of Green Guides, update of LCA methodology)
- Harmonisation and inter-linkages with current European project EFORWOOD (see Appendix 6)

Suggestions

Based on the above conclusions and the experience gained during this project a number of further work activities have been identified. These include:

- A series of seminars to broaden awareness of LCA and its applicability
- Gathering of at least 3-5 pilot studies on practical issues encountered by procurement practitioners
- Maintaining the momentum amongst individual manufacturers and relevant professional bodies
- Addressing technical barriers to utilisation of LCA-based recommendations
- Further development of the data gathering tool including processes at the beginning of life cycle (i.e. forestry) in updating existing data
- Expansion of scope for LCA work to comprehensively capture a representative sample of all forest-timber products manufactured and used in the UK

For further topics regarding generic LCA work see Appendix 4.

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Appendix 1 – LCA for Construction Products

The following pages present the deliverable '*Life Cycle Assessment for Construction Products; an introductory guide for manufacturers and specifiers'.*

Life Cycle Assessment for Construction Products:

an introductory guide for manufacturers and specifiers

Forestry Commission
www.forestry.gov.uk

BRE
www.bre.co.uk

JO MUNDY and KATIE LIVESEY December 2004

Introduction

Today, businesses are faced with ever stricter environmental controls and changing markets in which consumers are becoming increasingly aware of environmental matters. Conserving raw materials, saving energy and reducing waste will not only benefit the environment but will also improve the economic efficiency of your business. It may have the added benefit of enhancing the user's perception and appreciation of your product (which in turn may improve your place in the market).

What is Life Cycle Assessment?

Life Cycle Assessment (LCA) is a 'cradle to grave' assessment tool for products or processes. LCA systematically and objectively identifies and quantifies the inputs and outputs for a whole life cycle or for individual life cycle stages, such as cradle to gate or cradle to site. LCA can be used when analysing the origins of environmental impact problems related to a particular product; comparing improved variants of a given product; designing new products; or choosing between a number of comparable products.

Environmental reporting

Agenda 21, the European Commission's Integrated Product Policy (IPP), and the Construction Products Directive (CPD) recognise environmental information to be an important issue. Already, the EU energy label, mandatory in the UK, is considered to be a 'regulated Environmental Product Declaration (EPD)' by Defra. EPDs in the building and construction sector allow us to obtain LCA – based information from construction product manufacturers.

Why do we need LCA?

- To improve anything, you first have to measure it!
- Consumers are demanding products with environmental credentials.
- Manufacturers increasingly need to demonstrate their environmental performance and continuous improvement in their performance.

Various claims and counterclaims about 'environmental friendliness' cause a lot of confusion and they are meaningless unless they are supported by robust evidence. LCA identifies the material, energy and waste flows of a product over its entire life cycle so that the environmental impacts can be determined in a standardised way.

How is LCA done?

Figure 1 sets out the stages of LCA and this section describes these stages with particular reference to BRE's LCA methodology, which is tailored to the needs of LCAs for construction materials, components and buildings in the UK.

FIGURE 1 The phases of Life Cycle Assessment (according to ISO 14040), LINER

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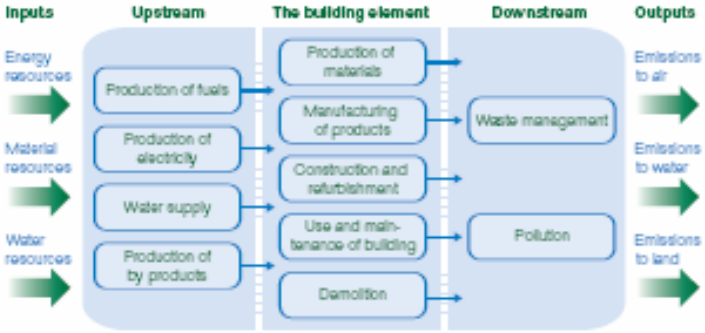
Stage 1: Goal and scope

This stage sets out the questions to be answered by the study: including why the study is being done, who it's for, what it's looking at, what environmental impact categories will be examined, the data needed and how the assessment will be done. LCA usually looks at achieving a purpose, like having 1 m² of external wall for 60 years (called the 'functional unit'. Different ways of making the wall could then be compared with each other. LCA can also be used to look at products, processes or services.

Stage 2: Inventory analysis

This is where the life cycle is mapped and all the data on inputs (materials, energy and fuels) and outputs (products, co-products, wastes and emissions) is gathered over the whole lifetime. The data is then converted into resources consumed, and emissions to air, water and land. The results are totalled for the whole life cycle into an inventory table.

FIGURE 2 The life cycle of a building element showing the inputs and outputs examined by LCA



Stage 3: Impact assessment

This stage is broken into 3 steps:

- Classification
- Characterisation
- Valuation

Classification

In this step, all the resources consumed and emissions generated over the whole life are attributed to all of the environmental impact categories that they contribute to.

Characterisation

The characterisation step allows the total impact in each category to be calculated. BRE's method gives a Characterised environmental profile (all categories in different units) that looks at the 13 different environmental impact categories set out in Table 1.

One substance can contribute to several categories and many different substances contribute to each category. This is why each category has its own reference substance and the amount of impact in each category is expressed in terms of how much of the reference substance is needed to give the same effect as the contributing substances. For example, sulphur dioxide (SO_2) is the reference substance for Acid Deposition (AD), so all substances causing AD are converted to the amount of SO_2 needed to give the same effect: 1 kg of ammonia (NH_3) causes 1.88 times as much damage as 1 kg of SO_2, so 1 kg NH_3 is equivalent (eq.) to 1.88 kg of SO_2.

Because the impacts in each category of the Characterised profile are in different units, the level of impact in each category can't be compared to that in any other category. BRE's methodology allows all

TABLE 1 BRE's environmental impact categories.

Impact category name	What it means	Abbreviation
Climate change	Global warming or greenhouse gases	GC100
Acid deposition	Gases causing acid rain etc.	AD
Ozone depletion	Gases destroying the ozone layer	OD
Human toxicity to air	Pollutants toxic to humans	HTox Air
Human toxicity to water	Pollutants toxic to humans	HTox Water
Summer smog	Air pollutants causing respiratory problems	POCP
Ecotoxicity	Pollutants toxic to the ecosystem	Ecotox.
Eutrophication	Water pollutants promoting algal blooms etc.	Eutroph.
Fossil fuel depletion	Coal, oil and gas consumption	FFD
Minerals extraction	Metal ores, minerals and aggregates	ME
Water extraction	Mains, surface and ground water consumption	WE
Waste disposal	Material sent to landfill or incineration	WD
Freight transport	Distance and mass of freight moved	TP&C

categories to be compared by dividing the Characterised environmental profile by the environmental profile of 1 UK citizen's annual impacts; giving all categories the units of 'per year'.

This step is called *normalisation* and shows how the values in the Characterised profile compare with the environmental impacts caused by human activity at the national level. BRE results are presented as either the number of UK citizens needed to cause the level of impact in one year or as percentages of the annual impacts of 1 UK citizen; so an impact of 100% is the same as that caused by one person.

The Normalised environmental profile shows where the biggest environmental impacts are but it does not answer the question, "Is the biggest impact of my functional unit the most environmentally critical one?" This is the purpose of the final step of Impact Assessment: valuation.

Valuation

Up to this point, LCA is firmly objective – it only says what the impacts are. It maintains a breadth of information on a wide range of issues. But which of these products has the lowest overall environmental impact:

- a product with high global warming impact but low water pollution impact or
- a product with low global warming impact but causing significant water pollution?

This is why systems of weighting the results of the Normalised environmental profile have been derived.

Valuation is generally used to produce a single numerical score by weighting each of the impact categories and summing them up into a single Ecopoints score. It is possible to look at the Ecopoints score for all the ways of achieving the functional unit you are interested in and giving them a ranked score (e.g. an A, B or C rating as in BRE's Green Guides 2000 & 2002) or by directly comparing the numerical scores to make your choice.

The weightings in the valuation scheme developed by BRE were the result of consensus-based research funded by DETR (before they became a part of Defra) to attach importance to sustainable construction issues. Building on other Eco-Indicator methods, the study used panels representing the perspectives of interest groups drawn from across the UK construction industry. These groups assessed economic, social and environmental sustainability issues. Through consultation with the panels, the research established the relative importance of different sustainability issues across the construction industry, finding a strong degree of agreement between the interest groups. The derived weightings for BRE's impact categories are used to calculate UK Ecopoints. BRE Digest 446 sets out further information on Ecopoints.

BREEAM, EcoHomes, Ecopoints, Environmental Profiles

BRE's Environmental Assessment Method (BREEAM) is a voluntary scheme for the environmental labelling of buildings, developed by BRE with private sector partners and sponsors. The basis of the scheme is a certificate awarded to the individual buildings stating clearly – and in a way that can be made visible to clients and users alike – the performance of the building against a set of defined environmental criteria scale from pass to excellent. EcoHomes, sponsored by the NHBC, is the homes version of BREEAM. It is a voluntary scheme for the environmental labelling of new and renovated homes. The Housing Corporation now requires an EcoHomes rating to award grants for social housing and several developers have committed to achieving the standard. English Partnerships requires the use of EcoHomes on all its developments and the WWF has made EcoHomes the basis for its high profile 'One Million Sustainable Homes' campaign.

One of the aims of BREEAM and EcoHomes is to encourage the use of materials that have lower impact on the environment, taking account of the full life cycle of the materials in question. BREEAM and EcoHomes include credits for selecting high environmental performance specifications for key building elements using the Green Guides for specific elements.

Green Guides ratings are obtained by calculating the environmental profile for all common construction specifications for a particular element, for example roofing. The range of impacts, from lowest to highest, is then divided into three (Figure 3). Any specification with an impact in the lowest (best) third of the range gets an A rating, in the mid-part of the range, a B rating, and in the part with the highest impact, a C rating. Rating are given to performance in each environmental impact category and in an overall, summary category.

These results are of interest to specifiers seeking products with a lower environmental impact because products with a summary A rating have comparatively less environmental impact than B or C rated products. These ratings, in turn, are used by the EcoHomes and BREEAM schemes.

Green Guides are based on functional unit for building elements put together in their typical, as-built form. Manufacturers can apply to have their product profiled and actively promote their Ecopoint scores and hence their Green Guide rating. Manufacturers have the opportunity to present their customers with data in a variety of ways:

- In the form of a full Environmental Profile
- As an A, B or C rating where a Green Guide element exists
- As an Ecopoints score

Manufacturers with certified environmental profiles are listed on the Environmental Profiles web site[1] as well as Redbook website[2], hosted by BRE Certification. Figure 4 shows the relationship of LCA, Ecopoints, Green Guides, BREEAM and EcoHomes.

FIGURE 3 Manufacturers can illustrate the environmental performance of their products within a building element on the Green Guide scale of A–C.

1. cig.bre.co.uk/envprofiles
2. www.redbooklive.com

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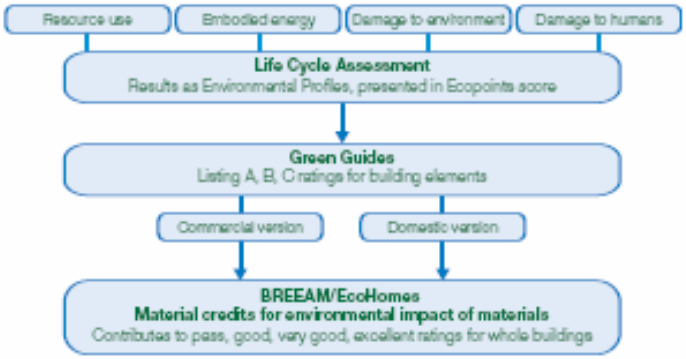
FIGURE 4 An illustration of the relationship of LCA and BREEAM/EcoHomes.



Glossary

characterised profile: the amount of impact in each of the environmental impact categories. Many different emissions can contribute to each impact category. The different emissions in each category are converted into the amount of reference substance needed to give the same effect. Each category has its own reference substance, e.g. CO_2 is the reference substance for Climate Change, and the amounts of any Green House gases in the Inventory Table are converted to the amount of CO_2 needed to cause the same effect. The impact categories are in different units and the values cannot be compared.

ecopoints: the normalised profile values are multiplied by weighting factors developed for each impact category and the results summed to give a single figure.

environmental impact category: environmental issue being examined, e.g. Climate Change, Acid Deposition and Human Toxicity to Air.

environmental profile: the level of impact in each environmental impact category for the functional unit or product being studied.

functional unit: the materials needed to achieve the desired purpose (function).

input: material or energy that enters a unit process (can include raw materials and intermediate products).

intermediate products: material that has already been processed before being used to produce a product.

inventory data: table of amounts of resources used, and products and emissions produced to achieve the product or function being studied.

life cycle: consecutive and interlinked stages of a product system from raw material acquisition or generation of natural resources to the final disposal.

life cycle assessment (LCA): compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.

normalised profile: The characterised profile is referenced to the environmental impact for each category at the national or global level in one year (usually for 1 citizen), giving a 'normalised' profile; the values are directly comparable.

output: material or energy that leaves a unit process (may include raw materials, intermediate products, products, emissions and waste).

raw materials: unprocessed material that is used to produce a product.

reference substance: substance that is used to calculate how much of this substance would be needed to give the same environmental impact as each of the many substance contributing to an environmental impact category. For example, carbon dioxide (CO_2) is the reference substance for Climate Change (GC100), so all the other gases contributing to Climate Change are converted into the amount of CO_2 that would be needed to give the amount of Climate Change that each different gas would cause, e.g. 1 kg of methane causes 21 times as much Climate Change as CO_2 (for the 100-year timeframe), so 1 kg methane is equivalent to 21 kg of CO_2.

Further reading

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www.breeam.org.uk
www.bre.co.uk/sustainable
www.bre.co.uk/envprofiles
www.leidenuniv.nl/cml/ssp
www.setac.org
www.uneptie.org/pc/sustain/lcinitiative

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Appendix 2 - Data for LCA method

BRE's Environmental Profiling method is based on Life Cycle Assessment (LCA). LCA follows all inputs into a system and all outputs that leaves it, which ensures that all impacts are attributed to the product being studied. Impacts come from the extraction, transport, processing, use and disposal of materials and energy. The following text illustrates the structure that has been used to set the data gathering (Appendix 7) based on the process that BRE adopts based on BRE's Environmental Profiling Methodology. This framework was used in a simplified way for the basic level of the tool as it is presented at the end of this project.

The following information is needed to properly evaluate the environmental impact of assessed products:

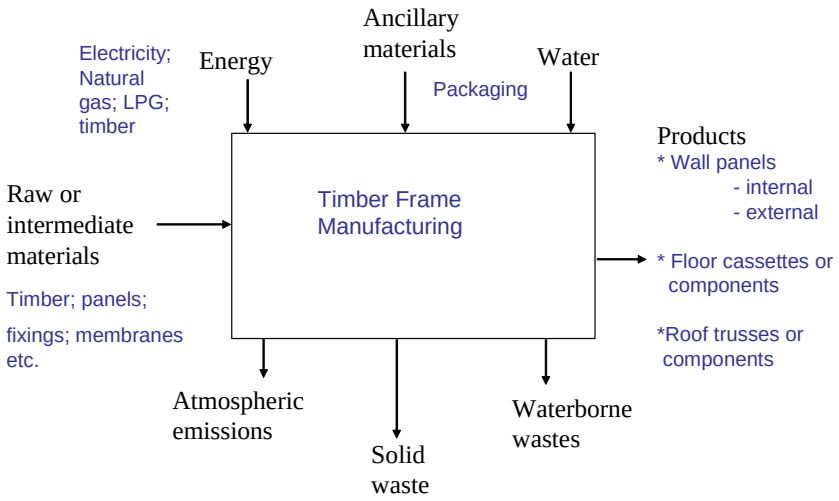
For 1 year's production:

1. **Types of materials and energy sources used;**
2. **Amounts of each material and energy source used;**
3. **Where each material and energy source came from;**
4. **How each material and energy source was delivered;**
5. **What products and emissions to air, water and land were produced by the process;**
6. **How much of each product and emission was produced.**

The data needs to be in physical units (kg, tonnes, litres, MJ, kWh etc) and cover one year of production.

Green Guide to Housing Specification
Any specifications that are produced on site and are part of interest to be assessed by LCA.

Life Cycle Inventory Template



Inputs & Outputs Checklist

INPUTS

MATERIALS	
Timber (kilned; kilned & treated)	
Wood-based panels (OSB, particleboard, plywood etc)	
Plasterboard	
Insulation	
Fixings • *Screws* • *Nails* • *Staples* • *Adhesives* • *Nail plates* • *Any other relevant items*	
Roofs (e.g. trusses or other relevant components)	
MEASURED EMISSIONS	
To Air	e.g. from presses or ovens
To Water	sewer & surface
To Land	e.g. controlled industrial & controlled special
Packaging	• *Banding (steel or plastic)* • *Wrapping (paper or plastic)*
ENERGY & FUELS	
Grid electricity	
Natural gas	
LPG	
Diesel (for processing not transport)	
Timber offcuts etc	
Any other relevant categories	

ON-SITE (FACTORY) TRANSPORT	
Diesel	
LPG	
WATER	

OUTPUTS

PRODUCTS	
Wall Panels	• *External* • *Internal*
Floor Cassettes	
Other products produced	

Plant information

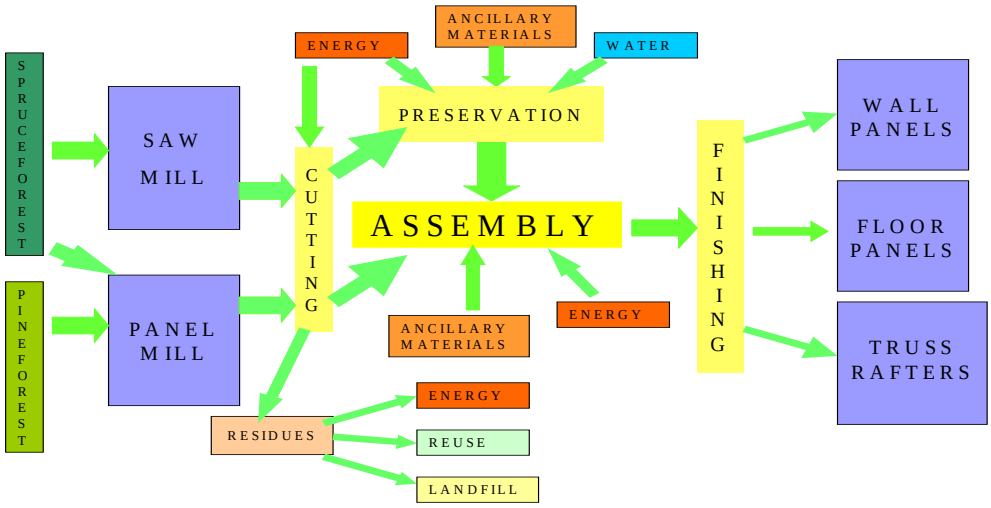
Company name
Company address
Contact name
Phone, fax, e-mail

Description of company & site

Size of site
Products produced
Where products used
Types of properties (houses, flats, hotels, residential nursing homes etc.)
Number of properties produced

Process Tree (Process Flow Diagram)

Please provide a diagram showing the processes products move through in your factory. Where possible, please indicate materials and energy entering each process & products, wastes and emissions leaving each process. The diagram below presents a generic Process Tree for timber frame manufacture and includes the upstream processes for the timber and wood-based panel inputs.



Data Gathering

i) Collection period

This should be for one year:

- Start month and year
- End month and year

ii) Products

This covers all products produced at the factory, e.g. wall panels, floor cassettes and roof panels, plus any co-products sold on (e.g. saw dust sold to panel factories). Units need to be as tonnes or to be convertible to tonnes, plus relative value of each product and co-product, if appropriate. Include BS or EN numbers, and Agrement Certificate numbers where appropriate.

'Typical' external wall specification – diagrams showing dimensions & materials. Fore wall panels inclusion of all materials, description of a 'typical product', fully itemised

'Typical' internal wall specification – diagrams showing dimensions & materials.

'Typical' floor cassette specification – diagrams showing dimensions & materials.

iii) Inputs

- **Materials (for each material input)**
  - Amount
  - Species (for timber and wood panels
  - Moisture content & density (for timber and wood panels)
  - Source
  - Transport to site

By ship

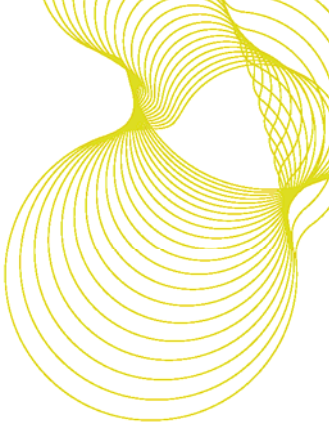
		Source of data
Amount		
Distance travelled		
Average load		
Number of loads		

By rail

		Source of data
Amount		
Distance travelled		
Average load		
Number of loads		

By road

		Source of data
Amount		
Distance travelled		
Vehicle type		
Average load		
Number of loads		
Road type		
%rural		
%highway		
Return journey		
loaded		
%part load		



- **Fuels and energy**

Include all fuels purchased for the site, including fuels used for heating and lighting in buildings and any fuels generated on site, e.g. wood waste. Please indicate what the fuels and energy are used for. This links back to the process flow diagram, and helps to ensure all fuels and energy are included.

Fuel Used	What is the fuel used for? (eg kilns, pressing)	Total quantity used per year	Units of fuel used (eg m^3 or kWh)	Source of data (eg meters, bills etc)
Grid Electricity[1]				
Natural Gas				
Fuel Oil				
Diesel/Gas Oil				
LPG				
Coal				
Kerosene				
Gasoline				
Landfill Gas				
Biomass-Specify Type				
Waste From Plant (Specify)				
External Waste[2] (Specify)				
Other (Specify)				

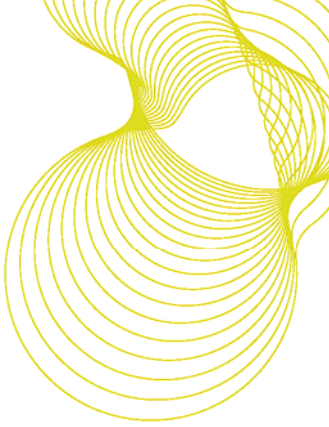
[1] If electricity is not purchased from the national supply, please indicate its source and list under Other.

[2] For example, wood residues, secondary liquid fuels (SLF).

- **Water**

Please provide data on the water used in the plant in the year. Where water is recycled within a local surface water or groundwater source, please supply further details. For surface water, please state source and discharge location, eg river, reservoir, rainwater from roof, etc. If volume of run-off is not known, please give site area.

Water Type	**Quantity taken into plant per year (litres, m^3)**	**Quantity discharged per year (litres, m^3)**
Mains water		
Surface water		
Groundwater		
Sewer		



Emissions, discharges and wastes

To Air (Outside)

BRE will convert general fuel data to emissions using standard conversion figures.

Wherever possible, provide specific data on Carbon Monoxide, Sulphur Dioxide, Nitrogen Oxides and Particulates or PM10s.

For the following categories, please list individual compounds wherever possible (with percentage composition for each component): Volatile Organic Compounds, Halogens, Hydrocarbons e.g. Methane, Metals e.g. Lead

- Carbon monoxide (CO)

Amount	
Measured volume	
Concentration	
Units	
Sampling procedure	
Baseline for sampling procedure	

- Nitrogen Oxides (NO_x)

Amount	
Measured volume	
Concentration	
Units	
Sampling procedure	
Baseline for sampling procedure	

- Hydrocarbons

Type (eg methane)	
Amount	
Measured volume	
Concentration	
Units	
Sampling procedure	
Baseline for sampling procedure	

To Water (discharges)

[1] *Please include data on specific compounds e.g.* oil and grease, metals (specify), cyanide, detergents, phosphates, phenol and phenolic compounds, ammonia and ammonium compounds, halogenated and non-halogenated organics, chlorides, heated water etc.

Discharges to water	Measured value (average and range)	Units (concentration or mass)	Sampling procedure
BOD to sewer			
BOD to surface water			
COD to sewer			
COD to surface water			
Total organic carbon To sewer			
Total organic carbon to surface water			
pH to sewer			
pH to surface water			
Suspended solids[1] to sewer			
Suspended solids[1] to surface water			
Other[1] to sewer			
Other[1] to surface water			
Other[1] to sewer			
Other[1] to surface water			
Other[1] to sewer			
Other[1] to surface water			

To Land (solid wastes)

- Please provide a list of the main materials in the description of the wastes produced.
- For special waste, it would be useful to use the National Waste Classification codes and Hazard Property codes (EPA 1990 Special Waste Regulations September 1996).
- Please also include all wastes that are recycled/re-used **externally** (i.e. off site), indicating the price that they are sold for or if they are given away. Wastes that are recycled/re-used internally do not need to be included.

Waste produced	Description of waste	Quantity per year (t)	Destination e.g. Landfill, incinerator, recycled	If recycled please state the price the material is sold for or if it is given away
Controlled: Commercial				
Controlled: Industrial				
Controlled: Special				

Any further information on the emissions and discharges…….

Transport beyond the factory gate

Background

This section is looking at the transport of your product from the factory gate. This data will be used to estimate the typical transport impacts associated with the transport of different construction materials from factory to site. This questionnaire requests the raw data that will allow these calculations to be made.

BRE has analysed data provided by DETR from their "Continuing Survey of Road Transport" and proposes to use the data on mean transport distance (loaded and empty journey), load and fuel consumption of vehicle for different commodity types provided by this analysis as the basis for this study. Data on vehicle type, loading and distance travelled is therefore only requested where it is easily available**. It is not intended that this survey should take hours to complete!** BRE will compare any actual transport data provided with the data analysis of the DETR statistics.

Products

Please give details of the product(s) covered by this questionnaire. If it is more convenient, please complete a separate questionnaire for each product.

Product 1……

Product 2……

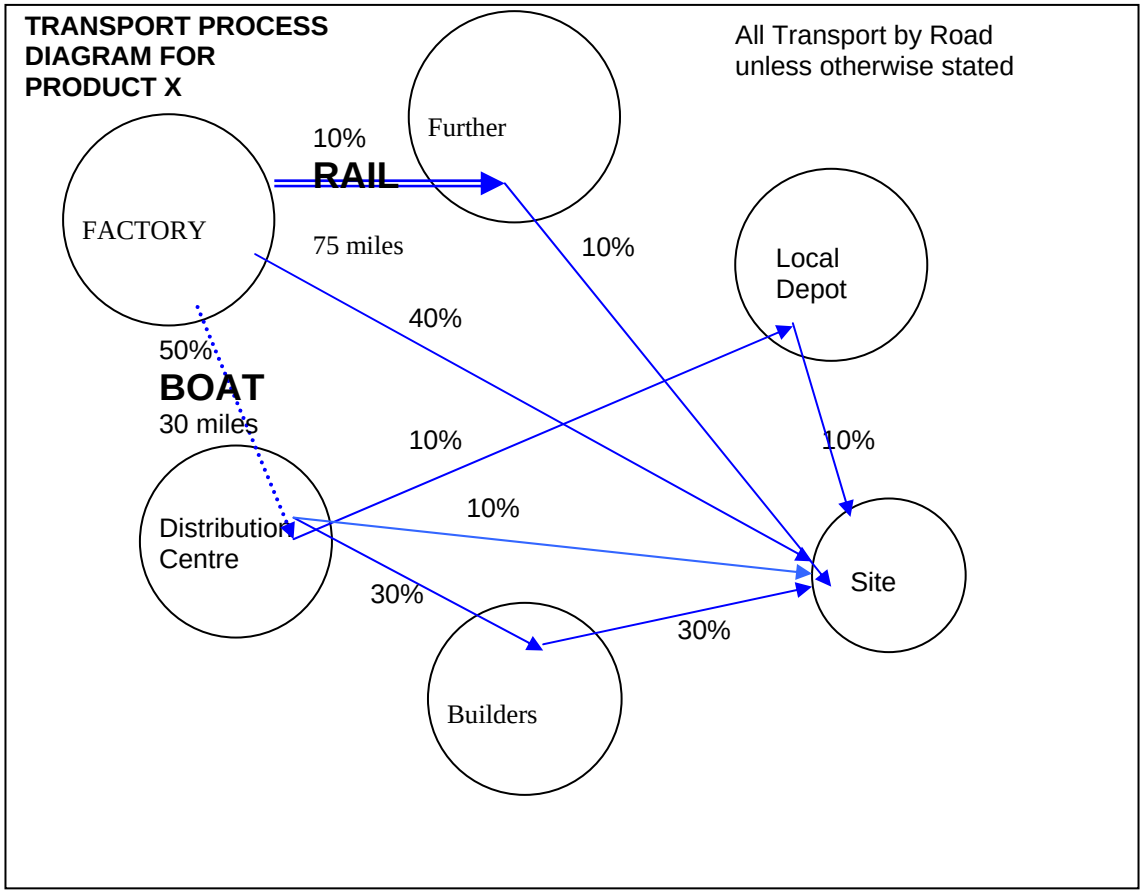
Product 3……

Product 4……

TRANSPORT PROCESS DIAGRAM

Below is a process diagram for an imaginary Product X showing some of the possible transport scenarios expected to arise relating to the transport of construction materials to site.

Figure 1



In the box on the next page, please insert a Transport Process Diagram similar to that shown in Figure 1 to illustrate the transport routes for Products where you are able to provide data. *Hand drawn diagrams are expected*. If several products are covered, you may find it easier to draw separate diagrams for each product using the further boxes provided. When creating the diagram, please consider the points listed below in Section 5.

PRODUCT: ……

Transport

Product: Please give details of the product or products which take these routes.

Routes: Please show the various routes used to transport the product from factory to site: eg direct to site; factory to distribution centre to site; factory to builders merchant to site; direct to site (builders merchant controlled) etc. If part of the factory production is exported, this should be shown with just one arrow pointing to EXPORT and showing the amount exported.

Proportion following route: Please give the amount of the product(s) following each stage of the route, eg 25%, ½ or 10,000 tonnes (total output must also be given if amounts are used). If using percentages or proportions, please ensure that these always relate to the total production of the product.

Mode of Transport: Building materials are commonly transported by road, rail and water. Please indicate the mode of transport for each stage of the journey from factory to site.

If details can be easily obtained, please list average load, distance and type of vehicle.

Appendix 3 – Selection of software used

This appendix provides a tabular summary of the reasoning for using access database as oppose to excel spreadsheet for the Environmental Profile tool.

Issue	Spreadsheet	Database
Purpose	To allow data, usually numerical data, to be analysed and presented in a variety of ways.	To allow data, either text or numerical data, to be entered, stored, managed, retrieved and manipulated.
Ease of use	Generic spreadsheets are intuitive and easy to use; customised spreadsheets may throw users who do not expect to be unable to see, edit or use large parts of the application. Customised spreadsheets use forms for data entry.	Use forms to allow the user to enter and see data (these forms usually replicate the appearance of a paper form); however the forms allow tighter control over what data may be entered into them.
Controlling data entered	Difficult to control quality of data entered; data may not be adequate	Easy to control aspects of quality, but data may still not be adequate
Extracting & presenting data	Difficult if data is to be extracted in any form other than how is was put it, or requires special extraction process; quality of presentation reasonable.	Data can be extracted through specially designed forms or reports, or can be extracted in MS Access by an expert user; new forms or reports can be cheaply designed and distributed. Quality of presentation high.
Flexibility of data model	Spreadsheets, once set up, are inflexible in the structure of the data they can accommodate. They do not handle one-to-many relationships (e.g. the fact that *one* supplier has *many* customers).	Highly flexible in the structure of the data they can accommodate. Specifically designed to handle one-to-many relationships.
Data integrity	Tend to contain duplicated data, which can lead to errors	Designed to avoid duplication
Metadata	Poor at managing information about who has used the application and when (metadata)	Usually designed to manage metadata along with the primary data

Issue	Spreadsheet	Database
Synchronising data	It is difficult to reconcile data held in different copies of a spreadsheet	It is easy to reconcile data held in different copies of a database
Scalability	Not truly scalable: with large datasets or several users tend to become very slow or crash	Can be scaled up to contain millions of records and to be used by tens or hundreds of people
Security against damage to the data and the application	Highly controlled and customised spreadsheets are usually quite secure	More secure than spreadsheets, with options for enhanced security
Security against unauthorised access to data	All users of a password-protected spreadsheet can open it with the same password	More secure: each user can have their own unique password
User training & support	Little difference between the two	Little difference between the two
Development & distribution costs	Development costs similar to those for a relational database; cost for each copy of the spreadsheet is negligible (staff time and material costs of copying and distributing the application)	Development costs similar to those for a spreadsheet; cost for each copy depends on whether database comes with a run-time version of MS Access bundled with it. If not, each user will need a copy of Access (@ c. £300)
Maintenance & upgrade costs	Little difference between the two	Little difference between the two

Appendix 4 - Generic profiles for discussion

Options for generating new or improved information on environmental performance using the LCA data collection tool are presented in the following table.

Option	Comments
Novel timber modification treatments suitable for UK-grown timber cladding, e.g. acetylation and hot oil treatment	None of these novel treatments is yet at the commercial scale needed to produce real products or generate the data needed to assess the inputs and outputs of commercial scale processing.
Bridges in the forest infrastructure	This could be used as a case study to determine whether a larger project would be beneficial. However, a scoping study investigating the types, purposes and maintenance regimes of forest bridges followed by a case study (or studies) has the potential to be more productive.
Forest roads – review of the model used to evaluate their contribution to the impacts of 1 green tonne of log at the forest roadside.	This presents an opportunity to revisit the assumptions made and the impacts caused by the forest road infrastructure derived in the PiT project completed in 2000. This investigation could also be used to ensure that the data gathering tool has the flexibility to apply to a wide range of forest-related industries. This study could also usefully revisit fertiliser and pesticide use because the impacts of these appear to have been underestimated in the PiT project.
Co-products – burn them for energy recovery or build with these	A scoping study to assess the potential environmental implications of using sawmill residues for composite panel production or energy production. The results could be used to develop Best Environmental Option guidelines for specific circumstances. Considerations should be given whether most useful study would focus on the national (strategic) level or for a specific case study.

Appendix 5 – A diary progress reports

September 04 – December 04

The first phase was completed at the end of 2005 with publication of a leaflet ‘LCA for construction products: an introductory guide for manufacturers and specifiers’. This first deliverable is available from the FC website, and hard copies from FC and BRE.

January 05 – March 05

The leaflet ’LCA for construction products: an introductory guide for manufacturers and specifiers’ was widely publicised at BRE events and features have appeared in one of the editions of the SFIC Newsletter and BRE’s Best Utilisation - News of CTTC work on UK timber.

The second stage is underway with design of the data gathering tool. A number of options of software packages were evaluated for use based on availability and ease of use. Categories of LCA data required were adapted, supporting explanatory information was prepared.

April 05 – June 05

The second phase addressed the remaining issues regarding the format of a tool for data gathering. An early draft was being alpha-tested internally. This early version did not contain all of the features that were planned for the final version.

This alpha testing in the second phase precedes beta testing (the last stage of testing involves sending the product to beta test sites for real-world, real projects, exposure). Thereafter, a further refinement will be based on comments from participants.

July 05 - September 05

The tool for data gathering was in the process of beta piloting phase with a timber frame manufacturer, UKTFA member Pinewood.

Beta piloting took longer than expected as companies found it difficult to keep to the tight timetable. It is, however, important to understand the practical implication of using the tool. Therefore, the beta testing phase was extended following discussions with the client (FC). Already, there was a positive spin-off from this phase as the piloting company had initiated a project towards certified LCA and began the process of data gathering.

October 05 – December 05

The data gathering tool refinement continued during the piloting phase to reflect practical implications of manufacturing processes. The necessity for differentiation between two objectives of the tool use, one off or continuous, was starting to emerge. This possibility of a two-level tool was further explored. A visit and presentation of this opportunity to another member of UKTFA was undertaken as well as to other professional bodies (e.g. TTF).

The third phase involved detailed discussions with UKTFA and its members. Also, other manufacturers, non-members of UKTFA approached BRE for initial discussion about the utilisation of this project (Palgrave Brown). This was a positive result from a number of presentations and other dissemination methods employed. It is necessary to have direct contact with the companies to present the information on LCA in conjunction with the tool. The ultimate uptake of the tool depends upon the industry.

January 06 – March 2006

The data gathering tool was continually upgraded on a stepwise basis. Differentiation of two levels was established and any relevant implications were addressed. Presentations were made to the UKTFA Commercial committee and other manufacturers. A number of issues were identified with the restrictions linked to tailoring the tool for TF manufacturing. It was agreed that other manufacturers will comment on use and application of this tool.

Further work with FEG was put on hold for the time being but it was hoped that detailed discussions could resume in the new financial year in conjunction with future project work. In this area focus was on manufacturers but allowing for an update of ‘upstream’ profiling that might significantly improve any ‘downstream’ profiles for individual manufacturers. Further useful discussions were held with BWF and TTF regarding LCA.

April 06 -June 06

Successful presentations were made to two additional companies (Stuart Milne and Finnforest). Both of the companies began the process of discussing proposals for LCA studies for their products. Another project (Pinewood) reached its final stage. The latter was the most important pilot study to determine the applicability of the tool.

The tool in its current form is useful to inform manufacturers of the issues involved (e.g. interactive raising awareness of sustainability indicators) as well as clarifying the level of detailed data required for an LCA study. One of the main findings was the low level of understanding of LCA requirements and opportunities it offers. Companies currently do not hold the information required for LCA. This tool should therefore be presented to the market at a basic level, without a large number of nested tables to enable continuous data collection. Uptake and understanding should be supported by a series of seminars for manufacturers to improve understanding that sustainability is a real opportunity for business. Currently, we are in discussions with TTF and Palgrave Brown to establish how such seminars may be run, perhaps in conjunction with potential clients of theirs.

The dissemination of this tool is suggested for any planned seminars that will be organised within the next 6 -8 months could also serve as an opportunity to present the tool at its basic level.

The focus remains on manufacturers but an update of 'upstream' profiling might significantly improve any 'downstream' profiles for individual manufacturers. Any future work on LCA will include practical feasibility of the advanced level tool within the existing systems that companies currently use. In the meantime, the basic level of the tool is available as the final deliverable (including a CD-ROM package that allows running of Access databases without having this software to increase coverage and decrease the barrier of internal manipulation of the tool).

Additionally, the tool may also be utilised within the current EFORWOOD project working with information on sustainability indicators and datasets for the European forestry-wood-chain (see Appendix 6).

Appendix 6 – EFORWOOD

EFORWOOD is a four-year integrated project, funded under the EU 'Global change and ecosystems' research activity of the Sixth Framework Programme.

The aim of the project is to provide methodologies and tools that will, for the first time, integrate Sustainability Impact Assessment of the whole European Forestry-Wood Chain (FWC), by quantifying performance of FWC, using indicators for all three pillars of sustainability; environmental, economic and societal. The project will provide methods to assess the sustainability impacts of modifications of Forestry-Wood Chains as influenced by policy changes, market drivers, or technological innovations.

Particular relevance to this project is Module 4 'Processing and manufacturing' (co-leader BRE). One of the main objectives of this module is to review and analyse existing tools and models and link them with the Tool for the Sustainability Impact Assessment (ToSIA), which will be the main deliverable of EFORWOOD. It is imperative that any data that will be provided for use in TOSIA are up to date for all regions considered. Thus, any data-sets for UK should be up-to-date to reflect the best practice and present a clear picture of the environmental assessment of the forestry-wood chain, including LCA. Furthermore, demonstrating active work in this field will contribute to raising the profile of the UK industry.

Currently, the UK holds a leading position in the work on sustainable procurement and environmental assessment within the forest-wood industry. This is a very encouraging development and any further work should be aimed at maintaining and improving this status.

Appendix 7 – Environmental Profile database tool

The following pages present a selection of print screens from the deliverable Environmental Profile database tool.