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Stepping up the Pace:
New Developments in Ecological Footprint Methodology, Policy & Practice

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Companies on the Scale: Comparing and Benchmarking the Footprints of Businesses

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ABSTRACT: Calculating the Ecological Footprint of a company must fulfil certain requirements. It must take into account the direct Footprint impacts such as direct land appropriation and emissions from vehicles and premises. And it also must take account of indirect impacts that are embodied in all the purchases the company makes. As companies and individual (final) consumers are not at the same place in the life-cycle of production and consumption, different calculations and conversion factors have to be applied, otherwise there would be double-counting and non-comparability of Footprints. Splitting up the life-cycle to account for the correct impacts of intermediate purchases and products is not trivial as every company is embedded in a complex web of suppliers and clients, each of which contribute their own Footprint to the total impact. We present an extended input-output approach to calculate Footprints of companies that are truly comparable. For purpose of international comparisons, results from different economies can be presented with an identical aggregation of economic sectors. The single region model currently in use leads to some limitations with respect to imports and international supply chains. We discuss the implications and how this shortcoming can be addressed in the future. We present a practical, quantitative example calculated with a new software tool (www.bottomline3.co.uk), including detailed breakdowns of all Footprint land types, sector benchmarking, structural path analysis (upstream supply chain analysis) and production layer decomposition. We discuss the implications for sustainable chain management and sector sustainability.

Conference Theme: Policy and Practice - Ecological Footprint as an organisational indicator

Keywords: company footprint, corporate sustainability, input-output analysis, benchmarking, supply chain analysis, sustainability threshold

1. Corporate Sustainability and Footprint Reporting

Corporations are beginning to apply the concept of sustainability at a practical level in terms of corporate citizenship or Corporate Social Responsibility (CSR). One of the possibilities for companies to report on their sustainability performance is Triple Bottom Line accounting. Triple Bottom Line (TBL) was a term originally coined by John Elkington[1] to describe corporations moving beyond reporting only on their financial "bottom line" to assessing and reporting on the three spheres of sustainability: economic, social and environmental.

Triple Bottom Line can be seen as a mere reporting device (e.g. information presented in annual reports) and/or an approach to improving decision-making and the fundamental functions of organisations (e.g. the provision of tools and frameworks for considering the economic, environmental and social implications of decisions, products, operations or future plans).

The concepts of Triple Bottom Line and associated systems and reporting frameworks are increasingly being taken up by companies worldwide as the Global Reporting Initiative (GRI)[2] and the work of bodies such as the OECD build momentum. In the wake of this work national and international regulations are changing and companies are more and more required to report their environmental performance.[3] TBL provides a framework for measuring and reporting corporate performance against economic, social and environmental benchmarks. Reporting on TBL makes transparent the organisation's decisions that explicitly take into consideration impacts on the environment and people, as well as on financial capital. It can reduce risk, assist in delivering better outcomes for employees, shareholders, customers and clients, and enhance reputation.

At the same time companies are increasingly choosing the 'Ecological Footprint' or the 'carbon footprint' as possible indicators of their environmental impacts. While the use of the Ecological Footprint for business has been considered for some time (Holland, 2003), carbon footprint assessments in particular have gained enormous popularity in 2006 and 2007 only with several high-profile reports, conferences or private and public initiatives dealing with this subject.[4] Both indicators, Ecological Footprint (EF) and carbon footprint (CF), can be incorporated into a TBL reporting scheme.

The ISA group at the University of Sydney have developed a new software tool, termed Bottomline[3] ("BL-cubed"). The UK version is available from ISA[UK] Research & Consulting.[5]

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1 His book "Cannibals with Forks: The Triple Bottom Line of 21st Century Business" introduced the concept of the Triple Bottom Line to a wider audience in 1997 (Elkington, 1997).

2 http://www.globalreporting.org

3 The EU Accounts Modernisation Directive (AMD), for example, introduces requirements for (large) companies to include a balanced and comprehensive analysis of the development and performance of the business in their Directors' Report. The analysis should "include both financial and, where appropriate, non-financial key performance indicators relevant to the particular business, including information relating to environmental and employee matters". This part of the EU Accounts Modernisation Directive is effective for financial years beginning on or after 1 April 2005.

4 E.g. Carbon Trust, 2006; Global Action Plan et al., 2006; Jackson et al., 2006; Hammond, 2007; http://www.endscarbonfootprints.com; http://www.tesco.com/climatechange.

5 http://www.bottomline3.co.uk

An organisation's financial accounts, together with on-site impact data, act as input. Software outputs include aggregate figures, detailed breakdowns and rankings of EF, CF and other economic, social and environmental indicators. Sector benchmarking, structural path analysis (upstream supply chain analysis) and production layer decomposition are available for all indicators. Quantification of 'shared responsibility' is realised by delineating impacts into mutually exclusive and collectively exhaustive portions of responsibility to be shared by all agents along a supply chain).

The need for robust tools and advice on environmental and sustainability reporting is growing rapidly and will persist in the future. A recent report from Trucost, published by Defra (DEFRA, 2006), hints at significant gaps:

- "… there is still a lack of quantification in most reporting. The Environment Agency study of Annual Reports and Accounts of the FTSE All Share companies, noted that the majority of reports lack depth, rigour or quantification. The study concluded that quantified environmental disclosure levels in Annual Reports and Accounts were found to be low…" (page 14)
- "Most business will have supply chain impacts that they should understand and consider reporting. There is no single, quantifiable measure that companies can use as a KPI [Key Performance Indicator] for the effect of their upstream supply chain on the environment." (page 63).

The methodology and the BL^3 tool described in this paper have been developed to address this lack of quantification and comparability. It is science-based, consistent and robust. It uses regularly published, publicly available National Accounts data. It ensures that the real bottom line is quantified, not a figure determined by an arbitrary cut-off point that could be different in different organisations. Reporting on the Ecological Footprint as well as the triple bottom line can deliver the full benefits of reporting, including: the ability to make comparisons within and between organisations; completely transparent communication of an organisation's impacts to all stakeholders; and detailed information across the whole supply chain as a basis for strategic decision making.

In this paper we

- describe the analytical approach to measure the total (direct + indirect) impacts of a producing entity, such as the Ecological Fooptrint in a comprehensive way,
- describe the new software tool Bottomline^3 that allows a consistent quantification of indirect impacts and their allocation to individual supply chains, and we
- provide empirical results of an EF analysis of a UK company in the sector 'Recreational Services'.

2. Measuring all indirect impacts

In this study, Ecological Footprints of a company are calculated using input-output analysis (IOA). Input-output analysis is a top-down economic technique, which uses sectoral monetary transactions data to account for the complex interdependencies of industries in modern economies. The result of generalised input-output analyses is a $f \times n$ matrix of impact factor multipliers, that is embodiments of f TBL indicators (such as EF, exports, labour, energy, etc.)

per unit of final demand of commodities produced by n industry sectors. A multiplier matrix **M** can be calculated from a $f \times n$ matrix **Q** containing the direct, sectoral TBL indicator scores (e.g. from national economic, social and environmental accounts), and from a $n \times n$ direct requirements matrix **A** according to

$$\mathbf{M} = \mathbf{Q}(\mathbf{I}-\mathbf{A})^{-1} \qquad \text{Eq. (1)}$$

where **I** is the $n \times n$ unity matrix. For many countries, the direct requirements matrix **A** can be compiled from the input-output tables published by the national statistical agencies.

The $f \times 1$ TBL inventory **F** of a given sectoral final demand represented by a $n \times 1$ commodity vector **y** is then simply

$$\mathbf{F} = \mathbf{My} \qquad \text{Eq. (2)}$$

An introduction into the input–output method and its application to environmental problems can be found in Leontief and Ford, 1970; Proops, 1977; Miller and Blair, 1985 and Lenzen, 2001.

There is a well-known precedent for IO analysis techniques improving assessment processes: In life cycle assessment (LCA), which aims to calculate the total environmental burdens associated with a product, IOA has experienced a significant role in overcoming what is known as the boundary problem, or the problem of incompleteness of an LCA inventory due to the arbitrary truncation of the system by a subjectively set boundary (Suh et al., 2004), thus preventing decision-makers from overlooking important hidden upstream impacts.

In an empirical application the IO formalism was applied by the ISA team at the University of Sydney to compile comprehensive Ecological Footprint and TBL accounts of the Australian economy and parts thereof (Lenzen and Murray, 2001; Lenzen et al., 2003; Global Footprint Network and ISA, 2005; Foran et al., 2005a and 2005b; see also Lenzen et al., 2007). National- and state-level economic sector level data for 344 sectors of the Australian economy were compiled, using input-output tables and additional data. A part of these accounts are published[6] and contain information on the aggregate and average performance of 135 economic sectors for ten TBL indicators together with their main data sources. The synthesis of disparate data sources is a major component of the development of a generalised IOA framework.

The Australian TBL sector accounts also describe in hard numbers economic, social and environmental indicators against a common unit of one dollar of final demand. The latter constitutes a convenient and meaningful numeraire, because it is the destination of GDP, the common measure of national economic performance. Social indicators such as employment, wages and government revenue can be described as "the minutes of employment generated per dollar of final demand". Environmental indicators such as greenhouse gas emissions, water requirement and land disturbance can be described as "kilograms of carbon dioxide equivalent emissions per dollar of final demand" or the like. However, the presentation of such complex analyses is always fraught with the tension between simplicity and complexity.

[6] www.isa.org.usyd.edu.au/publications/balance.shtml

3. Unravelling the supply chain

The boundary within which an organisation accounts for its environmental, social and/or economic effects is usually defined as that over which the company has direct influence and can exercise control. However, such a definition faces a number of challenges. The level of influence and control will vary from organisation to organisation and from year to year, invalidating comparisons within and between organisations. Moreover, extending the boundary beyond the immediate control of the organisation still begs the question of exactly where to draw the line. Decisions will differ between organisations and over time. Establishing a clear boundary for an analysis that is consistent across all indicators seems at first sight to be almost impossible.

Notwithstanding these challenges, the boundary problem can be solved by taking a full life-cycle perspective and by taking into account the structure of the economic system as described in the national input-output tables. This structure is best depicted as an ever-expanding "tree of interdependence" that starts at a particular economic entity, and stretches across upstream production layers, containing sectors at different production stages linked together by supply chains. Thus a particular impact associated with a good or a service cascades from primary industries producing raw materials, via secondary (manufacturing) industries into the sector or company that delivers the final product to the consumer.

The general decomposition approach described in the following was introduced into economics and regional science in 1984 under the name ‘structural path analysis’ (Crama et al., 1984; Defourny and Thorbecke, 1984). In order to systematically determine environmentally important production chains, the total factor multipliers derived in Eq. (1) can be decomposed into contributions from all input paths, by ‘unravelling’ the Leontief inverse using a series expansion. A multiplier m_i for industry i can then be derived, representing the sum over a direct factor input q_i, occurring in industry i itself, and higher order input paths (see Lenzen, 2002 and 2003 for details).

Such a structural path analysis covers the entire upstream supply chain. It "unravels" a company’s impacts into single contributing supply paths. It gives extensive detail of the impact of a sector’s or company’s activities. It allows investigating the location of impacts within the supply chain. In the case of a company, the control over the input procurement process then provides the possibility of substituting impact-intensive suppliers with more sustainable suppliers.

Detailed outputs of the Bottomline[3] tool derived from the application of structural path analysis include:

- a description of the path
- the path value (e.g. the greenhouse gas impact in grams of CO_2-equivalent per £ of final output of business management services),
- the path order (that is, from which upstream supply layer the path originates),
- the path coverage, that is, the relative contribution (in %) to the total TBL impact of the company.

4. Ecological Footprint Analysis of a UK Service Company using Bottomline^3

4.1. An introduction to Bottomline^3

At the University of Sydney, TBL Accounting has been formulated as a quantitative framework using an input-output-based LCA method. This framework has been applied to dozens of organisations in reporting on their sustainability performance – companies, government departments, NGOs. Experiences were collected in a 3-year pilot project. It became clear that the data collection burden for the organisation has to be as small as possible. As a result, a software tool was developed in collaboration with the using organisations, enabling users to create a comprehensive sustainability report solely by importing their existing financial accounts.

This software tool is called Bottomline^3, or short BL^3 ("BL-cubed"). A version for the UK economy has been co-developed by ISA^{UK} Research & Consulting, who are also licensing the tool in the United Kingdom.[7]

BL^3 accepts any organisation's financial accounts as imported input, and uses this financial information to calculate upstream, indirect impacts in terms of physical indicators chosen by the user. On-site physical impacts are entered separately. The TBL indicator set of BL^3 UK features a number of economic, social and environmental indicators, including the Ecological Footprint; carbon footprint; greenhouse gases; toxic, ozone-creating, acidifying and eutrophicating air pollutants; heavy metals; energy and resource use as well as material flows. In total the whole database distinguishes well over 100 indicators.

[7] See www.bottomline3.co.uk and www.isa-research.co.uk

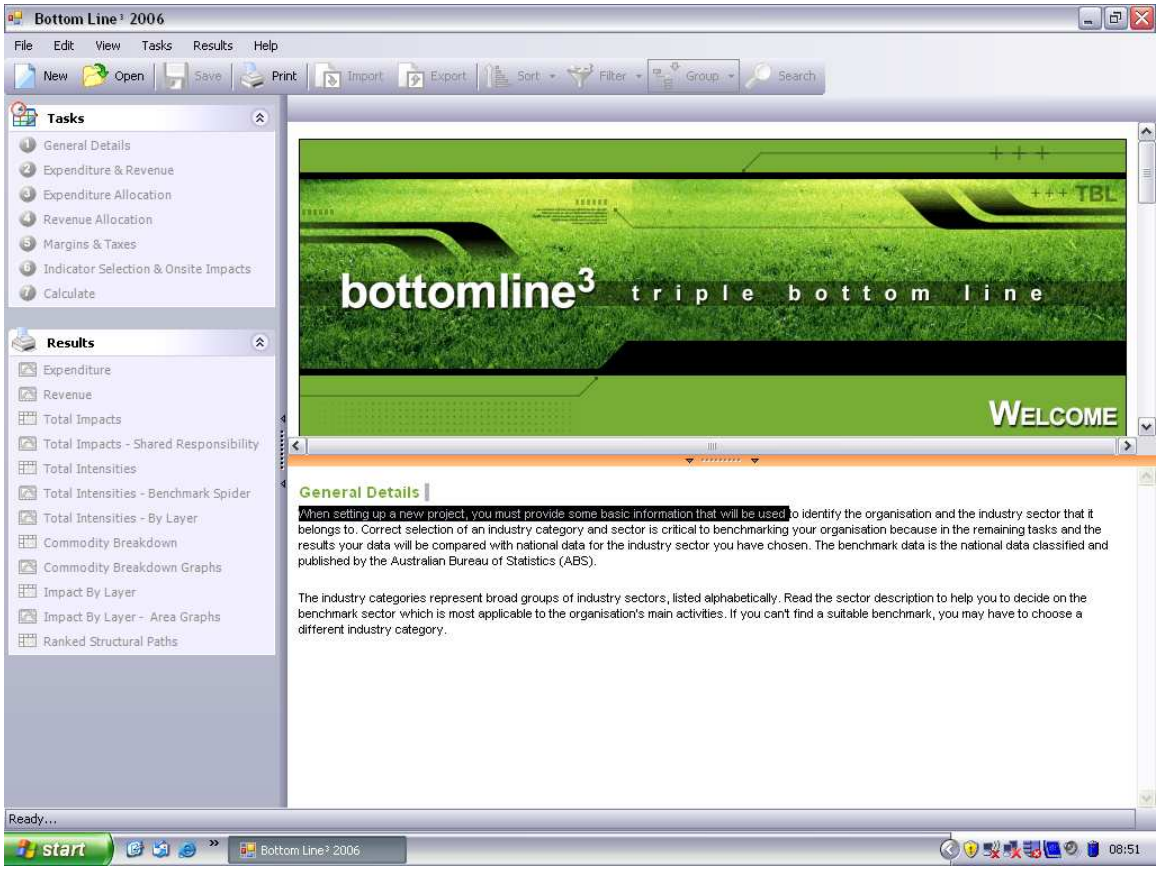

Figure 1: Introduction page of the Bottomline^3 software

Software outputs include aggregate figures, detailed breakdowns, sector benchmarking and rankings of indicators into supply chain contributions. Several examples are presented in the following.

A number of Triple Bottom Line figures for a company, including the Ecological Footprint, can be compared to the average performance of the sector to which the company belongs (see the analysis below). This is called 'benchmark spider diagram'. The regular polygon in the centre of the diagram (thick black line) shows the average TBL performance of the sector whereas the company's performance in key financial, social and environmental indicators is shown as a red line. Indicators with above average performance are closer to the centre, while below average indicators are positioned closer to the outside boundary. The smaller the area enclosed by the red line, the smaller is the total "footprint" of the company.

The BL^3 software has been extensively road-tested over three years. Users had no difficulty in understanding and accepting indirect impacts occurring off-site, in addition to on-site direct impacts. Users felt that assessing their organisation's indirect impacts was a valuable feature because it increases abatement options, enables meaningful benchmarking, avoids loopholes in reporting and informs about real risk. Sydney University's TBL software has been designed so it can readily be implemented for any economy for which input-output data complemented with physical data are available. The tool is available in Australia and the UK, trial versions include Japan, the US, and Germany. In principle it is possible to develop a version based on a multi-national IO framework that covers international trade flows (see also Wiedmann et al., 2007b).

The BL^3 tool quantifies supply chain contributions to TBL impacts according to the principle of 'shared responsibility'. This is realised by delineating impacts into mutually exclusive and collectively exhaustive portions of responsibility to be shared by all agents along a supply chain. A detailed description of this concept is given in Gallego and Lenzen (2005), Lenzen et al. (2006) and Wiedmann and Lenzen (2006).

The outputs of the Bottomline^3 tool enable the user to determine

- which of the operating inputs embody the largest impacts,
- whether these impacts occur at direct suppliers, or at more remote supply chain locations,
- and which single input paths carry the largest impacts (through structural path analysis).

Users perceive especially the latter information as very helpful, because it can be used for organisational planning and priority setting for informed action towards financial, social and environmental sustainability. In particular, it shows organisations alternatives for effective procurement policy changes, which may be applied instead of perhaps costly on-site measures.

4.2. EF analysis of a UK service company – Results and Discussion

The business investigated in this study is a small company that sells, rents out and distributes film, DVD and video material, employs three full-time staff and has an annual turnover of approximately £400,000. For the purpose of this paper, we call the business 'Company V'. The sector to which the company belongs is "Recreational Services", SIC code 92, more precisely 92.12: "Motion picture and video distribution".

Data used for the analysis comprise financial accounts and direct energy consumption data of Company V for the year 2001. We analysed the total (direct and indirect) impacts for the following indicators, measured in global hectares (gha):

- Total Ecological Footprint
- Fossil fuel energy Footprint
- Nuclear energy Footprint
- Crop land Footprint
- Pasture Footprint
- Built land Footprint
- Sea Footprint
- Forest Footprint

Table 1 shows the results for total Ecological Footprint as well as for all seven land types. The fossil fuel energy Footprint (6.98 gha) and the built land Footprint (1.94 gha) contribute most to the overall EF of 11.1 gha. Total absolute values for the whole sector of Recreational Services are included for comparison.

Table 1: Absolute Ecological Footprint of Company V and the whole sector of Recreational Services in the UK (gha = global hectares)

Indicator	**Company V's Impact**	**Total Sector Impact**	**Percentage** (company's of total sector impact)
Total Ecological Footprint	11.1 gha	997,090 gha	0.0011 %
Fossil fuel energy Footprint	6.98 gha	630,821 gha	0.0011 %
Nuclear energy Footprint	0.57 gha	44,318 gha	0.0013 %
Crop land Footprint	0.45 gha	60,529 gha	0.0007 %
Pasture Footprint	0.15 gha	20,417 gha	0.0007 %
Built land Footprint	1.94 gha	151,348 gha	0.0013 %
Sea Footprint	0.11 gha	21,278 gha	0.0005 %
Forest Footprint	0.90 gha	68,378 gha	0.0013 %

The relative performance measured in impact per £ of total output (total expenditure) is listed in Table 2 and depicted in Figure 2. Company V has higher EF intensities than the sector in most categories, especially in those related to energy consumption and the use of built-land. The pasture and cropland EF are close to sector average whereas the sea Footprint is the only component where Company V is performing better than the rest of the sector.

This, together with information from Table 1 suggests that energy consumption, because of high absolute and relative values for the energy footprint, is a major impact area of the company and one where there is room for improvements.

Table 2: Relative Ecological Footprint intensities of Company V and the whole sector of Recreational Services in the UK (g-m^2 = global square metres)

Indicator	**Company V**	**Total Sector Intensity**
Ecological Footprint	0.64 g-m^2/£	0.37 g-m^2/£
Fossil fuel energy Footprint	0.40 g- m^2/£	0.23 g-m^2/£
Nuclear energy Footprint	0.030 g-m^2/£	0.017 g-m^2/£
Crop land Footprint	0.0042 g-m^2/£	0.0040 g-m^2/£
Pasture Footprint	0.012 g-m^2/£	0.011 g-m^2/£
Built land Footprint	0.019 g-m^2/£	0.010 g-m^2/£
Sea Footprint	0.016 g-m^2/£	0.019 g-m^2/£
Forest Footprint	0.013 g-m^2/£	0.007 g-m^2/£

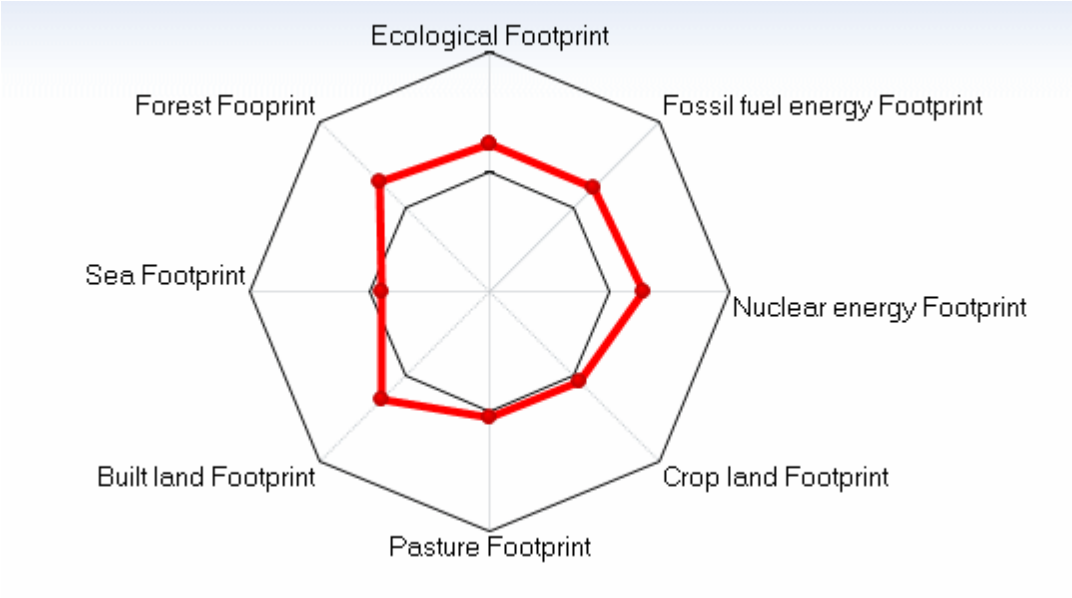

Figure 2: A spider diagram presentation of Ecological Footprint performance of Company V, broken down in contributions from land types (red line). The regular polygon in the centre of the diagram (black line) shows the average EF performance of the Recreational Services sector, allowing a benchmark comparison between the company and its sector. Company Footprint values with above average performance are closer to the centre, while below average indicators are positioned closer to the outside boundary.

The following graph shows again the company performance (0.64 gm^2/£) in comparison to the sector performance (0.37 gm^2/£) for the total Ecological Footprint. It also reveals that less than one third (27.6%) of the total EF can be attributed to direct or on-site impacts of Company V (1st order section, light grey area). The rest (2nd and higher orders) are all indirect impacts from other sectors in the economy. About 50% of these indirect impacts can be attributed to direct suppliers of Company V as they are located in the 2nd order or layer of the upstream production process.

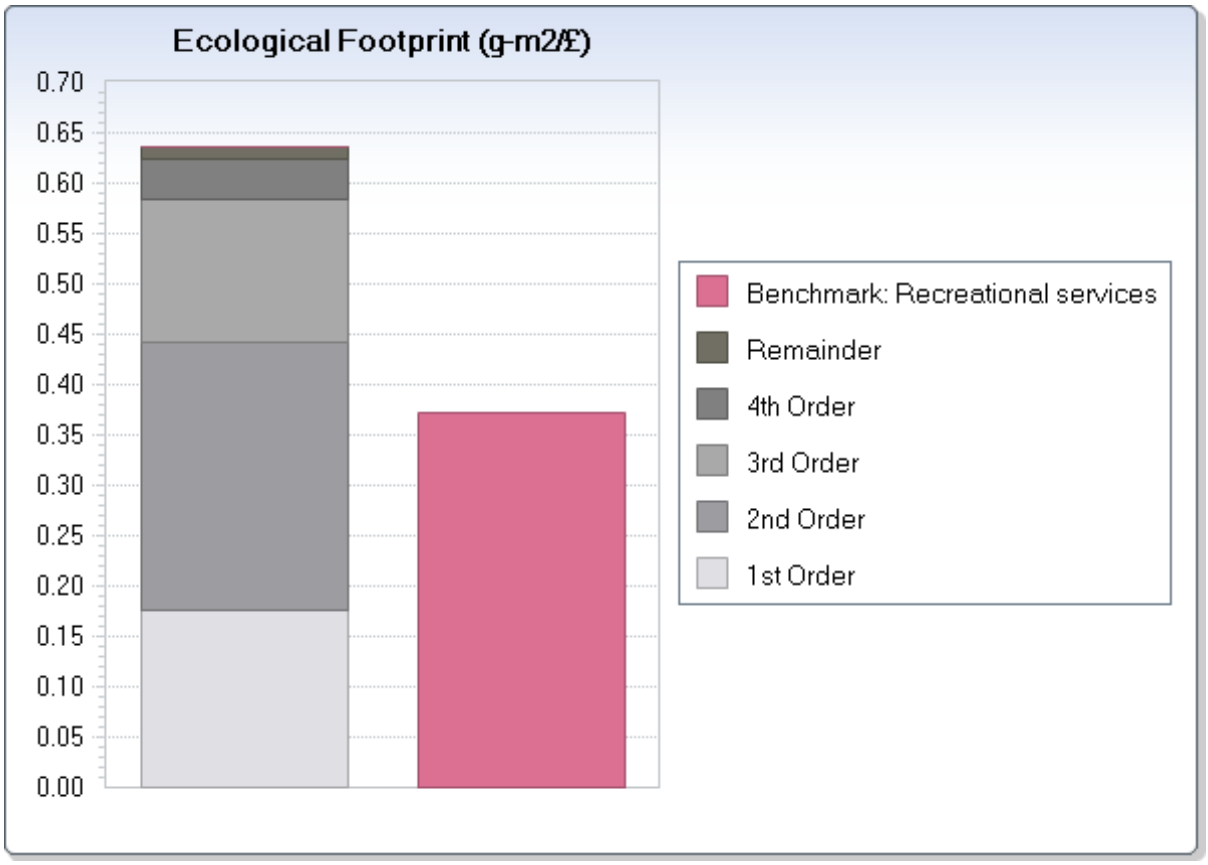

Figure 3: Comparison of total Ecological Footprint intensity of Company V (1st order) and its sector of Recreational Services (benchmark). Most indirect impacts come from suppliers (2nd order) and suppliers of suppliers (3rd order) of Company V.

But who are the suppliers of Company V and where exactly do these indirect impacts come from? The next graph qualifies this result in that it does not only show how much is added to the indirect EF in each production layer (or supply chain link), but also to which main parts of the economy this EF can be attributed. In order to capture more than 90% of the total EF of Company V at least four production layers have to be taken into account. This is something which is difficult to achieve with process-based information alone which is being used in Life Cycle Analyses (LCA), for instance. Unless four or more production stages of *each* major supply chain line are taken into account, it is possible that significant amounts of the total Ecological Footprint are not captured.

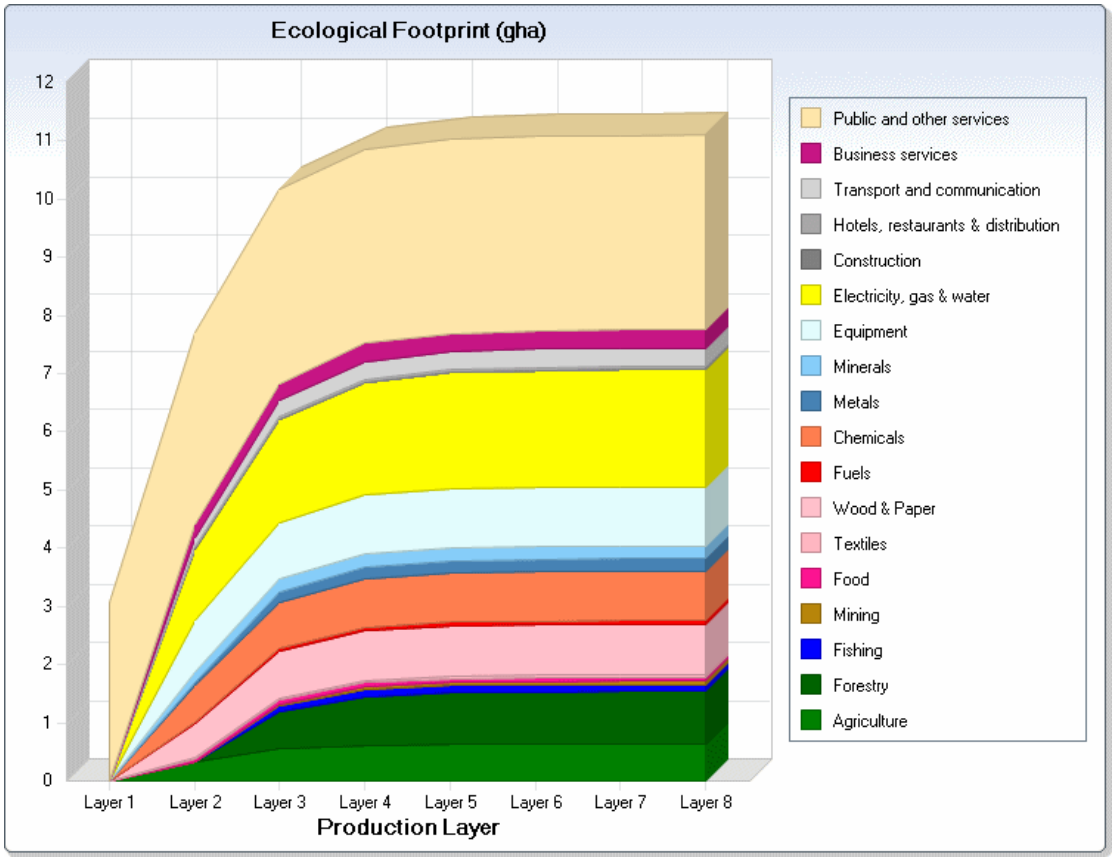

Figure 4: Production layer decomposition of the total Ecological Footprint (11.1 gha) of Company V. The company's direct Footprint of 3.06 gha sits in Layer 1 (direct or on-site impact). Suppliers of Company V (Layer 2), suppliers of suppliers (Layer 3), and so on, all contribute to the indirect EF with electricity production being the largest contributor. Note that Forestry only starts adding impact from Layer 3 onwards. "Public and other services" is the umbrella term for the part of the economy to which Company V belongs.

The consumption of electricity by Company V is obviously the area which contributes most to the indirect Footprint. Other major contributions come from the areas Equipment, Chemicals, Wood and paper, and Forestry. Note that the Footprint contribution from Forestry does not come from a commodity bought directly by (supplied directly to) Company V! The impact does only start in Layer 3 (supplier of supplier) and Table 2 below reveals that the Footprint impact comes from wood products purchased by Company V.

Table 2 shows the results of a structural path analysis of the total EF (this analysis can also be done for each Footprint land type separately, see e.g. Table 4), providing a further refinement of the location of total Ecological Footprint contributions from individual commodity supply chains. 27.6% of the Footprint is direct or on-site; significant indirect contributions come from the consumption of electricity (9.8%), furniture (4.4%), forest resources used for wood products (4.3%), paper (3.6%) and inorganic chemicals bought by the company (3.2%).

Table 3: Results of a BL^3 structural path analysis of a Company V's total Ecological Footprint. The total EF embodied in the supplies from upstream producers is broken down into contributions from commodities traded through supplying sectors. The list shows path values and orders (i.e. how large and how far away the impacts are). The total EF of Company is 11.1 gha.

Rank	Path Description	Path Value	Path Order	Percentage of total impact
1	Company V	3.06 gha	1	27.6 %
2	Electricity production and distribution > Company V	1.09 gha	2	9.80 %
3	Furniture and miscellaneous manufacturing > Company V	0.49 gha	2	4.41 %
4	Forestry > Wood and wood products > Company V	0.47 gha	3	4.27 %
5	Pulp and paper > Company V	0.40 gha	2	3.61 %
6	Inorganic chemicals > Company V	0.36 gha	2	3.22 %
7	Agriculture > Company V	0.32 gha	2	2.87 %
8	Electricity production and distribution > Electrical machinery > Company V	0.21 gha	3	1.90 %
9	Legal, consultancy and other business services > Company V	0.21 gha	2	1.89 %
10	Agriculture > Food and drink > Company V	0.19 gha	3	1.69 %
11	Electrical machinery and equipment > Company V	0.14 gha	2	1.25 %
12	Pulp and paper > Printing and publishing > Company V	0.12 gha	3	1.05 %
13	Recreational services > Company V	0.12 gha	2	1.05 %
14	Water supply > Company V	0.12 gha	2	1.04 %
15	Wood and wood products > Company V	0.11 gha	2	0.97 %
16	Membership organisations > Company V	0.10 gha	2	0.94 %
17	Cement, lime and plaster > Company V	0.09 gha	2	0.85 %
18	Forestry > Printing and publishing > Company V	0.09 gha	3	0.83 %
19	Office machinery and computers > Company V	0.09 gha	2	0.80 %
20	Fishing > Food and drink > Company V	0.08 gha	3	0.72 %

All these analyses can be undertaken for other parts (land types) of the Ecological Footprint. In the following we show the results of an impact breakdown by commodity for the Fossil Fuel Energy Footprint (Figure 5) and the Nuclear Energy Footprint (Figure 6), a production layer decomposition of the Built land Footprint (Figure 7), and a structural path analysis of the Forest Footprint (Table 4). Results are explained in the respective captions.

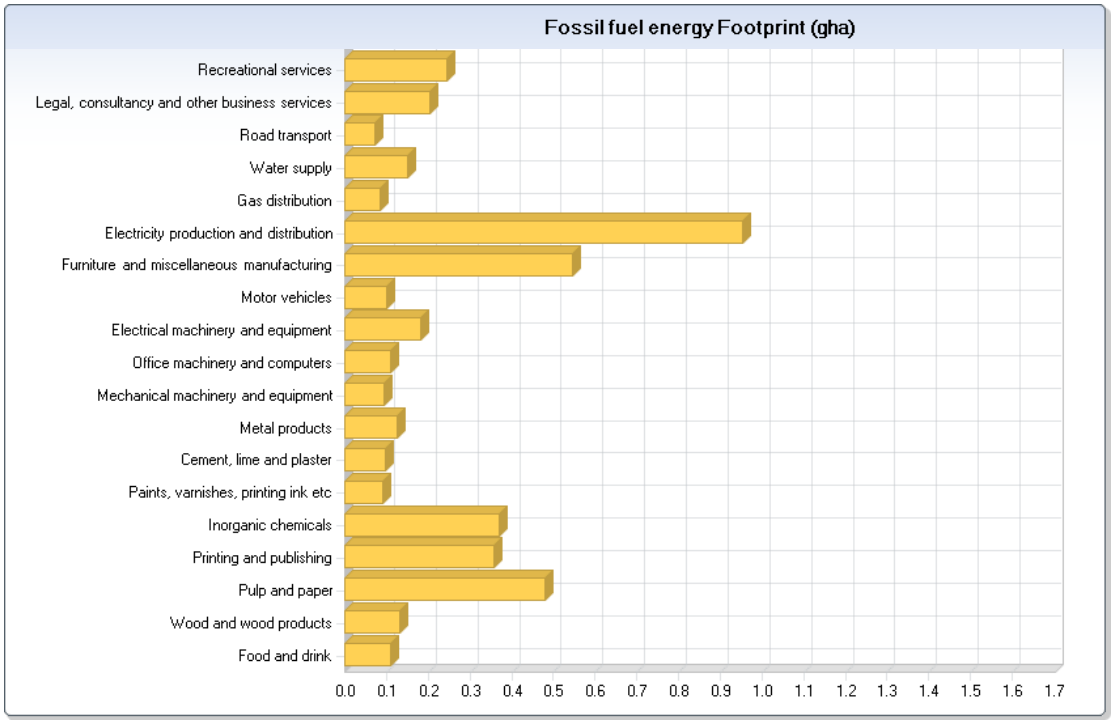

Figure 5: Fossil fuel energy Footprint of main commodities bought by Company V in global hectares (gha). All Footprints are indirect – embodied in the products or services. Main impacts come from electricity, furniture and paper products.

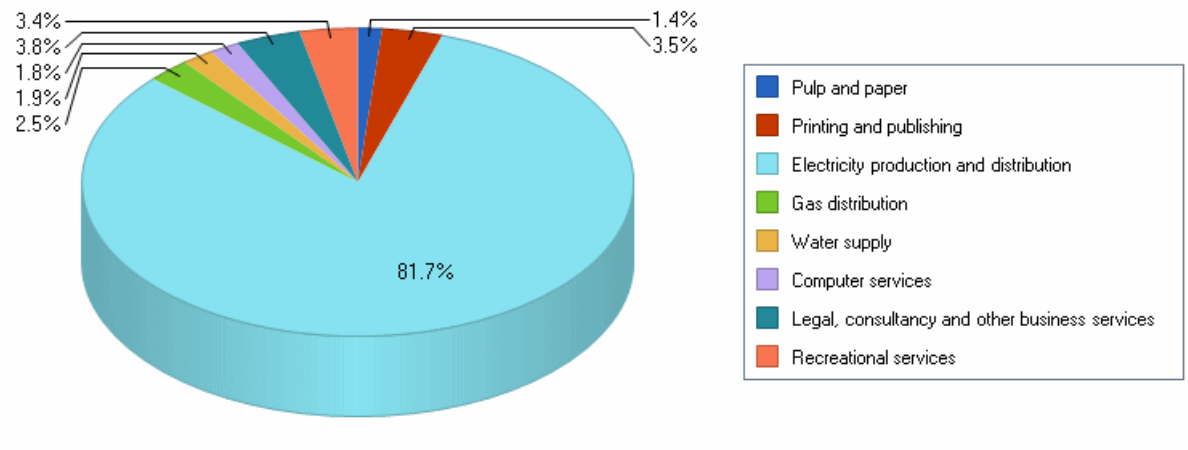

Figure 6: Nuclear energy Footprint of main products and services purchased by Company V in percentages of total nuclear energy Footprint. global hectares (gha). About 82% of this Footprint impact comes from the use of electricity by Company V.

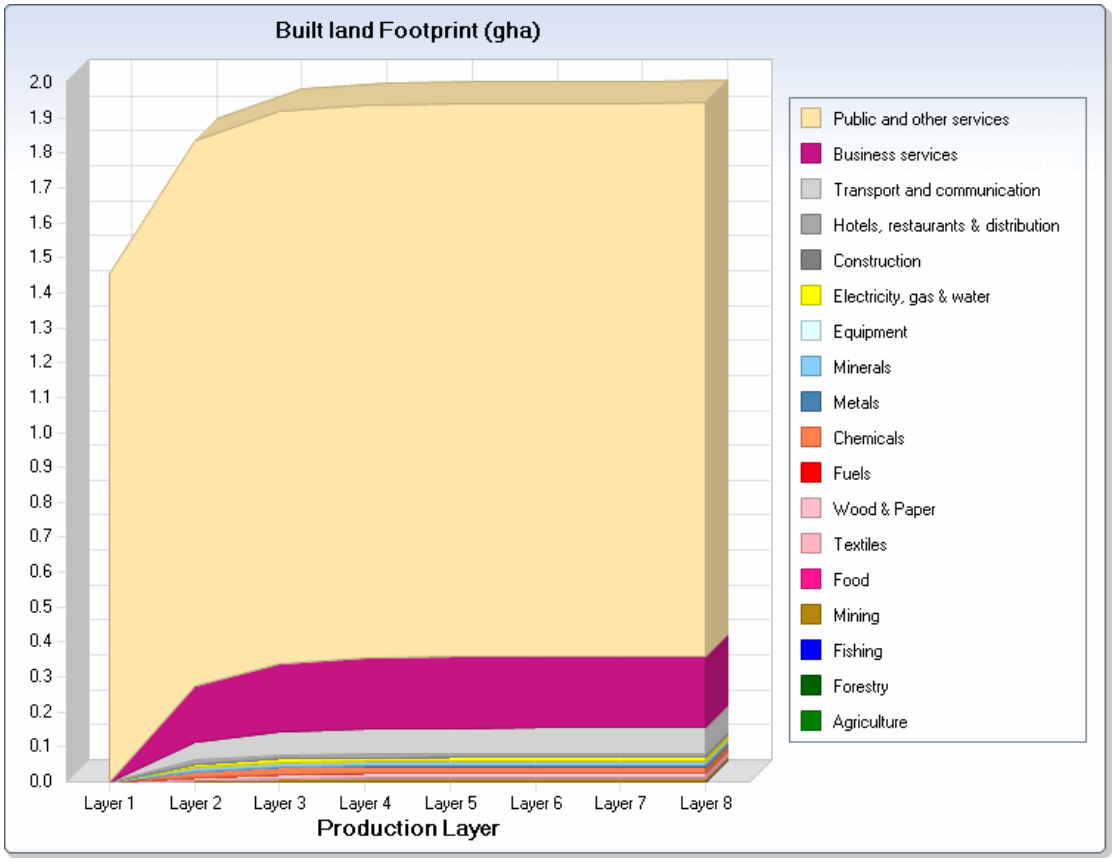

Figure 7: Production layer decomposition of the Built land Footprint (1.94 gha) of Company V. The company's direct Footprint of 1.45 gha sits in Layer 1; these are direct or on-site land requirement for premises ("Public and other services" is the umbrella term for the part of the economy to which Company V belongs). Business service providers (dark purple) contribute most to the indirect built land Footprint of Company V.

Table 4: Results of a BL^3 structural path analysis of Company V's total Forest Footprint. The Forest EF embodied in the supplies from upstream producers is broken down into contributions from commodities traded through supplying sectors. The list shows path values and orders (i.e. how large and how far away the impacts are).

Rank	Path Description	Path Value	Path Order	Percentage in total impact
1	Forestry > Wood and wood products > Company V	0.120 ha	3	52.8 %
2	Forestry > Printing and publishing > Company V	0.024 ha	3	10.3 %
3	Forestry > Wood and wood products > Wood and wood products > Company V	0.011 ha	4	4.77 %
4	Forestry > Forestry > Wood and wood products > Company V	0.011 ha	4	4.53 %
5	Forestry > Pulp and paper > Company V	0.008 ha	3	3.63 %
6	Forestry > Wood and wood products > Furniture and miscellaneous manufacturing > Company V	0.007 ha	4	2.97 %
7	Forestry > Wood and wood products > Pulp and paper > Company V	0.0030 ha	4	1.29 %
8	Forestry > Pulp and paper > Printing and publishing > Company V	0.0025 ha	4	1.06 %
9	Forestry > Recreational services > Company V	0.0025 ha	3	1.06 %
10	Forestry > Forestry > Printing & publishing > Company V	0.0021 ha	4	0.88 %
11	Forestry > Printing and publishing > Printing and publishing > Company V	0.0019 ha	4	0.81 %
12	Forestry > Wood and wood products > Recreational services > Company V	0.0017 ha	4	0.72 %
13	Forestry > Legal, consultancy and other business services > Company V	0.0014 ha	3	0.59 %
14	Forestry > Food and drink > Company V	0.0012 ha	3	0.49 %
15	Forestry > Chemical products > Company V	0.0011 ha	3	0.47 %
16	Forestry > Wood and wood products > Wood and wood products > Wood and wood products > Company V	0.0010 ha	5	0.43 %
17	Forestry > Furniture and miscellaneous manufacturing > Company V	0.0010 ha	3	0.42 %
18	Forestry > Forestry > Wood and wood products > Wood and wood products > Company V	0.0010 ha	5	0.41 %
19	Forestry > Forestry > Forestry > Wood and wood products > Company V	0.0009 ha	5	0.39 %
20	Forestry > Wood and wood products > Pulp and paper > Printing and publishing > Company V	0.0009 ha	5	0.38 %

5. Conclusions

Numerate Triple Bottom Line accounting at the company level highlights a number of key issues important to the sustainable development agenda. Especially if all upstream impacts stemming from a web of supply chains are taken into account, new insights and useful information for corporate decision-making can be gained. With the approach described in this work and by using the Bottomline[3] software tool we are able to allocate Ecological Footprint loadings of products and services used by a company as well as the impacts' location in their respective upstream supply chains.

The results of such a detailed analysis provide valuable insights into the causes for Ecological Footprints. Based on the findings, the company in this example is now looking into the possibility of reducing its high consumption of electricity and fossil fuels. Some energy-saving measures have already been put in place. The business will also look into their use of paper and their printing processes (and associated use of chemicals). Impacts associated with furniture and wood products can be attributed to purchasing and refurbishing in this particular year and are not likely to occur on an annual basis. However, if new purchases are due, the company will enquire with the suppliers about the environmental impacts of their products.

Thus, the analytical approach presented in this paper has proved methodologically robust as well as useful in practical terms. Its strength lies in the simplicity of operation on the one hand and its comprehensiveness on the other hand. At the moment, the input-output model used is based on a single region (the UK) with the assumption that imports have been generated with domestic production technology. One possibility to overcome this limitation is the implementation of a multi-region input-output model as described in Turner et al., (2007) and Wiedmann et al. (2007a and 2007b).

International corporate reporting approaches such as 'The Global Reporting Initiative' and 'The Equator Principles' are rapidly gaining headway and have widespread support through many globalised companies and national governments. However they are currently orientated to a 'within the factory fence' approach, but do acknowledge a number of first order issues such as the origin of water and energy, and some second and third order effects particularly the labour practices used to supply intermediate inputs to production. Part of the harmonisation process will require the development of indicator datasets that match the requirements of these initiatives, as well as collaborating in the development of international software tools that enable the fluent use of whole economy accounting without boundaries. The approach and tool presented in this study contributes to this goal.

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