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Identifying resource productivity for five key economic sectors in the South West region

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Identifying resource productivity for five key economic sectors in the South West region

An environmental scoping study using the Triple Bottom Line (BL^3) software tool

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Executive Summary

This study was commissioned by SCPnet[1] to inform the regional debate in the South West on Environmental Limits. Underpinned by the UK Government's Sustainable Development Strategy[2], the Regional Economic Strategy for South West England (RES) intends to demonstrate that economic growth can be secured within environmental limits[3]. To assess the direct and indirect environmental impacts of a range of production and service operations, previous work by the South West RDA had identified the following economic sectors in the South West region:

- Transport Equipment manufacture including aerospace
- Motor Vehicle manufacture
- Hotels and Catering services
- Food and Drink manufacture
- Business Services

This scoping study is a first attempt to estimate the environmental pressures from these economic sectors using the carbon footprint as a main indicator. Methane and nitrous oxide emissions were included for Hotels and Catering services, and Food and Drink production.

The study identified potentials for improving resource efficiency in the chosen sectors, and also benchmarked the region's sectors against their UK averages. Better on-site and supply chain management is a prerequisite for increasing resource efficiency; in turn, this can strengthen a region's competitiveness. In addition, improved resource productivity can reduce the sectors' carbon footprint and the release of toxic substances into the environment. In this sense, the results of this study can support the RES delivery framework's strategic objectives in terms of supporting business productivity, innovation, and for competing in the global market. The key results from this study were:

- For all five sectors that were analysed in this report, the largest single source of CO_2 emissions is associated with direct on-site operations of manufacturing and services. With regard to indirect emissions, the majority are generated by the direct suppliers to a sector. This is good news as direct manufacturing and service operations, and immediate suppliers, can easier be influenced than more remote agents in the supply chain. In general, energy efficiency measures and a higher share of renewable energy would reduce direct and indirect CO_2 emissions in the supply chain.

- **Overall CO_2 emissions**: the SW Food and Drinks sector has the highest overall emissions followed by Business Services, Transport Equipment manufacture, Motor Vehicle production, and Hotels and Catering services.

- **Impacts per £ spent (intensities)**: compared to their respective UK sectors, the SW Motor vehicle production sector was the most efficient followed Food and Drinks production, Hotels and Catering services, and Transport Equipment manufacture. Business services were the least efficient.

- **Impacts per £m GVA**: in terms of CO_2 emitted, per £m of GVA the analysed sectors are less efficient than their average UK sectors as follows: Business Services 95% less efficient; Hotels and catering services 35%; Transport equipment manufacture, 5%; Food and Drink production 1%; Motor Vehicle manufacture, 185%.

1 Sustainable Consumption network (SCPnet) comprising the Environment Agency, the English Regions (RDAs and Regional Assemblies) and WWF.

2 http://www.sustainable-development.gov.uk/publications/uk-strategy/index.htm

3 http://www.southwestrda.org.uk/what-we-do/policy/res-review2005/draft-res.shtm

Hence, the three worst performing SW sectors in terms of impact intensities per £ spent and per £m GVA are the Business Services sector, Transport Equipment manufacture, and Motor Vehicle manufacture.

- **SW Transport Equipment**
  The single highest impacts in the supply chain are from the transport equipment sector itself. On-site electricity use was solely related to the manufacturing of aerospace equipment. First suggestions are a) a further analysis of the industrial processes to establish where energy savings in facilities, plants, and machinery could be made, b) switching to renewable energy suppliers, and c) possibly a further analysis of industrial processes of the direct suppliers to the transport and equipment manufacturers.

- **SW Motor Vehicles manufacture**
  The sector itself contributed most in terms of the carbon footprint, followed by other motor vehicle manufacturers (possibly parts manufacture) and metal producers who directly supply this sector. Although energy consumption was 10% higher than the UK average, this sector performed better than average in terms of CO_2 emissions. A further analysis of on-site and suppliers' industrial processes, and switching to renewables, could further reduce the sector's carbon footprint.

- **SW Hotels and Catering services**
  For the ecological footprint, total impacts were highest for the fishing industry, the SW Hotels and Catering sector itself, and for the agricultural sector. For CO_2, the sector itself caused the highest emissions within the supply chain followed by food and drink production and road transport. Electricity production was also significant. Methane and nitrous oxide emissions, associated with livestock production, could be traced back to the agricultural sectors serving the Hotels and Catering sector either directly or through the food and drinks industry. In terms of impact per £ spent, SW hotels and caterers performed worse than the UK average for the sector in terms of ecological footprint, CO_2, methane and nitrous oxide. Suggestions to improve the performance of this sector include energy efficiency and management measures for e.g. heating, lighting, and kitchen procedures and preferably a change in electricity mix. The indirect greenhouse gas emissions from the food and agriculture sectors raise further questions regarding the production, slaughtering, and distribution of livestock that is turned over by the SW Hotels and Catering industry. Whether expenditure on meat dishes due to tourism is higher than in other regions could be explored further.

- **SW Food and Drink manufacture**
  For the ecological footprint, the highest total impacts were from agriculture, fishing, and directly from the SW Food and Drinks sector. The highest total CO_2 emissions occurred directly on-site, followed by agriculture and other food and drink sectors serving the SW Food and Drink industry. Per £ spent, ecological footprint, CO_2, methane and nitrous oxide emissions were higher than the UK average. To address this sector's direct emissions, a first step would be to explore options for saving energy in food production (e.g. processing, cooking, cooling and lighting) and switching to a "greener" electricity mix. Methane and nitrous oxide emissions were almost entirely associated with

livestock production. Like for Hotels and Catering services, the greenhouse gas dynamics in the meat sector indicate complex trade interactions and supply chains within this industry and raise further questions regards supply chains of livestock and meat that is processed in the SW region. The high ecological footprints from agriculture in the Food and Drink and Hotels and Catering sectors may partly be explained by the dispersed geographic circumstances.

- **SW Business Services**
  The highest single CO_2 emitter were the Business services itself; this was mainly attributed to on-site electricity consumption. Road transport services and electricity producers were the other major carbon emitters directly supplying this sector. The priorities for this sector are to switch to more decentralised and renewable energy suppliers, exploring where energy consumption in offices can be reduced (e.g. for lighting, heating, use of office machinery, air conditioning) and where possible, a higher use of rail transport and ICT.

- In the context of the environmental limits debate it is important to bear in mind that these limits cannot be discussed by looking at the production side alone – it also needs to be placed in the context of final demand, consumption and demographic issues. In addition, not all goods produced in the South West will be consumed there. The RES intends to improve resource efficiency and use of renewable energy, but also prioritises ambitious infrastructure projects and does not contain CO_2 reduction targets. In the light of the projected growth figures for the region these policies are more likely to put additional pressures on resources and climate change, and to continuously induce demand for further infrastructure development. Hence, for the region as a whole, any efficiency gains achieved by the industrial sectors could be outweighed through increased final demand for resources in the region.

- A next step should be a more in-depth exploration of the direct and indirect trade operations in the South West region.

1 Background

This study was commissioned by SCPnet[4] to inform the regional debate in the South West on Environmental Limits. During stakeholder consultation on the Regional Economic Strategy (2006-15), "securing economic growth within environmental limits" was identified as one of five key issues that should be debated in the region to inform any future Regional Economic Strategy (RES). The other four debates were: 1) Population growth, ageing and diversity, 2) Energy challenges, 3) Regional leadership and 4) Competitive threats and opportunities from globalisation.[5]

The South West of England is still largely rural in its landscape, with few major towns and many small settlements. 12% of the regional economy relies directly on its natural environment: its uniqueness and cultural attractions make it an important economic asset for tourism and agriculture. It is also is a relatively wealthy and productive region with one of the fastest economic growth rates and the lowest unemployment rates during recent years. Over the next decade, its economic growth is expected to continue at around 3% per year - implying a doubling of output value by 2026 should this trend continue. Between 1999 and 2004, the value of exports rose by around 33% compared to 14% for the UK. However, in terms of resource productivity per capita, the South West performed 7% below the UK average. Changing technologies, industries, and competition from emerging global markets such as China, have been identified as challenges to the region's economic long-term prosperity. At the same time with the population projected to grow by 800,000 people by 2026, England's South West will face significant challenges from pressures on infrastructure, energy and resource use.

Underpinned and guided by the UK Government's Sustainable Development Strategy[6], the RES for South West England seeks to demonstrate that economic growth can be secured within environmental limits. The RES is framed around three overarching strategic objectives: Successful and competitive businesses, strong and inclusive communities, and an effective and confident region[7].

To assess the direct and indirect environmental pressures of a range of production and service activities, previous work by the South West RDA had identified the following economic sectors in the SW region:

- Transport Equipment Manufacturing, including Aerospace (UK SIC: 35)
- Motor Vehicle Manufacturing (UK SIC:34)
- Food and Drink Manufacturing (UK SIC:15)
- Hotels and Catering Services (UK SIC:55)
- Business Services (UK SIC:74)

These sectors were chosen because Transport (including the SW Advanced Engineering sector) and Food and Drink are both economic priority sectors for the South West. The Hotels and Catering sector is part of the wider leisure and tourism sector. In its entirety, the leisure and tourism sector is difficult to assess due to SIC definitions. The SW sectors Hotels and Catering, and Business services are expected to increase substantially; Food and Drink Manufacturing are known as large energy consumers in the region[8]. This study

4 Sustainable Consumption network (SCPnet) comprising the Environment Agency, the English Regions (RDAs and Regional Assemblies) and WWF.

5 http://www.swdebates.info/

6 http://www.sustainable-development.gov.uk/publications/uk-strategy/index.htm

7 http://download.southwestrda.org.uk/file.asp?File=/res/general/delivery_framework.pdf

8 Pers. Comm. Allison McCaig and Carol Wilson, Feb. 2008.

will focus on assessing the regional resource productivity of these sectors, and further analyse and identify the manufacturing sectors with the highest impacts (particularly in terms of overall CO_2 emissions but also in terms of impacts per £ spent). The results include identifying where productivity gains can be made, and benchmarking the regional sectors against their UK averages.

The study is a first attempt to calculate a range of indicators such as the carbon footprint and ecological footprint of a region's economic operations. This should take into account the direct environmental impacts such as direct land appropriation and emissions from vehicles and premises but also the indirect impacts that are embodied in all the purchases and economic transactions that are associated with an economic sector. This study will, for the first time, provide a complete picture of key environmental indicators that are associated with the operations of five economic sectors in the South West of England. The focus will be on the carbon footprint (CO_2), to a lesser degree, the ecological footprint (in global hectares, gha) and on the greenhouse gases nitrous oxide (N_2O) and methane (CH_4) for sectors involved in food production. The study used predominantly ECON-i data for the SW Economy. The Triple Bottom Line Tool (BL^3) was used for data analysis to provide the direct and indirect impacts of the region's production activities.

2 Understanding supply chains

Private and public organisations have traditionally defined the boundaries of their operations firmly, thus restricting the extent to which they are prepared to act and report on the economic, social and environmental impacts associated with their activities.

More recently, the introduction of Integrated Product Policy and Life-cycle thinking has provided organisations with the conceptual framework to transcend operational boundaries and track products throughout the entire supply chain. Though simple enough in principle, supply chain management requires the coordination of networks rather than isolated organisational initiatives. This places an emphasis on innovative partnerships and the involvement of organisations that have interests ranging from the strategic and international to the particular and local.

Globally, the Sustainability Reporting Guidelines of the Global Reporting Initiative have emerged as the most commonly adopted framework for triple bottom line (TBL) reporting. TBL accounting can be defined as an approach to management and performance assessment that stresses the importance and interdependence of economic, environmental and social performance, with environmental reporting being the most developed. At a practical level, organisations are encouraged to define the extent of their actions based on the degree of control and influence they have over supply chain activities. This underpins the 'boundary protocol' guidance provided by the Global Reporting Initiative but it is still flexible enough to be interpreted in different ways across sectors and social and environmental issues.

This results in some organisations working together to influence the entire supply chain while others are choosing to limit supply chain cooperation to those they directly deal with (usually first tier suppliers or customers).

At the same time, a wider range of actors in Europe and beyond are debating the extent to which the environmental and social impacts of products should be traced through the supply chain. Stakeholders are continuously asking for more transparency of a product or service along the supply chain.

Businesses are increasingly expected to report on their supply chains, and proactive sustainability reporting can enhance the image of organisations and thus, returns. A meta analysis of corporate and financial performance suggested that corporate virtue terms of social and environmental responsibility is positively associated with financial performance, thus bringing more scientific certainty into this relationship (Orlitzky et al, 2003). The "Global 100 Most Sustainable Corporations in the World" project[9] specialises in analysing extra-financial drivers of risk and shareholder value including companies' performance on social, environmental and strategic governance issues. This includes how 1,800 companies across 16 countries manage environmental risks and opportunities relative to their industry peers. "Social, environmental and governance factors are increasingly relevant to financial performance and companies which show superior management of these issues are fast gaining an edge over their competitors – an edge which we believe will translate into out performance in the long haul"[10].

As businesses continue to outsource their operations, company boundaries become less transparent. It is not uncommon for a business's human resources and marketing to be dealt with by specialised companies and all the component parts of its products to be produced and assembled externally. Distributors of the final product may be responsible for quality control and branding but the majority of activities related to a product or service's development are carried out by a long and distant supply chain. This is particularly the case with service industries. For some economic sectors such as the banking, finance and service sectors, up to 98% of carbon dioxide emissions can be classified

9 Initiated by Corporate Knights Inc. with Innovest Strategic Value Advisors Inc.

10 The Global 100 project: http://www.global100.org/what.asp (20.12.07)

as "indirect"[11]. The increase in specialisation in almost all markets means that supply chains are in essence endless. Indirectly, every industrial sector will somewhere interact with every other sector. In the literature, the call for a greater understanding of supply chains is not backed up with a method or approach to monitor those (Foran et al., 2005a).

2.1 THE TRADITIONAL APPROACH

Currently available reporting systems approaches suffer from the same problem. While many try to understand the impacts along supply chains this is always done in an ad-hoc fashion. For example a telecommunications company's sustainability report refers to its supply chain and "indirect effects associated with its mobile phone base stations", but not other indirect effects such as the energy embodied in the manufacture of the vehicles used to service them. Each company decides the boundaries for themselves. All current approaches can be described as "Audit Approaches". The disadvantage of audit approaches is that they do not take into account the TBL impacts of the upstream supply chain into account and can lead to inconsistencies and loopholes (Foran et al., 2005a). Life Cycle Assessment (LCA) has traditionally been used to assess supply chains and ideally, should capture the total life cycle impacts of goods and services. In practice, however, this is an unmanageable task due to system complexities caused by global trade interactions. More suitable for analyses at the micro level, traditional LCAs suffer from incomplete and inconsistent system coverage, which leads to an underestimation of the total impact of a production system. This is a significant loophole of "Audit Approaches" meaning that that no comparisons can be made between performances.

In comparison, "Environmental Input-Output Analysis" (EIOA) has the ability to model the pathways of transactions through the complex economic supply chain from production to consumption, and to assign environmental and other impacts to the sector demanding the supplied goods and services on a consistent accounting framework. It also allows for a high level of responsiveness to the Sustainable Consumption and Production agenda and organisations' requirements to understanding supply chains.

2.2 AN ALTERNATIVE APPROACH

The Bottomline3 (BL^3) tool is a software package that can be used to carry out a complete supply chain analysis of the environmental impacts arising from an organisation's procurement activities. It preforms an input – output based life cycle analysis to provide a comprehensive – and until now absent – set of 'triple bottom-line' accounts for 76 economic sectors and can be applied to an organisation, a company, service, or a product group.

A distinct advantage of BL^3 is that the various environmental, economic and social impacts of procurement options can be expressed per unit of economic activity (impact per £ spent). This allows sustainable procurement to be understood in terms of resource efficiency and best value.

BL^3 can also be used to:

- Give a quantitative indication of a region or an organisation's economic, social and environmental performance.
- Provide a standardised way of working with suppliers in the procurement process to compare the supply chain impacts of different products and services.
- Quantify the carbon emissions associated with the direct or immediate effects as well as the indirect or diffuse effects of a large and distant supply chain.
- Enable meaningful benchmarking of the entire procurement process within and across sectors or organisations.

11 "Indirect Emissions" occur along the supply chain in the production of any product or delivery of any service. For example, the emissions that were released from a paper mill to produce paper for the finance industry would be indirect emissions of the finance industry

3 Introduction to carbon footprinting and Terminology

The carbon footprint takes a "consumption perspective". For an economic sector, these are all CO_2 emissions generated through its use of resources, directly or indirectly. This means that the carbon footprint does not just measure the carbon dioxide emissions generated "on-site" from the burning of fossil fuels but also takes a more holistic view and accounts for emissions that are generated somewhere else in the country or world when goods or services are consumed, for example by the South West region. In this respect the term 'footprint' can be seen as a synonym for 'life cycle', meaning that all indirect emissions occurring during the life cycle of a product or service are taken into account. Such a comprehensive perspective facilitates the identification of 'carbon hotspots' in the region's operations and the prioritisation of actions for an effective climate change strategy.

The 'carbon footprint' has been defined as a measure of the exclusive total (global) amount of carbon dioxide emissions that is directly and indirectly caused by a human activity or is accumulated over the life stages of a product (Wiedmann and Minx 2007). This includes activities of individuals, populations, governments, companies, organisations, processes, industry sectors, and goods and services. In any case, all direct (on-site, internal) and indirect emissions (off-site, external, embodied, upstream, and downstream) have to be taken into account.

A crucial issue is the inclusion of all indirect emissions embodied in upstream production processes on top of the direct, on-site emissions of the economic sector under consideration. This aspect gains a particular importance when it comes to carbon offsetting, where a clear definition of scope and boundaries is essential, e.g. when projects to reduce or sequester CO_2 emissions are sponsored. When accounting for indirect emissions, methodologies need to be applied that avoid under-counting as well as double-counting of emissions.

Carbon footprint accounting is still a young area of research and only very few organisations have ventured into measuring their total carbon footprint from a life-cycle perspective. Regions and Local Authorities in the UK have so far focussed on either their direct CO_2 emissions or they have monitored the carbon footprint or ecological footprint of the population in their area. This work is a first and groundbreaking attempt of a truly comprehensive assessment of certain elements of a region's carbon footprint associated with economic activity.

3.1 METHODOLOGY

The task of calculating carbon footprints can be carried out using one of two approaches, using: (a) LCA, a bottom-up process analysis or (b) a top-down Environmental Input-Output (EIO) analysis. The method of choice will often depend on the purpose of the enquiry and the availability of data and resources. It can be said that EIO analysis is superior for the establishment of carbon footprints in higher-level systems. In this context a carbon footprint of industrial sectors, individual businesses, larger product groups, households, government, the average citizen or an average member of a particular socio-economic group can easily be performed by input-output analysis. LCA on the other hand has advantages when looking at micro systems: a particular process, an individual product or a relatively small group of individual products.

Every region is embedded in a complex web of suppliers and clients, each of which contribute their own footprint to the total impact. In this work an extended input-output approach is employed to calculate the Ecological and carbon footprint of the South West Region. The method is based on environmentally extended input-output analysis on the national (UK) level, using official data from the ONS National (economic) Accounts and ONS Environmental Accounts. This means that all results all fully consistent with standard accounting and fully comparable amongst each other. The sophisticated methodology is based on long-standing scientific research, has been field-tested over five years, has been published in numerous journal articles, and has recently been incorporated into a software

tool named Bottomline3 (BL3, see http://www.bottomline3.co.uk).

The BL3 UK software employed in this project is based on a static, single-region, open, basic-price, 76-sector industry-by-industry input-output model of the UK economy as of 2000, augmented with a database of environmental, social and economic indicators from 2001. The model framework is described in Foran et al. (2005a) with a summary available in Foran et al. (2005b). A short summary of the methodology can also be found in Wiedmann and Lenzen (2006).[12]

The comprehensive nature of the input-output approach means that the whole UK economy – including imports and excluding exports – are the system boundary, which is a major advantage when compared with LCA. Conventional LCAs are based on process analyses, meaning that only on-site, most first-order, and some second-order impacts are considered. The truncation of the system boundary can lead to a significant underestimation of the true impact (boundary problem). Using environmental input-output analysis (EIO), as done in this project, the error caused by this truncation can be avoided. On the other hand, EIO is limited by the number of sectors it can distinguish (currently 76 in BL3) and relies on average values for prices and emissions per sector.

Whatever method is used to calculate carbon footprints it is important to avoid double-counting along supply chains or life cycles. This is not least because there are significant implications on carbon trading and carbon offsetting. Although the Bottomline3 software avoids double-counting by automatically splitting impacts between agents in a supply chain, this feature is not used in the present work and instead the full direct and indirect emissions are presented. This means the emissions are consciously double-counted, which has the advantage that the full extent of both direct and indirect emissions can be shown. However, one has to bear in mind that the sectors in the South West Region cannot be held responsible for all of these emissions alone. If carbon emissions were to be traded or offset, a shared responsibility approach needs to be applied. For a further discussion of this issue please see (Wiedmann and Lenzen 2006a) and (Lenzen et al. 2007).

Two types of input data are required for our ecological footprint and carbon footprint approach, financial accounts and on-site fuel use data. Financial accounts include all expenditure and revenue data from one year, ideally as detailed as possible. Data for direct (on-site) energy consumption include fossil fuels needed for industrial and manufacturing processes, heating and vehicles and should be in physical units (e.g. kWh of gas).[13]

3.2 EXPENDITURE INPUT DATA (INDIRECT IMPACTS)

Detailed expenditure data for the financial year 2003 were taken from the South West Regional Accounts (SWRA) using the ECON-I database version 2.1. The SWRA as presented in the ECON-I database[14] are an integrated economic information system for the South West, comprising information of the region's economy in a single, consistent, and integrated resource. The SWRA are structured around a 111 industry classification, based on the SIC 2003 and consistent with the United Kingdom Input-Output accounts. However, there are some uncertainties because expenditure data in the ECON-I database were not always complete. This may overestimate the impact intensities (such as CO_2 per £ spent) since impacts are divided over a smaller amount.

12 Further details are available from http://www.isa.org.usyd.edu.au/publications/index.shtml and http://www.isa.org.usyd.edu.au/research/tbltwo.shtml

13 Although emissions from electricity use occur at the power station and not on-site the manufacturing plant, here they were presented as "direct emissions". This is because electricity inputs from the REEIO database are in physical and not in financial units, and thus appear as on-site energy consumption in BL3.

14 The ECON|i software package provides a gateway to the information in the SWRA and to a number of analytical and graphing tools; further information is available at: http://www.economicsystems.co.uk/south-west/

3.3 ENERGY INPUT CONSUMPTION DATA (DIRECT IMPACTS)

The South West's direct energy use by sector and fuel was taken from the SCPnet Regional Resource Use and Emissions database using the REEIO tool developed by Cambridge Econometrics for the year 2003.[15] All energy consumption data for the different fuels was converted into kWh to provide a consistent input format for BL3.

3.4 BUILT UP INPUT LAND (DIRECT IMPACTS)

The direct land use appropriated by an industrial sector was obtained by scaling the ecological footprint data for built up land (in gha) previously calculated from the UK national accounts to the regional (SW) level by using Gross Value Added (GVA in %) from the ECON-I database.

3.5 BREAKDOWN OF IMPACTS

The environmental impacts are first broken down by **Commodity Group**. The commodity group table provides the first level of breakdown of the total impacts. This output addresses the questions: Which inputs (in the form of goods and services) to the sector carry the greatest impact? What is the major contributor to each of the chosen indicators? The impacts in the commodity group tables are ranked; i.e. the first rank has the highest impact for that indicator.

The total impacts are also broken down into **Production Layers**, which means the order of suppliers in the economy from the first order (the impact of the manufacturing sector itself) to the fifth order. At a glance, these data show whether the impact occurs mostly on-site, or is dominated by the impacts of the supply chain.

Once the commodities with the greatest impacts are known, **Ranked Structural Paths** (RSP) provide supply information broken down into individual supply chain contributions. Structural paths provide the most highly detailed results, addressing the questions: Which inputs (expenditure/purchases) carry high impacts and at which layer are they located? Are the impacts from immediate suppliers or are they remote, somewhere in the background economy? Which layer of the supply chain are they in? A RSP listing is the most detailed output for identifying leverage points for abatement action and is useful for developing improvement strategies. A ranked structural path table enables identification of the most important inputs into a sector. It also shows how far removed these inputs are in the supply chain and therefore the likelihood of being able to influence production. Hence, structural path analysis provides information for choosing better suppliers in the supply chain.

For analysing the economic sectors using RSP, data from the commodity group tables were combined with data from the RSP tables. Focussing on the commodity groups with the highest environmental impact, information from the RSP tables was used to trace the paths that contribute to a specific commodity group. The CO_2 emissions from the contributing paths sum up to the total CO_2 emissions of the respective commodity group. (Note that BL3 only lists the most significant structural paths up to 20 layers).

3.6 NOTE ON TERMINOLOGY

Throughout the text the prefix SW refers to the South West sector itself that is being analysed. For example, "SW Motor Vehicles" refers to the specific emissions of the sector that occur on-site, whereas "motor vehicles" refers to any other motor vehicle sector in the supply chain.

15 http://www.wwflearning.org.uk/scpnet/download-centre/

4 Main results for manufacturing sector "Transport Equipment, including Aerospace"

4.1 TOTAL IMPACTS

Table 1 and Table 2 break down the total impacts and show which inputs in terms of goods, services or processes contribute most to the sector's ecological and carbon footprint in descending order. For the financial year 2003, the SW Transport Equipment sector was responsible for an ecological footprint of 244,000 gha and emitting a total of 527,000 tonnes of CO_2. The three greatest contributors to the ecological footprint and carbon footprint are the manufacture of transport equipment itself [16] – such as ships and aircraft but excluding the manufacture of motor vehicles. This sector accounts for 57% of the ecological footprint and 37% of the carbon footprint, followed by electricity and metal products production.

4.2 DIRECT AND INDIRECT IMPACTS

Distinguishing direct and indirect impacts separately helps to identify those on-site impacts that a sector is able to control directly and those that must be addressed through the supply chain. It is easier for a sector or industry to influence its direct on-site impacts or emissions than those caused by suppliers further up the supply chain.

Table 1: SW transport equipment - ecological footprint by commodity group

Commodity	Ecological footprint (gha)	% of total Footprint
SW Transport Equipment excl MV	139,000	57.0%
Electricity production and distribution	21,600	8.9%
Metal products	17,500	7.2%
Iron and steel	13,100	5.4%
Ships, aircraft and other transport equipment	8,320	3.4%
Inorganic chemicals	7,530	3.1%
Non-ferrous metals	7,400	3.0%
Mechanical machinery and equipment	5,050	2.1%
Wood and wood products	3,110	1.3%
Railway transport	2,340	1.0%
Office machinery and computers	2,200	0.9%
Pulp and paper	2,070	0.8%
Electrical machinery and equipment	1,920	0.8%
Wholesale distribution	1,590	0.7%
Banking and finance	1,540	0.6%
All other commodities	9,730	4.0%
Total	**244,000**	**100%**

16 These are on-site impacts from the SW Transport Equipment manufacture. Contributions from supplying industries can be seen in the structural path analysis which is explained in section 6.1.3.

Table 2: SW Transport equipment - CO_2 emissions by commodity group

Commodity	CO_2 emissions (t)	% of total carbon footprint
SW Transport Equipment excl MV	196,000	37%
Electricity production and distribution	63,200	12%
Metal products	57,500	11%
Iron and steel	41,200	8%
Ships, aircraft and other transport equipment	37,200	7%
Non-ferrous metals	30,800	6%
Inorganic chemicals	16,800	3%
Mechanical machinery and equipment	16,700	3%
Office machinery and computers	7,970	2%
Electrical machinery and equipment	6,750	1%
Pulp and paper	5,640	1%
Wholesale distribution	5,060	1%
Banking and finance	5,030	1%
Paints, varnishes, printing ink etc	4,500	1%
Plastic products	3,940	1%
All other commodities	28,710	5%
Total	**527,000**	**100%**

As can be seen from Figure 1 below, 57% of the ecological footprint is associated with direct impacts – mainly from fossil fuel use (75%), built up land (20%) and some nuclear fuel associated with electricity consumption (5%). 63% of the carbon footprint is generated by suppliers to the SW Transport Equipment manufacturers. Only 37% are direct impacts that are likely to be from plant and machinery operations in transport equipment production. Table 3 shows that 87% of these direct emissions are from on-site electricity use associated solely with the manufacture of aerospace equipment.

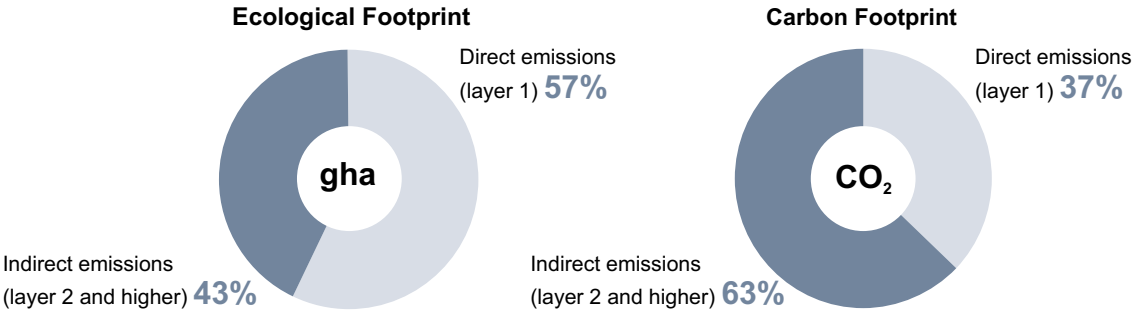


Fig 1: Direct and indirect emissions for SW transport equipment

Table 3: On-site emission sources by emission source for SW Transport Equipment

On-site emission source	CO_2 (t)	% of direct emissions
Natural gas	18,168	9%
Coal	887	0%
Fuel Oil	1,791	1%
Gas oil	2,871	1%
Other carbon based fuels	2,068	1%
Net electricity (2003)	170,215	87%
Total:	**196,000**	**100%**

4.3 BREAKDOWN OF DIRECT AND INDIRECT IMPACTS

Breaking down the layers further, as indicated in Figure 2, shows that production layer 2 contributes 28% to the ecological footprint, with more remote layers gradually contributing less. The majority of the carbon footprint (58%) is caused by supplier layers 2 and 3. Hence, the most pressing responsibilities for the transport equipment sector are in managing its energy use – especially electricity consumption in aerospace manufacture (and its land use for manufacturing plants).

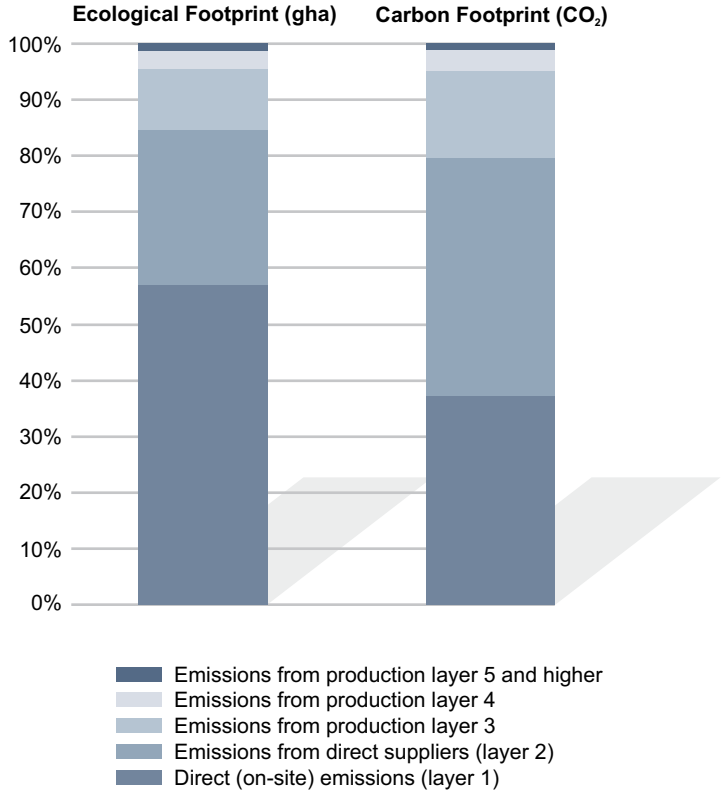


Fig 2: Direct and indirect impact by layers for SW transport equipment

4.4 RANKED STRUCTURAL PATH ANALYSIS

In the following section, information from the RSP table was combined with the information from the commodity group table (Table2).

With 196,000 tonnes of CO_2 from on-site fuel use the direct, on-site emissions from the **transport equipment industry** comprise the lion's share of CO_2 emissions. The next three main CO_2 contributors are **electricity production and distribution**, and **metals production** (see commodity breakdown in Table 2). These first three industries are responsible for 60% of the total emissions and are located in the second layer of the supply chain (Table 4). These industries are the first suppliers to the final producers of transport equipment of which electricity producers are the most prominent.

The **Electricity production and distribution sector** emits a total of 63,200 tonnes of CO_2 (see commodity breakdown) "on behalf" of the SW Transport Equipment sector. In terms of carbon emissions based on the RSP analysis, the key suppliers to the electricity production industry are other industry sectors that produce and distribute electricity and are thus emitting 50,000 and 9,700 tonnes of CO_2, respectively. In total these suppliers are responsible for producing 59,700 tonnes of CO_2 and are located in production layers 2 and 3. The remaining emissions (3,500 tonnes of CO_2) are attributed to all other indirect emissions of the electricity supply chain that are located in production layers above layer 3.

Table 4: Ranked structural paths for SW Transport Equipment

Path Description	Path Value (CO_2 in t)	Unit	Path Order	Percentage in total impact
SW Transport Equipment excl MV	196,000	t	1	37%
Electricity production and distribution > SW Transport Equipment excl MV	50,000	t	2	9%
Iron and steel > SW Transport Equipment excl MV	36,200	t	2	7%
Non-ferrous metals > SW Transport Equipment excl MV	26,600	t	2	5%
Metal products > SW Transport Equipment excl MV	26,300	t	2	5%
Inorganic chemicals > SW Transport Equipment excl MV	15,900	t	2	3%
Ships, aircraft and other transport equipment > SW Transport Equipment excl MV	15,100	t	2	3%
Iron and steel > Metal products > SW Transport Equipment excl MV	12,600	t	3	2%
Mechanical machinery and equipment > SW Transport Equipment excl MV	12,400	t	2	2%
Electricity production and distribution > Electricity production and distribution > SW Transport Equipment excl MV	9,700	t	3	2%
Office machinery and computers > SW Transport Equipment excl MV	6,230	t	2	1%
Electrical machinery and equipment > SW Transport Equipment excl MV	5,010	t	2	1%
Pulp and paper > SW Transport Equipment excl MV	4,550	t	2	1%
Non-ferrous metals > Metal products > SW Transport Equipment excl MV	3,870	t	3	1%
Paints, varnishes, printing ink etc > SW Transport Equipment excl MV	3,820	t	2	1%
Electricity production and distribution > Ships, aircraft and other transport equipment > SW Transport Equipment excl MV	3,620	t	3	1%
Electricity production and distribution > Metal products > SW Transport Equipment excl MV	3,510	t	3	1%
Plastic products > SW Transport Equipment excl MV	3,050	t	2	1%
Medical and precision instruments > SW Transport Equipment excl MV	2,850	t	2	1%
Iron and steel > Iron and steel > SW Transport Equipment excl MV	2,300	t	3	0%
All other paths	87,390	t		17%
Total	**527,000**	**t**		**100%**

The "**Metal products**" manufacturing sector in the commodity breakdown emits a total of 57,500 tonnes of CO_2. From the RSP analysis (Table 4), contributors to these are mainly:

- Other metal producers (26,300 tonnes of CO_2)
- Iron and steel production (12,600 tonnes of CO_2)
- Non-ferrous metal producers (3,870 tonnes of CO_2)
- Electricity production and distribution (3,510 tonnes of CO_2)

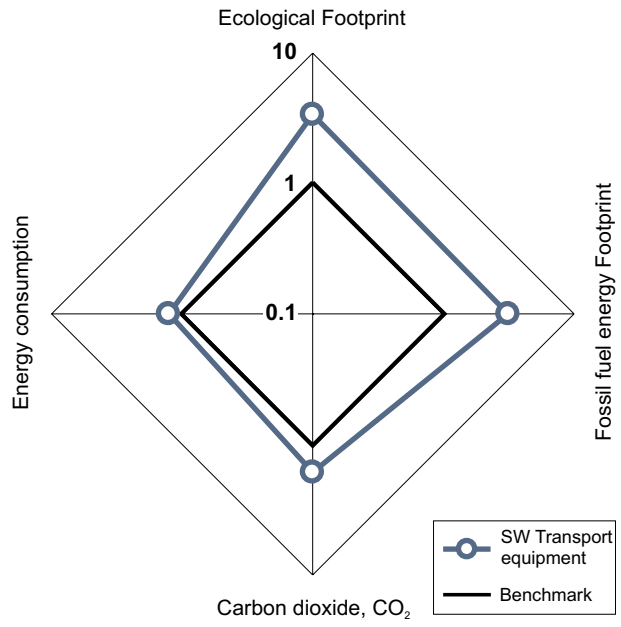
These four main suppliers contribute 46,280 tonnes of CO_2; the remaining embedded emissions of 11,220 tonnes are emitted further upstream above layer 3.

4.5 BENCHMARKING

The spider diagram (Box 1) shows the relative performance of all chosen indicators in an integrated way. It measures how the direct and indirect impact intensities of the SW Transport Equipment sector compare against the UK industry sector benchmark. The consistency in boundary setting and the impact calculation ensures that the TBL indicators shown in the

benchmark spider can be compared, and that trade-off analyses are valid. The fact that each indicator is calculated in the same way allows them to be shown in the same diagram. By expressing the impact categories as total impacts per £ spent, a comparison between the different indicators is possible.

The blue line shows the SW Transport Equipment sector's performance for each indicator. The regular polygon in the centre of the diagram (thick black line) shows the average performance of the UK transport equipment sector, allowing a benchmark comparison between the SW Transport Equipment sector and the UK average. A performance better than average is indicated when the blue line falls inside the thick black line ("the smaller the area encircled by the blue line, the smaller the footprint").



Indicator	SW Transport equipment	Total UK Sector Intensity 2001	Unit	SW TE as % of Total Sector UK
Ecological footprint	1.49	0.45	g-m²/£	231%
Carbon dioxide, CO_2	322	201	g/£	60%
Energy consumption	0.00008	0.00007	toe/£	14%

Box 1: Spider diagram for SW transport equipment

Compared to the average UK transport equipment sector, per £ spent the SW Transport Equipment industries have a higher environmental impact profile. The ecological footprint is 231% higher than the national average; the carbon dioxide emissions are 60% higher. Energy consumption is only 14% higher in comparison.

This does not necessarily mean that the SW Transport Equipment sector is less resource efficient than its UK average. The specific processes used and products manufactured in the South West are likely to differ fromt he average and these will influence the relative release of the emissions. However, the results indicate that either there are more emissions per unit of output or the output is relatively small with regard to the emissions created and in comparison with the UK average. More detailed economic analyses are required to be conclusive. These should take in to account other variables such as number of employees, physical outputs (products sold) and perhaps geographical circumstances.

4.6 SUMMARY AND CONCLUSIONS FOR SW TRANSPORT EQUIPMENT

For all indicators, the single highest impacts in the SW Transport Equipment supply chain come from the Transport Equipment sector itself. 87% of the on-site emissions are associated with electricity use and were solely related to the manufacturing of aerospace equipment. Further analysis of the industrial processes could identify where energy savings in the running of facilities, plants, and machinery could be made, together with a possible switch to renewable energy. The same could be suggested for the direct suppliers to the transport and equipment manufacturers. These are the heavy industries: electricity production and metal production. Further analysis is needed here before more detailed recommendations can be made.

5 Main results for manufacturing sector "SW Motor Vehicles"

5.1 TOTAL IMPACTS

In 2003, the SW Motor Vehicles sector had an ecological footprint of 184,000 gha and emitted a total of 490,000 tonnes of CO_2, as shown in Table 5 and Table 6 below. The three highest contributions to the ecological footprint are from the SW Motor Vehicles industry sector itself, followed by iron and steel production, and other motor vehicle producers (possibly from parts or body manufacture). Together they constitute more than half of the total footprint (55%). In terms of CO_2, these three sub sectors contribute 42% of the total emissions in the motor vehicle production chain.

Table 5: SW Motor Vehicles: ecological footprint by commodity group

Commodity	Ecological footprint (gha)	% of total Footprint
SW Transport_Motor vehicles	59,200	32%
Iron and steel	21,000	11%
Motor vehicles	20,900	11%
Metal products	11,000	6%
Electricity production and distribution	9,380	5%
Inorganic chemicals	8,870	5%
Plastic products	8,570	5%
Non-ferrous metals	7,880	4%
Mechanical machinery and equipment	7,160	4%
Road transport	3,680	2%
Rubber products	3,430	2%
Wood and wood products	3,420	2%
Electrical machinery and equipment	3,210	2%
Metal castings	2,810	2%
Furniture and miscellaneous manufacturing	2,000	1%
All other commodities	11,490	6%
Total	**184,000**	**100%**

Table 6: SW Motor Vehicles: CO_2 emissions by commodity group

Commodity	CO_2 emissions (t)	% of total carbon footprint
SW Transport_Motor vehicles	85,900	18%
Motor vehicles	74,600	15%
Iron and steel	65,900	13%
Metal products	36,200	7%
Non-ferrous metals	32,800	7%
Plastic products	29,000	6%
Electricity production and distribution	27,400	6%
Mechanical machinery and equipment	23,700	5%
Inorganic chemicals	19,900	4%
Road transport	12,800	3%
Rubber products	11,900	2%
Electrical machinery and equipment	11,300	2%
Metal castings	9,010	2%
Paints, varnishes, printing ink etc	7,220	1%
Furniture and miscellaneous manufacturing	6,420	1%
All other commodities	35,950	7%
Total	**490,000**	**100%**

5.2 DIRECT AND INDIRECT IMPACTS

As can be seen from Figure 3 for the SW Motor Vehicles production, 32% of the ecological footprint is related to the direct impacts – mainly from fossil fuel use (78%), built land (19%) and a small fraction of nuclear energy use (3%), with 68% of the footprint being from indirect sources.

In the case of the carbon footprint, 82% are indirect emissions from the supply chain and 18% are on-site emissions of which the majority are associated with electricity and gas use (71% and 15%).

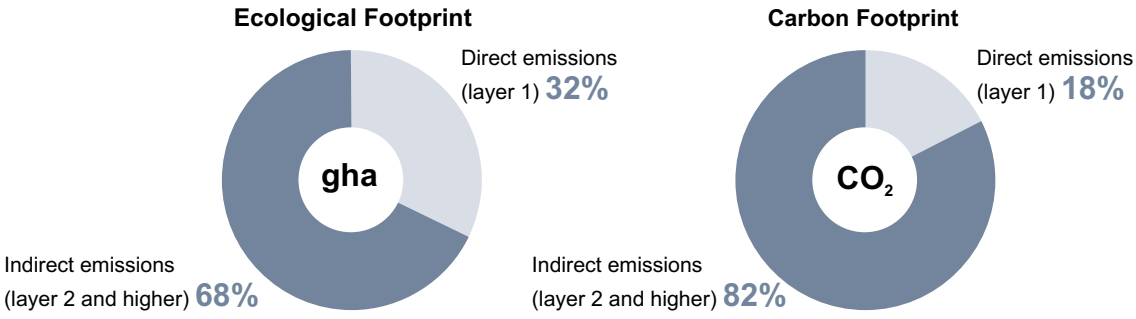


Fig 3: Direct and indirect impacts for SW Motor Vehicle

Table 7: On-site emission sources by type for SW Motor Vehicles

On-site emission source	CO_2 (t)	% of direct emissions
Natural gas	13,236	15%
Coal	4,833	6%
Fuel Oil	1,293	2%
Gas oil	4,579	5%
Other carbon based fuels	683	1%
Net electricity (2003)	61,276	71%
Total:	**85,900**	**100%**

5.2 OVERVIEW DIRECT AND INDIRECT IMPACTS

A further breakdown of production layers in Figure 4 shows that for the ecological footprint, most of the impacts relate to the direct suppliers to the automotive industry, i.e. in production layer 2 (48%), with on-site impacts (layer 1) contributing 32% and the balance of 15% being located in layer 3.

61% of the carbon footprint relates to layer 2, with 18% being the layer 1 on-site emissions and 16% coming from production layer 3. SW Motor V-ehicle production is responsible for emitting 74,600 tonnes of CO_2 of which the majority (53,400 and 3,590 tonnes) come from other motor vehicle industries. The remaining emissions (17,610 tonnes) come from other indirect sources.

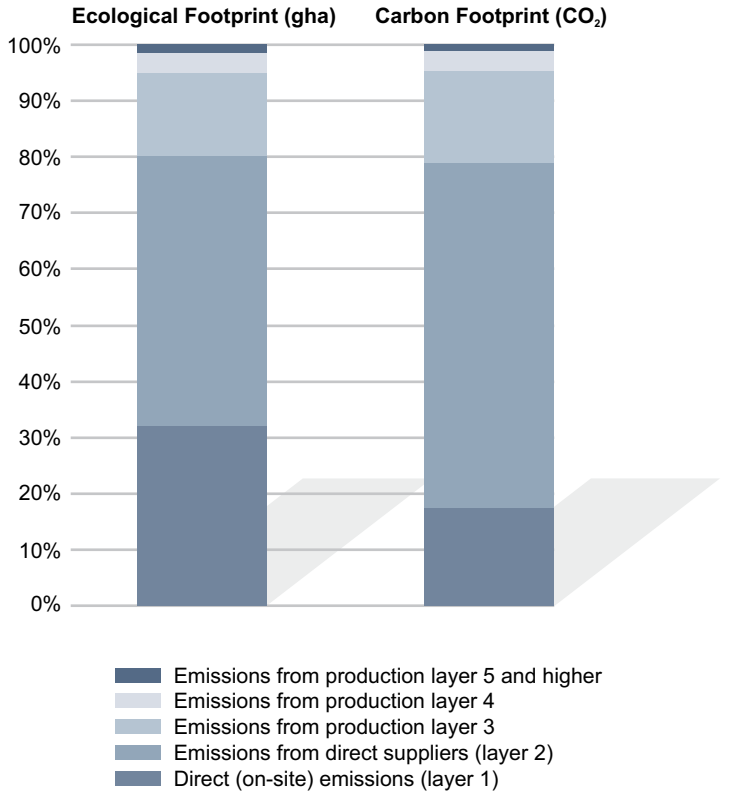


Fig 4: Direct and indirect impact by layers for SW Motor Vehicles

5.3 RANKED STRUCTURAL PATH ANALYSIS

At 85,900 tonnes, the SW Motor Vehicles sector itself emits most CO_2 emissions through the on-site use of energy and fuels, followed by other motor vehicles producers (74,600 tonnes) and iron and steel production (65,900 tonnes, see Table 6).

Motor vehicle producers who supply directly to the SW motor vehicles sector (located in production layer 2 – as most of suppliers in the SW Motor Vehicles production chain) contribute the highest amount to the SW motor vehicle sector (53,400 tonnes of CO_2). Iron and steel producers are located in production layer 3 and add 3,590 tonnes of CO_2 (Table 8); the remaining 17,610 tonnes of CO_2 are attributed to all other indirect emissions from motor vehicle production are located in production layers above layer 3.

The decomposition of the third highest emitter, the **iron and steel sector,** reveals that its 65,900 tonnes of CO_2 come mostly from other iron and steel producers located in layers 2 and 3 (57,800 and 3,680 tonnes of CO_2). The remainder of 4,420 tonnes of CO_2 is emitted further up production layer 3.

Table 8: Ranked structural paths for SW Motor Vehicle production

Path Description	Path Value (CO_2 in t)	Unit	Path Order	Percentage in total impact
SW Transport_Motor vehicles	85,900	t	1	18%
Iron and steel > SW Transport_Motor vehicles	57,800	t	2	12%
Motor vehicles > SW Transport_Motor vehicles	53,400	t	2	11%
Non-ferrous metals > SW Transport_Motor vehicles	28,400	t	2	6%
Plastic products > SW Transport_Motor vehicles	22,500	t	2	5%
Electricity production and distribution > SW Transport_Motor vehicles	21,700	t	2	4%
Inorganic chemicals > SW Transport_Motor vehicles	18,700	t	2	4%
Mechanical machinery and equipment > SW Transport_Motor vehicles	17,600	t	2	4%
Metal products > SW Transport_Motor vehicles	16,600	t	2	3%
Road transport > SW Transport_Motor vehicles	11,200	t	2	2%
Rubber products > SW Transport_Motor vehicles	9,800	t	2	2%
Electrical machinery and equipment > SW Transport_Motor vehicles	8,380	t	2	2%
Iron and steel > Metal products > SW Transport_Motor vehicles	7,950	t	3	2%
Paints, varnishes, printing ink etc > SW Transport_Motor vehicles	6,130	t	2	1%
Furniture and miscellaneous manufacturing > SW Transport_Motor vehicles	5,690	t	2	1%
Glass and glass products > SW Transport_Motor vehicles	4,720	t	2	1%
Electricity production and distribution > Electricity production and distribution > SW Transport_Motor vehicles	4,210	t	3	1%
Iron and steel > Iron and steel > SW Transport_Motor vehicles	3,680	t	3	1%
Iron and steel > Motor vehicles > SW Transport_Motor vehicles	3,590	t	3	1%
Textiles > SW Transport_Motor vehicles	2,900	t	2	1%
All other paths	99,150	t		20%
Total	**490,000**	**t**		**100%**

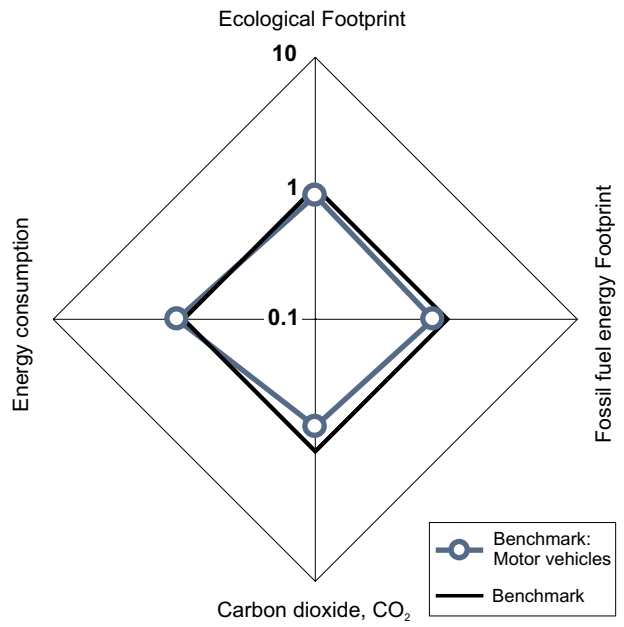
5.4 BENCHMARKING

For both the ecological footprint and the carbon footprint this sector in the South West performs better than the UK sectoral average. Per £ spent, the ecological footprint has only 87% of the impacts than the national average (1.72 global metres squared (gm^2)/ £ compared to 1.97 gm^2/£) and, despite energy consumption being 10% higher than average, emits only 65% of the average CO_2 emissions of the UK sectoral average (Box 2).

5.5 SUMMARY AND CONCLUSIONS SW MOTOR VEHICLE PRODUCTION

For total impacts, the SW Motor Vehicles sector itself contributed most in terms of ecological footprint and CO_2 emissions through its on-site emissions, followed by other motor vehicle manufacturers and iron and steel producers in layers 2 and 3. For indirect impacts, the direct suppliers to the SW Motor Vehicles industry in layer 2 are responsible for the lion's share of emissions along the supply chain. Although the SW Motor Vehicles sector

performs better than the UK sector in terms of emissions, energy consumption is still 10% above the benchmark. An in-depth process analysis could reveal potentials for efficiency gains. The same applies to the sector's direct suppliers. In addition, switching to a renewable electricity mix should further reduce the sector's carbon footprint.



Indicator	SW Motor vehicles	Total Sector Intensity 2001	Unit	SW MV as % of Total Sector UK
Ecological footprint	2.76	0.45	g-m2/£	-13%
Carbon dioxide, CO_2	502	201	g/£	-35%
Energy consumption	0. 00012	0. 00007	toe/£	10%

Box 2: Spider diagram for SW Motor Vehicle manufacturing

6 Main results for "Hotels and Catering services" sector

6.1 TOTAL IMPACTS

For food related sectors, methane and nitrous oxide emission have also been taken into account.

In terms of ecological footprint, Table 9 shows that the three main contributors are the fishing industry, the Hotels and Catering industry itself, and agriculture. For Carbon dioxide emissions (Table 10), the majority of emissions come from SW Hotels and Catering services itself, followed by the food and drinks production sector, road transport and electricity production. For methane emissions, the key emitters are agriculture, the food and drinks industry, gas distributors, and electricity production. For the SW, N_2O emissions were mainly caused by agriculture, food and drink production, road transport and wholesale distribution (Table 11 and Table 12). Human-induced nitrous oxide emissions are mostly related to the livestock sector and to a lesser degree, industrial sources and the burning of fossil fuels in internal combustion engines.

Table 9: SW Hotels and Catering services : ecological footprint by commodity group

Commodity	Ecological footprint (gha)	% of total Footprint
Fishing	101,000	29.4%
SW Hotels and catering	100,000	29.1%
Agriculture	55,300	16.1%
Food and drink	51,900	15.1%
Road transport	10,400	3.0%
Electricity production and distribution	8,490	2.5%
Wholesale distribution	3,600	1.0%
Legal, consultancy and other business services	2,150	0.6%
Wood and wood products	1,870	0.5%
Furniture and miscellaneous manufacturing	1,570	0.5%
Pulp and paper	1,320	0.4%
Coke ovens, refined petroleum & nuclear fuel	1,000	0.3%
Other service activities	600	0.2%
Computer services	520	0.2%
Banking and finance	440	0.1%
All other commodities	3,840	1.1%
Total	**344,000**	**100%**

Table 10: SW Hotels and Catering services : CO_2 emissions by commodity group

Commodity	CO_2 emissions (t)	% of total carbon footprint
SW Hotels and catering	131,000	41%
Food and drink	57,100	18%
Road transport	36,400	11%
Electricity production and distribution	24,800	8%
Fishing	15,000	5%
Wholesale distribution	11,400	4%
Agriculture	9,040	3%
Furniture and miscellaneous manufacturing	5,050	2%
Coke ovens, refined petroleum & nuclear fuel	4,610	1%
Legal, consultancy and other business services	4,300	1%
Pulp and paper	3,590	1%
Other service activities	2,050	1%
Computer services	1,760	1%
Banking and finance	1,440	0%
Textiles	1,370	0%
All other commodities	9,090	3%
Total	**318,000**	**100%**

Table 11: SW Hotels and Catering services : Methane emissions by commodity group

Commodity	CH_4 emissions (t)	% of total CH_4 emissions
Agriculture	890	60%
Food and drink	480	32%
Gas distribution	40	3%
Electricity production and distribution	20	1%
Wholesale distribution	10	1%
Road transport	8.0	1%
Legal, consultancy and other business services	6.0	0.4%
Other service activities	4.0	0.3%
Coke ovens, refined petroleum & nuclear fuel	3.0	0.2%
Hotels and restaurants	2.0	0.1%
Fishing	2.0	0.1%
Computer services	2.0	0.1%
Banking and finance	1.40	0.1%
Pulp and paper	1.10	0.1%
Education	0.60	0.0%
All other commodities	9.900	1%
Total	**1,480**	**100%**

Table 12: SW Hotels and Catering services : Nitrous oxide emissions by commodity group

Commodity	N_2O emissions (t)	% of total N_2O emissions
Agriculture	90	64%
Food and drink	50	36%
Road transport	2	1%
Wholesale distribution	1	1%
Electricity production and distribution	1	1%
Legal, consultancy and other business services	0.4	0.3%
Hotels and restaurants	0.3	0.2%
Fishing	0.2	0.2%
Other service activities	0.2	0.2%
Coke ovens, refined petroleum & nuclear fuel	0.2	0.1%
Computer services	0.1	0.1%
Banking and finance	0.1	0.1%
Wood and wood products	0.1	0.1%
Furniture and miscellaneous manufacturing	0.1	0.1%
Pulp and paper	0.1	0.0%
All other commodities	5.62	-4%
Total	**140**	**100%**

6.2 DIRECT AND INDIRECT IMPACTS

For the ecological footprint, 29% are from on-site sources and related to fossil fuel use (70%), built up land (27%) and nuclear energy from electricity production (3%). For the carbon footprint, 41% are direct impacts attributed to electricity and gas use (65% and 35%, Table 13).

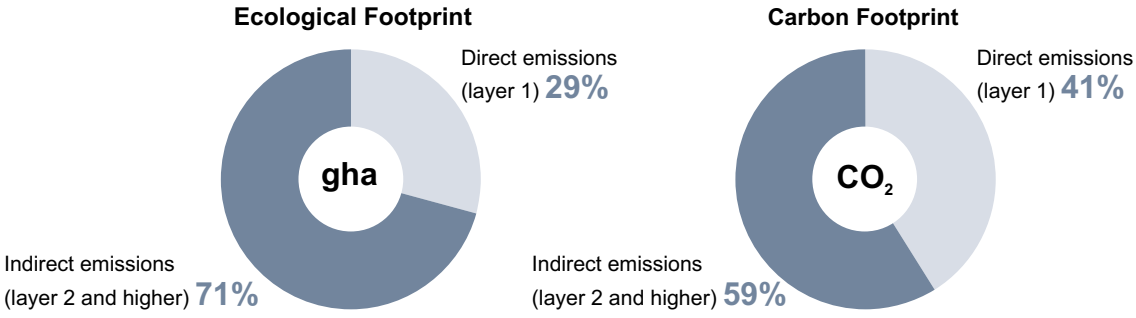


Fig 5: Direct and indirect impacts for SW Hotels and Catering services

Table 13: On-site emission sources by type for SW Hotels and Catering services

On-site emission source	CO_2 (t)	% of direct emissions
Natural gas	46,138	35%
Coal	0	0%
Fuel Oil	0	0%
Gas oil	0	0%
Other carbon based fuels	0	0%
Net electricity (2003)	84,862	65%
Total:	**131,000**	**100%**

6.3 OVERVIEW DIRECT AND INDIRECT IMPACTS

For the ecological footprint, the greatest contribution (52%) comes from production layer 2 (direct suppliers to Hotels and Catering services). For CO_2, most emissions occur equally in layers 1 and 2 (both around 40%; Figure 6). For methane and nitrous oxide, 100% of the emissions come form indirect sources along the supply chain[17].

Most of the methane and nitrous oxide emissions occur in production layers 2 (61% and 64%) and 3 (33% and 36%; Figure 7).

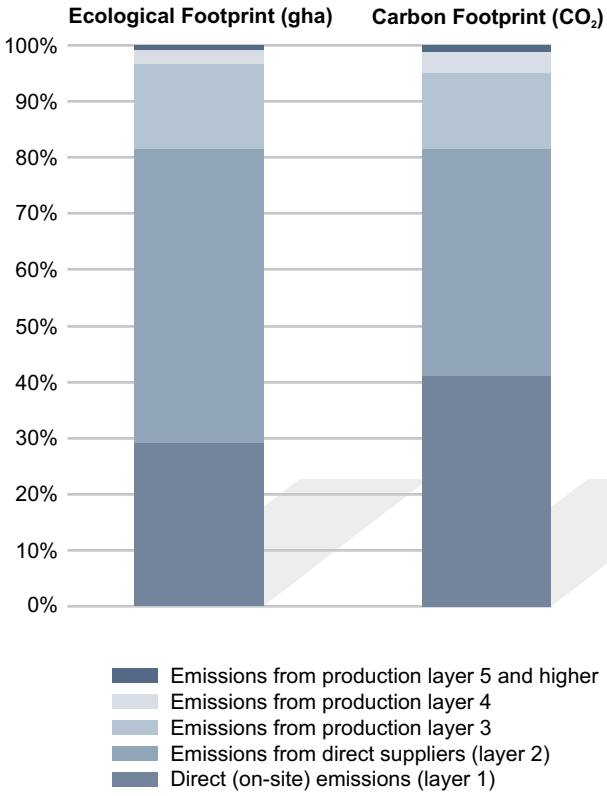


Fig 6: Direct and indirect impacts by layers for SW Hotels and Catering services, ecological footprint and CO_2

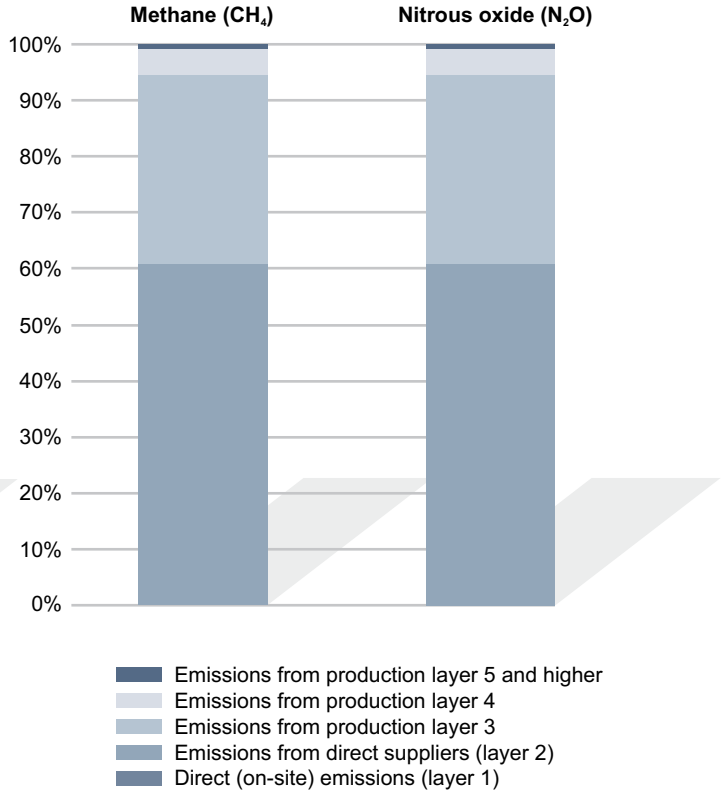


Fig 7: Direct and indirect impacts by layers for SW Hotels and Catering services, CH_4 and N_2O

17 Although some on-site methane and nitrous oxides may be generated through e.g. gas leakage or the on-site combustion of fossil fuels, these amounts will be relatively small. At present, these on-site emissions are not included in BL3.

6.4 RANKED STRUCTURAL PATH ANALYSIS – CO_2

With 131,000 tonnes of CO_2, the SW Hotels and Catering industry itself generates the single highest proportion of emissions in the supply chain, with food and drinks, road transport services, and electricity production being the next highest emitters. Together, these three sectors contribute 78% of the entire supply chain emissions (see Table 10). The food and drinks sector emits 57,100 tonnes of CO_2, of which the majority (47,000 tonnes) is emitted by the food and drinks industry directly supplying the SW Hotels and Catering industry. The remainder, of 10,000 tonnes, is emitted further upstream of layer 3. (Table 14).

Most of the emissions for **road transport services** (36,400 tonnes) are caused directly by road transport itself; the remaining 4800 tonnes are emitted elsewhere higher up the supply chain.

Fishing, agriculture and wholesale services as direct suppliers to the SW Hotels and Catering services contribute 35,440 tonnes of CO_2 (11%) of which 9,760 tonnes are emitted above layers 2 and 3.

Ranked Structural Path Analysis – methane and nitrous oxide

The RSP for methane show that none of the methane is generated by the Hotels and Catering industry directly but mostly by **agriculture** (882 tonnes of methane; the remaining 8 tonnes being emitted above layer 4). These emissions mainly come from livestock farming. Emissions from the **food and drink sector** (480 tonnes) are also caused mainly by

Table 14: Ranked structural paths – CO_2

Path Description	Path Value (CO_2 in t)	Unit	Path Order	Percentage in total impact
SW Hotels and catering	131,000	t	1	41%
Food and drink > SW Hotels and catering	32,500	t	2	10%
Road transport > SW Hotels and catering	31,600	t	2	10%
Electricity production and distribution > SW Hotels and catering	19,600	t	2	6%
Fishing > SW Hotels and catering	13,700	t	2	4%
Agriculture > SW Hotels and catering	6,490	t	2	2%
Furniture and miscellaneous manufacturing > SW Hotels and catering	4,470	t	2	1%
Electricity production and distribution > Electricity production and distribution > SW Hotels and catering	3,810	t	3	1%
Coke ovens, refined petroleum & nuclear fuel > SW Hotels and catering	3,670	t	2	1%
Wholesale distribution > SW Hotels and catering	3,530	t	2	1%
Electricity production and distribution > Food and drink > SW Hotels and catering	3,090	t	3	1%
Agriculture > Food and drink > SW Hotels and catering	2,970	t	3	1%
Pulp and paper > SW Hotels and catering	2,900	t	2	1%
Food and drink > Food and drink > SW Hotels and catering	2,410	t	3	1%
Pulp and paper > Food and drink > SW Hotels and catering	1,970	t	3	1%
Road transport > Wholesale distribution > SW Hotels and catering	1,960	t	3	1%
Plastic products > Food and drink > SW Hotels and catering	1,570	t	3	0.5%
Fishing > Food and drink > SW Hotels and catering	1,430	t	3	0.5%
Legal, consultancy and other business services > SW Hotels and catering	1,180	t	2	0.4%
Road transport > Food and drink > SW Hotels and catering	1,160	t	3	0.4%
All other paths	46,990	t		15%
Total	**318,000**	**t**		**100%**

the sector itself (390 tonnes) but can be traced back to agriculture. The remaining methane sources originate from other agriculture sectors in layers 3, 4, and 5, further sewage services and coal and gas distribution. Only 19 tonnes of methane are emitted by indirect sources above layer 5. The presence of methane in higher order supply chains indicates long and complex supply chain interactions in the food industry. Methane emissions from gas distribution (40 tonnes) are predominantly emitted by the industry itself (30 tonnes), the remainder occurring elsewhere above layer 5 (Table 15).

For nitrous oxide most emissions (90 tonnes of N_2O) are caused by **agriculture** itself (80 tonnes). N_2O emissions from agriculture are mainly due to the use of nitrogen-based fertilizers and livestock farming (manure). Most of the emissions in agriculture are again from other agricultural produce and fertilizer production; only 1.5 tonnes are attributed to industries above production layer 4. The food and drinks sector is responsible for 50 tonnes of nitrous oxides of which in turn the majority is caused by agriculture (40 tonnes). Small amounts are allocated to other agricultural sectors, fertilizer and electricity production. Only 0.3 tonnes occur elsewhere above supply chain layer 4. A small amount (2 tonnes) is emitted through road transportation of which 1 tonne is directly caused by this service, the remainder coming from other indirect sources (Table 16).

Table 15: Ranked structural paths – methane

Path Description	Path Value (CH_4 in t)	Unit	Path Order	Percentage in total impact
Agriculture > SW Hotels and catering	850	t	2	58%
Agriculture > Food and drink > SW Hotels and catering	390	t	3	26%
Gas distribution > SW Hotels and catering	30	t	2	2%
Agriculture > Agriculture > SW Hotels and catering	30	t	3	2%
Agriculture > Food and drink > Food and drink > SW Hotels and catering	29	t	4	2%
Agriculture > Agriculture > Food and drink > SW Hotels and catering	15	t	4	1%
Coal extraction > Electricity production and distribution > SW Hotels and catering	13	t	3	1%
Sewage and refuse services > Food and drink > SW Hotels and catering	10	t	3	1%
Coal extraction > Food and drink > SW Hotels and catering	8	t	3	1%
Gas distribution > Food and drink > SW Hotels and catering	5	t	3	0.4%
Gas distribution > Electricity production and distribution > SW Hotels and catering	4	t	3	0.3%
Electricity production and distribution > SW Hotels and catering	4	t	2	0.2%
Sewage and refuse services > Other service activities > SW Hotels and catering	3	t	3	0.2%
Agriculture > Wholesale distribution > SW Hotels and catering	3	t	3	0.2%
Road transport > SW Hotels and catering	3	t	2	0.2%
Coal extraction > Electricity production and distribution > Electricity production and distribution > SW Hotels and catering	3	t	4	0.2%
Oil and gas extraction > Coke ovens, refined petroleum & nuclear fuel > SW Hotels and catering	2	t	3	0.2%
Agriculture > Food and drink > Food and drink > Food and drink > SW Hotels and catering	2	t	5	0.2%
Coal extraction > Electricity production and distribution > Food and drink > SW Hotels and catering	2	t	4	0.1%
Agriculture > Food and drink > Agriculture > SW Hotels and catering	2	t	4	0.1%
All other paths	73	t		4%
Total	**1,480**	**t**		**100%**

Table 16: Ranked structural paths – nitrous oxide

Path Description	Path Value (N_2O in t)	Unit	Path Order	Percentage in total impact
Agriculture > SW Hotels and catering	80	t	2	58%
Agriculture > Food and drink > SW Hotels and catering	40	t	3	27%
Agriculture > Agriculture > SW Hotels and catering	3	t	3	2%
Fertilisers > Agriculture > SW Hotels and catering	3	t	3	2%
Agriculture > Food and drink > Food and drink > SW Hotels and catering	3	t	4	2%
Agriculture > Agriculture > Food and drink > SW Hotels and catering	2	t	4	1%
Road transport > SW Hotels and catering	1	t	2	1%
Fertilisers > Agriculture > Food and drink > SW Hotels and catering	1	t	4	1%
Food and drink > SW Hotels and catering	1	t	2	1%
Electricity production and distribution > SW Hotels and catering	1	t	2	1%
Agriculture > Wholesale distribution > SW Hotels and catering	0.3	t	3	0.2%
Wholesale distribution > SW Hotels and catering	0.3	t	2	0.2%
Agriculture > Food and drink > Food and drink > Food and drink > SW Hotels and catering	0.2	t	5	0.2%
Agriculture > Food and drink > Agriculture > SW Hotels and catering	0.2	t	4	0.1%
Fertilisers > Fertilisers > Agriculture > SW Hotels and catering	0.2	t	4	0.1%
Agriculture > Food and drink > Wholesale distribution > SW Hotels and catering	0.2	t	4	0.1%
Electricity production and distribution > Electricity production and distribution > SW Hotels and catering	0.2	t	3	0.1%
Fishing > SW Hotels and catering	0.2	t	2	0.1%
Agriculture > Agriculture > Agriculture > SW Hotels and catering	0.1	t	4	0.1%
Electricity production and distribution > Food and drink > SW Hotels and catering	0.1	t	3	0.1%
All other paths	3	t	0	3%
Total	**140**	**t**		**100%**

6.5 BENCHMARKING

For energy consumption, per £ spent the SW performs similar to the UK average hotel and catering sector but for a range of other indicators, the SW Hotels and Catering industry performs worse than its national average. For the ecological footprint, the SW Hotels and Catering sector is 88% higher compared to the UK average. It is in line with the UK sector's energy consumption but its emissions are 59% higher for CO_2, 22% higher for methane, and 33% higher for nitrous oxide emissions compared to the UK total sector (Box 3).

6.6 SUMMARY AND CONCLUSIONS SW HOTELS AND CATERING SERVICES

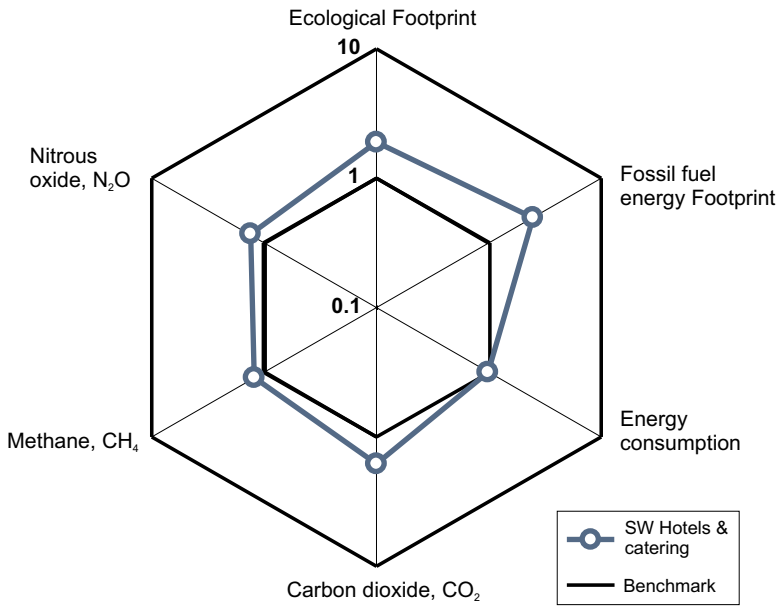
For the ecological footprint, total impacts are highest for the fishing industry as direct suppliers to hotels and caterers, for the SW Hotels and Catering services, and for agricultural sectors in production layers 2 to 4. Around 60% of the sector's ecological footprint is due to sea catch as a likely favourite on the region's menus. In terms of CO_2, SW Hotels and Catering services themselves had the highest emissions along the supply chain (41%), followed by food and drink production (18%) and road transport services (passenger and freight, 11%). Both

are direct suppliers to the Hotels and Catering sector. The contribution from the electricity production and distribution sector is also significant, comprising 8% of the supply chain. Breaking down the CO_2 impacts attributable to the Hotels and Catering sector, 65% of the emissions are from on-site electricity use and the remainder from gas use.

Methane and nitrous oxide production, associated with livestock production, can be traced back to the agricultural sectors serving SW Hotels and Catering either directly or through the food and drinks industry. The presence of these greenhouse gases in the higher order supply chains indicates complex interactions within the agricultural sector, and long supply chains for meat and livestock. By impact per £ spent, SW Hotels and Catering sector performs worse than the UK average (88% higher for the ecological footprint, 59% for CO_2, and 22% and 33% for methane and nitrous oxide from agriculture).

A priority is thus to explore the operations in the Hotels and Catering industry to identify where electricity consumption could be saved. This should include building insulation measures, water heating (for example, frequency of changing towels per guest), use of lighting and energy saving light bulbs, kitchen procedures (cooking, cooling) and the installation of measuring devices to monitor and manage energy use. Secondly, switching to energy providers with a higher proportion of renewables or a decentralized energy supply (for example, solar and CHP) would further reduce CO_2 emissions. In addition, there may be possibilities to improve the management of food supply chains.

The indirect greenhouse gas emissions and dynamics in the food and agriculture sectors raise further questions on the production, slaughtering and distribution of livestock and meat to satisfy the demand in the SW region. In addition, meat consumption (and therefore increased expenditure in meat production) may be higher in the SW than in other regions – in turn perhaps stimulated by the tourist industry and thus, a possible higher spending on meat dishes in restaurants and other food outlets. This is an aspect that could be explored further.



Indicator	SW H&C	Total UK Sector Intensity 2001	Unit	SW H&C sector as % of total UK Sector
Ecological footprint	1.95	1.04	g-m2/£	88%
Energy consumption	0.00006	0.00006	toe/£	0%
Carbon dioxide, CO_2	180	113	13 g/£	59%
Methane, CH_4	0.84	0.69	g/£	22%
Nitrous oxide, N_2O	0.08	0.06	g/£	33%

Box 3: Spider diagram for SW Hotels and Catering

7 Main results for manufacturing sector "Food and Drink"

7.1 TOTAL IMPACTS

For the Ecological footprint, Table 17 shows that the three main contributors are from agriculture, the fishing industry, and the SW Food and Drink sector itself. For CO_2, the SW Food and Drink sector is the highest emitter, followed by agriculture and other food and drink production industries (Table 18).

For methane (Table 19) almost all emissions (91%) come from the agriculture sector – the very small remainder is from other food and drink industries, and coal extraction. For nitrous oxide emissions, 93% are from agriculture. None of the methane or nitrous oxide emissions come directly from food and drink production.

7.2 DIRECT AND INDIRECT IMPACTS

For the SW Food and Drink sector, 19% of the ecological footprint is related to on-site sources and mostly caused by fossil fuel use (96%). For CO_2, 49% are on-site emissions mainly from electricity use (42%), gas use

Table 17: SW Food and Drinks sector: ecological footprint by commodity group

Commodity	Ecological footprint (gha)	% of total Footprint
Agriculture	536,000	49%
Fishing	207,000	19%
Food & Drink	206,000	19%
Food and drink	61,200	6%
Electricity production and distribution	19,100	2%
Plastic products	13,300	1%
Road transport	8,980	1%
Pulp and paper	7,410	1%
Inorganic chemicals	3,730	0%
Metal products	3,050	0%
Mechanical machinery and equipment	2,830	0%
Wood and wood products	2,490	0%
Wholesale distribution	2,000	0%
Legal, consultancy and other business services	1,740	0%
Glass and glass products	1,210	0%
All other commodities	6,960	1%
Total	**1,083,000**	**100%**

Table 18: SW Food and Drinks sector: CO_2 emissions by commodity group

Commodity	CO_2 emissions (t)	% of total carbon footprint
Food & Drink (48%)	372,000	48%
Agriculture (11%)	87,700	11%
Food and drink (9%)	67,400	9%
Electricity production and distribution (7%)	56,000	7%
Plastic products (6%)	45,100	6%
Road transport (4%)	31,300	4%
Fishing (4%)	30,700	4%
Pulp and paper (3%)	20,200	3%
Metal products (1%)	10,000	1%
Mechanical machinery and equipment (1%)	9,360	1%
Inorganic chemicals (1%)	8,350	1%
Wholesale distribution (1%)	6,340	1%
Glass and glass products (1%)	4,900	1%
Legal, consultancy and other business services (<1%)	3,480	0.4%
Printing and publishing (<1%)	3,270	0.4%
All other commodities (3%)	22,900	3%
Total	**779,000**	**100%**

Table 19: SW Food and Drinks sector : Methane emissions by layer

Commodity	CH_4 emissions (t)	% of total CH_4 emissions
Agriculture	8,640	91%
Food and drink	560	6%
Coal extraction	100	1%
Gas distribution	70	1%
Electricity production and distribution	60	1%
Plastic products	7.0	0.1%
Road transport	7.0	0.1%
Wholesale distribution	7.0	0.1%
Pulp and paper	6.0	0.1%
Fishing	6.0	0.1%
Legal, consultancy and other business services	5.0	0.1%
Metal products	4.0	0.0%
Glass and glass products	2.10	0.0%
Renting of machinery etc	2.00	0.0%
Banking and finance	2.00	0.0%
All other commodities	21.900	0.2%
Total	**9,500**	**100%**

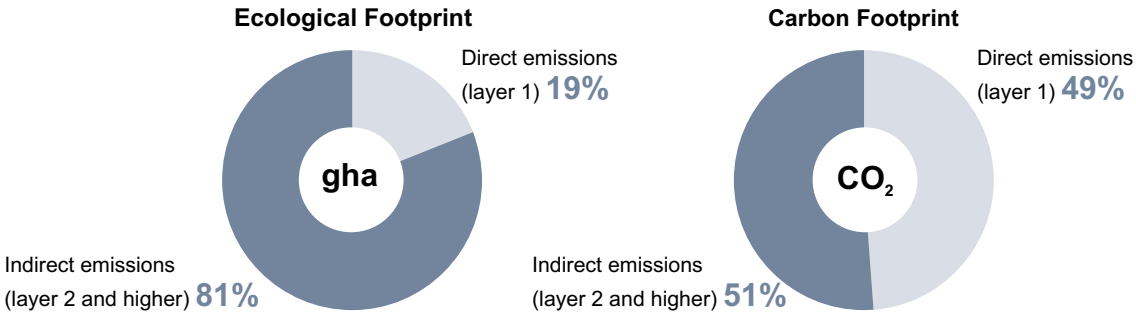


Fig 8: Direct and indirect impacts for SW Food and Drink sector

Table 20: On-site emission sources by type for SW Food and Drink sector

On-site emission source	CO_2 (t)	% of direct emissions
Natural gas	104,673	28%
Coal	65,728	18%
Fuel Oil	15,804	4%
Gas oil	21,490	6%
Other carbon based fuels	7,706	2%
Net electricity (2003)	156,600	42%
Total:	**372,000**	**100%**

(28%) and coal (18%; Figure 8 and Table 20). Methane and nitrous oxide emissions are 100% from indirect sources (mainly agriculture).

7.3 OVERVIEW DIRECT AND INDIRECT IMPACTS

Most of the ecological footprint (71%) in SW Food and Drink production occurs in production layer 2, the direct suppliers to the SW Food and Drink industry. For carbon dioxide emissions, most emissions are caused on-site (49%) and in production layer 2 (38%). 89% of methane emissions and 86% of nitrous oxide emissions are caused in production layer 2, the direct suppliers to SW Food and Drink sector (Figure 9 and Figure 10).

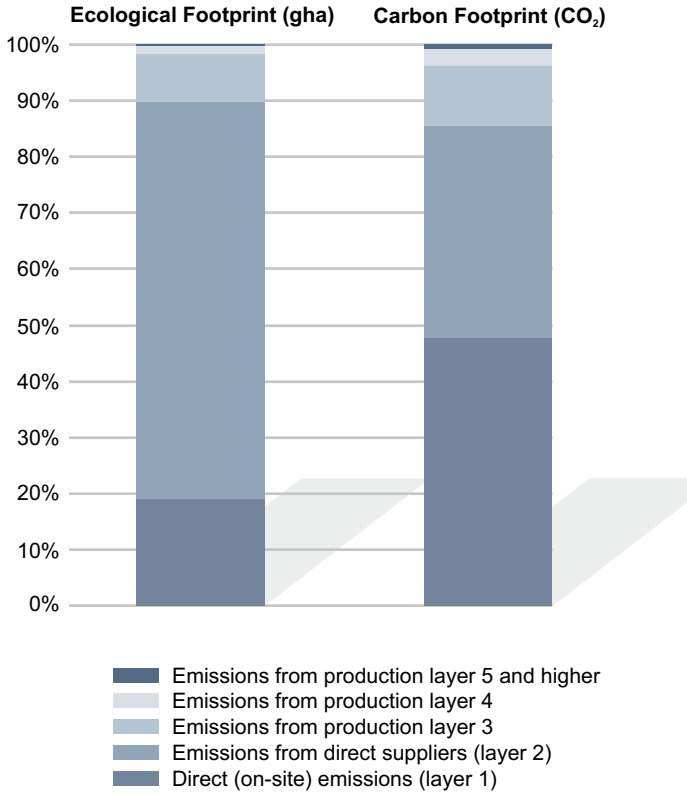


Fig 9: Direct and indirect impacts by layers for SW Food and Drink sector, ecological footprint and CO_2

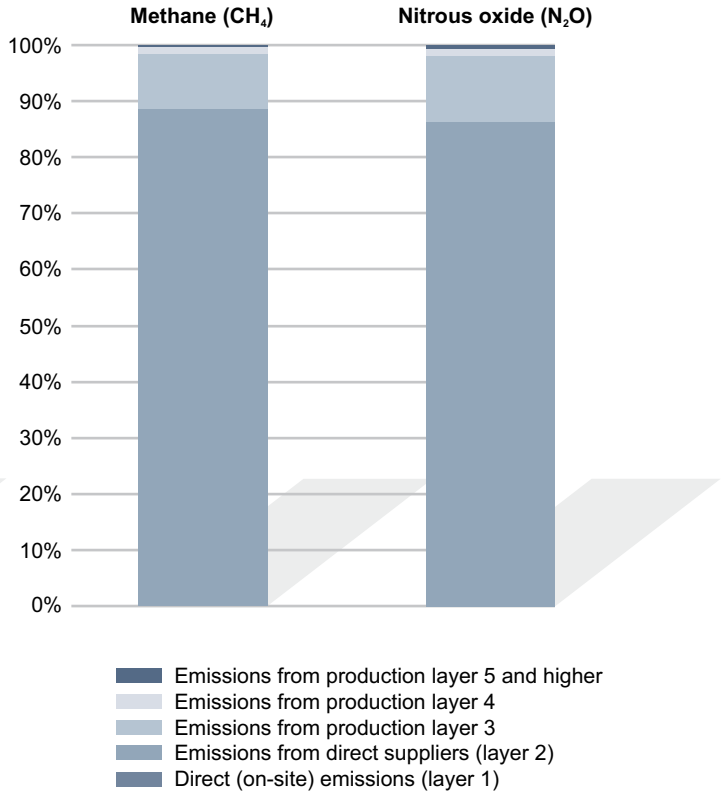


Fig 10: Direct and indirect impacts by layers for SW Food and Drink sector, CH_4 and N_2O

7.4 RANKED STRUCTURAL PATH ANALYSIS – CO_2

As seen from the commodity breakdown in Table 18, with 372,000 tonnes the SW Food & Drink sector emits most of the of CO_2 emissions in the supply chain followed by agriculture and other food and drink industries in the supply chain.

These three sectors also provide 68% of the CO_2 emissions in the supply chain. **Agriculture** emits a total of 87,700 of CO_2 of which 63,000 tonnes are emitted by other agriculture sectors, fertilizer production (3,970 tonnes), electricity production (3,700 tonnes) and again, other agricultural sectors (2,490 tonnes). The remainder of 14,540 tonnes of CO_2 is emitted somewhere else upstream the supply chain. **Other food and drink sectors** (67,400 tonnes of CO_2) mainly trade with each other (38,300 and 2,840 tonnes of CO_2 from other food and drink production, Table 21). The remaining 26,260 tonnes are emitted elsewhere upstream from other suppliers.

7.5 RANKED STRUCTURAL PATH ANALYSIS – METHANE AND NITROUS OXIDE

None of the methane and nitrous oxides emissions are associated with the SW Food & Drink sector itself, with most of these emissions coming from agriculture in layers 2 and 3. For methane, 8,260 tonnes or 87% of the emissions come from direct agricultural suppliers to the SW Food & Drinks industry. The remaining methane emissions (363 tonnes) are from other agricultural suppliers in layers 3 and 4. Only 17 tonnes are emitted elsewhere upstream in the supply chain. Similarly, 86% of nitrous oxide emissions are caused by the agricultural sector that directly supplies the SW Food & drink industry (Table 22 and Table 23). The presence of nitrous oxide in the higher layers (5) in the agricultural sector indicates complex trade interactions within this industry.

Table 21: Ranked structural paths – CO_2

Path Description	Path Value (CO_2 in t)	Unit	Path Order	Percentage in total impact
Food & Drink	372,000	t	1	48%
Agriculture > Food & Drink	63,000	t	2	8%
Electricity production and distribution > Food & Drink	44,300	t	2	6%
Food and drink > Food & Drink	38,300	t	2	5%
Plastic products > Food & Drink	35,000	t	2	4%
Fishing > Food & Drink	28,100	t	2	4%
Road transport > Food & Drink	27,200	t	2	3%
Pulp and paper > Food & Drink	16,300	t	2	2%
Electricity production and distribution > Electricity production and distribution > Food & Drink	8,580	t	3	1%
Inorganic chemicals > Food & Drink	7,880	t	2	1%
Mechanical machinery and equipment > Food & Drink	6,950	t	2	1%
Metal products > Food & Drink	4,600	t	2	1%
Fertilisers > Agriculture > Food & Drink	3,970	t	3	1%
Electricity production and distribution > Agriculture > Food & Drink	3,700	t	3	0.5%
Glass and glass products > Food & Drink	3,690	t	2	0.5%
Electricity production and distribution > Food and drink > Food & Drink	3,650	t	3	0.5%
Agriculture > Food and drink > Food & Drink	3,510	t	3	0.5%
Food and drink > Food and drink > Food & Drink	2,840	t	3	0.4%
Plastics & Synthetic resins etc > Plastic products > Food & Drink	2,690	t	3	0.4%
Agriculture > Agriculture > Food & Drink	2,490	t	3	0.3%
All other paths	100,250	t		13%
Total	**779,000**	**t**		**100%**

7.6 BENCHMARKING

The spider diagram (Box 4) shows that per £ spent, the SW Food and Drink sector performs 76% worse than the UK average in terms of its ecological footprint, and 15%, 68% and 74% worse in terms of CO_2, methane and nitrous oxide respectively. However, in terms of energy consumption, the Food and Drink industry performs 13% better than average.

7.7 SUMMARY AND CONCLUSIONS SW FOOD AND DRINK SECTOR

For the ecological footprint, the highest impacts are from the agriculture and fishing sectors in and the SW Food and Drink sector itself. For indirect impacts, the high ecological footprints from agriculture and fishing in layers 2 and 3 are explained by the use of fossil fuels in agriculture – possibly

Table 22: Ranked structural paths – methane

Path Description	Path Value (CH_4 in t)	Unit	Path Order	Percentage in total impact
Agriculture > Food & Drink	8,260	t	2	87%
Agriculture > Food and drink > Food & Drink	460	t	3	5%
Agriculture > Agriculture > Food & Drink	330	t	3	3%
Coal extraction > Food & Drink	90	t	2	1%
Gas distribution > Food & Drink	70	t	2	0.7%
Agriculture > Food and drink > Food and drink > Food & Drink	30	t	4	0.4%
Coal extraction > Electricity production and distribution > Food & Drink	29	t	3	0.3%
Agriculture > Agriculture > Food and drink > Food & Drink	18	t	4	0.2%
Agriculture > Food and drink > Agriculture > Food & Drink	18	t	4	0.2%
Agriculture > Agriculture > Agriculture > Food & Drink	13	t	4	0.1%
Sewage and refuse services > Food and drink > Food & Drink	11	t	3	0.1%
Gas distribution > Electricity production and distribution > Food & Drink	10	t	3	0.1%
Coal extraction > Food and drink > Food & Drink	9	t	3	0.1%
Electricity production and distribution > Food & Drink	8	t	2	0.1%
Gas distribution > Food and drink > Food & Drink	6	t	3	0.1%
Coal extraction > Electricity production and distribution > Electricity production and distribution	6	t	4	0.1%
Gas distribution > Gas distribution > Food & Drink	3	t	3	0.02%
Agriculture > Food and drink > Food and drink > Food and drink > Food & Drink	3	t	5	0.02%
Road transport > Food & Drink	3	t	2	0.02%
Coal extraction > Electricity production and distribution > Agriculture > Food & Drink	2	t	4	0.02%
All other paths	122	t		1.2%
Total	**9,500**	**t**		**100%**

partly due to the dispersed geographic circumstances - and land used for pasture (30 and 17% of the ecological footprint). Sea catch accounted for 46% of the total Footprint for the Food and Drinks sector, indicating a high level of sea food processing.

For CO_2, the highest emissions are generated by the SW Food and Drink sector itself, followed by agriculture and other food and drink sectors in the supply chain directly serving the SW Food and Drink industry.

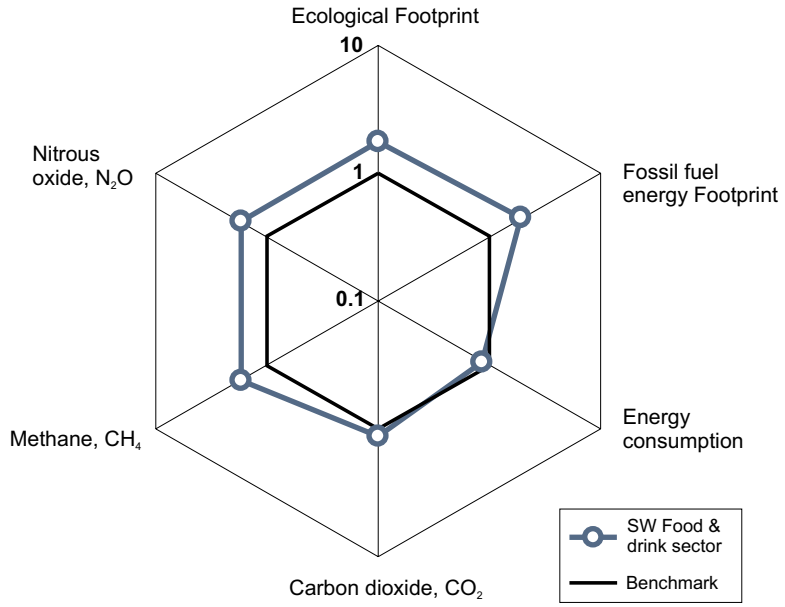
None of the methane and nitrous oxide emissions are produced on-site but are almost entirely associated with the agricultural sector in relation to livestock production. Both methane and nitrous oxide emissions also occur in the higher production layers associated with other agricultural sectors higher up in the

Table 23: Ranked structural paths – nitrous oxide

Path Description	Path Value (N_2O in t)	Unit	Path Order	Percentage in total impact
Agriculture > Food & Drink	810	t	2	86%
Agriculture > Food and drink > Food & Drink	50	t	3	5%
Agriculture > Agriculture > Food & Drink	30	t	3	3%
Fertilisers > Agriculture > Food & Drink	30.00	t	3	3%
Agriculture > Food and drink > Food and drink > Food & Drink	3.00	t	4	0.4%
Electricity production and distribution > Food & Drink	1.80	t	2	0.2%
Agriculture > Agriculture > Food and drink > Food & Drink	1.80	t	4	0.2%
Agriculture > Food and drink > Agriculture > Food & Drink	1.80	t	4	0.2%
Fertilisers > Agriculture > Food and drink > Food & Drink	1.70	t	4	0.2%
Fertilisers > Fertilisers > Agriculture > Food & Drink	1.60	t	4	0.2%
Agriculture > Agriculture > Agriculture > Food & Drink	1.30	t	4	0.1%
Organic chemicals > Food & Drink	1.20	t	2	0.1%
Road transport > Food & Drink	1.20	t	2	0.1%
Fertilisers > Agriculture > Agriculture > Food & Drink	1.20	t	4	0.1%
Food and drink > Food & Drink	1.10	t	2	0.1%
Plastic products > Food & Drink	0.50	t	2	0.1%
Organic chemicals > Agriculture > Food & Drink	0.40	t	3	0.0%
Electricity production and distribution > Electricity production and distribution > Food & Drink	0.40	t	3	0.0%
Fishing > Food & Drink	0.30	t	2	0.0%
Organic chemicals > Plastic products > Food & Drink	0.29	t	3	0.0%
All other paths	10	t	0	1%
Total	**950**	**t**		**100%**

supply chain. This indicates complex trading interactions and supply chains within this sector and, in association with relative high carbon dioxide emissions from agriculture, raises the question as to where the livestock or meat is produced, slaughtered and transported to serve the food processing industry in the SW region. This assumption is also supported by the higher than average environmental impact per £ spent in terms of ecological footprint, CO_2, methane and nitrous oxide emissions and could be explored further.

Almost half of the total CO_2 emissions in the SW Food and Drink supply chain are associated with on-site sources. As far as the data could be broken down in relation to the direct impacts, 42% of emissions are related to electricity use, 28% from gas and 18% from coal consumption. As a first step, exploring options for saving energy in food production (for example in processing, cooking, cooling and lighting) and switching to a "greener" electricity mix with less coal could reduce CO_2 emissions.



Indicator	SW F&D	Total UK Sector Intensity 2001	Unit	SW F&D sector as % of total UK Sector
Ecological footprint	6.13	3.48	g-m2/£	76%
Energy consumption	2	2	kWh/£	-13%
Carbon dioxide, CO_2	441	383	g/£	15%
Methane, CH_4	5.38	3.20	g/£	68%
Nitrous oxide, N_2O	0.54	0.31	g/£	74%

Box 4: Spider diagram SW Food and Drink sector

8 Main results for "SW Business Services"

8.1 TOTAL IMPACTS

The SW Business Services sector had an ecological footprint of 330,000 gha and emitted a total of 691,000 tonnes of CO_2 (Table 24 and Table 25). By far the highest contributor to the ecological footprint was the SW Business Services sector itself (55%) followed by legal and consultancy services, and electricity production. Similarly in terms of CO_2, the highest emitters are SW Business Services, road transport services, and electricity production. Together these three sub sectors contribute 63% of the total supply chain emissions.

Table 24: Business services: ecological footprint by layer

Commodity	Ecological footprint (gha)	% of total Footprint
SW Business services sector	183,000	55%
Legal, consultancy and other business services	30,700	9%
Electricity production and distribution	27,600	8%
Road transport	24,100	7%
Pulp and paper	8,100	2%
Motor vehicles	5,430	2%
Furniture and miscellaneous manufacturing	4,720	1%
Mechanical machinery and equipment	4,500	1%
Wood and wood products	3,420	1%
Food and drink	3,320	1%
Post and telecommunications	3,180	1%
Computer services	2,910	1%
Renting of machinery etc	2,840	1%
Motor vehicle distribution and repair, automotive fuel retail	2,540	1%
Banking and finance	2,230	1%
All other commodities	21,410	6%
Total	**330,000**	**100%**

Table 25: Business services: CO_2 by layer

Commodity	CO_2 emissions (t)	% of total carbon footprint
SW Business services sector (39%)	271,000	39%
Road transport (12%)	84,100	12%
Electricity production and distribution (12%)	80,800	12%
Legal, consultancy and other business services (9%)	61,500	9%
Pulp and paper (3%)	22,100	3%
Motor vehicles (3%)	19,300	3%
Furniture and miscellaneous manufacturing (2%)	15,100	2%
Mechanical machinery and equipment (2%)	14,900	2%
Post and telecommunications (2%)	11,600	2%
Computer services (1%)	9,830	1%
Renting of machinery etc (1%)	9,700	1%
Coke ovens, refined petroleum & nuclear fuel (1%)	9,500	1%
Motor vehicle distribution and repair, automotive fuel retail (1%)	8,930	1%
Banking and finance (1%)	7,270	1%
Other service activities (1%)	7,020	1%
All other commodities (8%)	58,350	8%
Total	**691,000**	**100%**

8.2 DIRECT AND INDIRECT IMPACTS

More than half of the total ecological footprint is from on-site impacts related to fossil fuel use (80%) and built-up land (17%), and 39% for the carbon footprint (Figure 11). Table 26 shows the breakdown of direct CO_2 emissions as being electricity use (71%), gas (15%) and oil (14%).

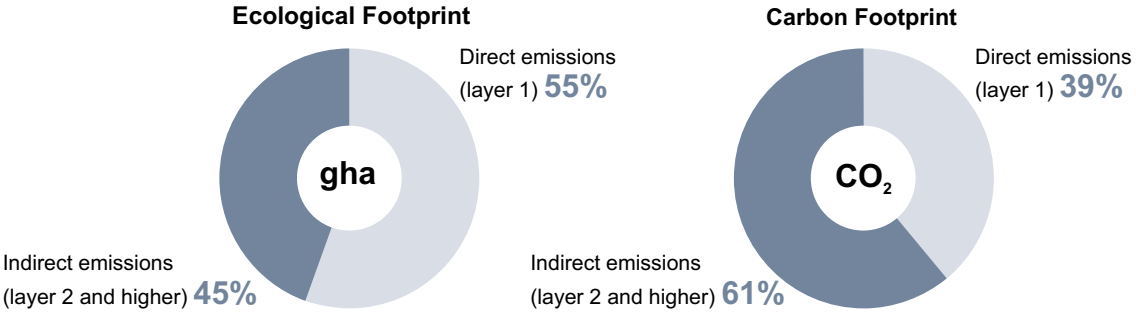


Fig 11: Direct and indirect impacts for SW Business services

Table 26: On-site emission sources by type for SW Business services

On-site emission source	CO_2 (t)	% of direct emissions
Natural gas	56,552	15%
Coal	0	0%
Fuel Oil	18,239	5%
Gas oil	32,462	9%
Other carbon based fuels	1,339	0%
Net electricity (2003)	263,407	71%
Total:	**372,000**	**100%**

8.3 OVERVIEW OF DIRECT AND INDIRECT IMPACTS

The indirect impacts occur mainly in production layer 2 from direct suppliers to the SW Business Services sector, as shown in Figure 12, with impacts levelling off with the more remote production layers. Hence, the priorities for mitigating environmental impacts should be for the SW Business Sector itself and in the management of its direct suppliers.

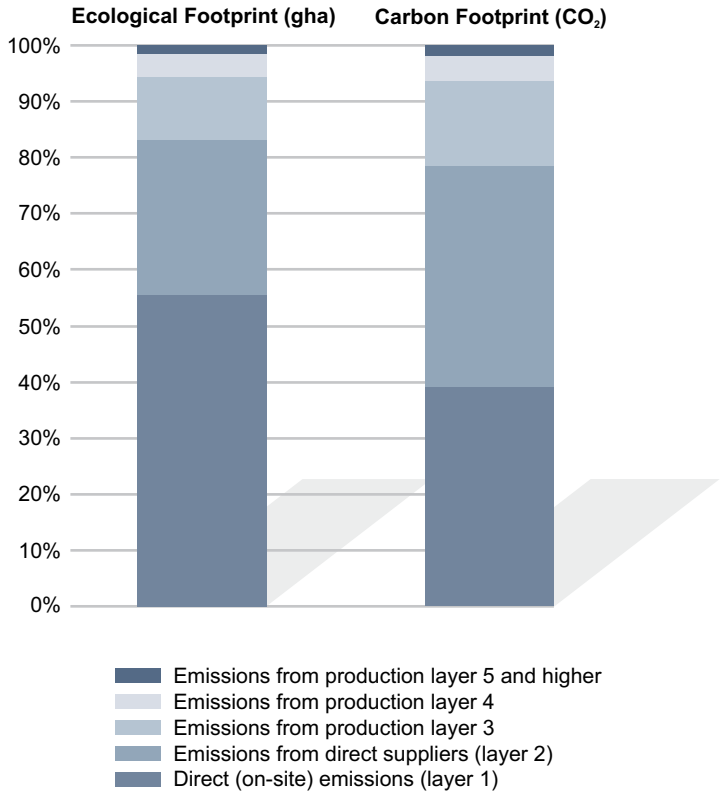


Fig12: Direct and indirect impacts by layers for SW Food and Drink sector, ecological footprint and CO_2

8.4 RANKED STRUCTURAL PATH ANALYSIS

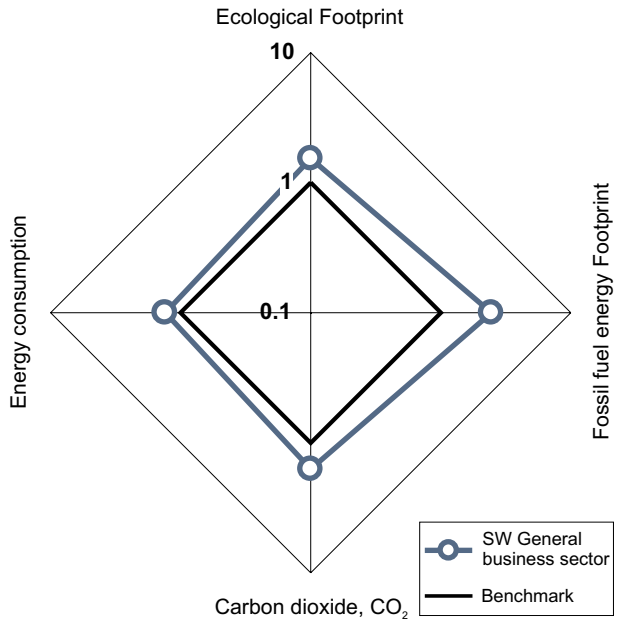
In the commodity breakdown from Table 25, the SW Business Services itself (271,000 tonnes of CO_2), road transport services (84,100 tonnes), and electricity production and distribution (80,800 tonnes) make up 63% of the total CO_2 emissions in the supply chain. Of these, the SW Business Services directly cause 39% of the emissions (Table 27).

As direct suppliers to the sector, **road transport services** emit 73,100 tonnes of CO_2, the remainder (11,000 tonnes) being emitted somewhere further upstream in the supply chain.

63,900 tonnes of CO_2 are associated with the direct **supply of electricity** to the SW Business Services. 12,400 tonnes come from other electricity producers in layer 3; the remaining 4500 tonnes of CO_2 being emitted elsewhere in the supply chain.

Table 27: Ranked structural paths – CO_2

Path Description	Path Value (CO_2 in t)	Unit	Path Order	Percentage in total impact
SW Business services sector	271,000	t	1	39%
Road transport > General Business services sector	73,100	t	2	11%
Electricity production and distribution > General Business services sector	63,900	t	2	9%
Pulp and paper > General Business services sector	17,800	t	2	3%
Legal, consultancy and other business services > General Business services sector	16,800	t	2	2%
Motor vehicles > General Business services sector	13,900	t	2	2%
Furniture and miscellaneous manufacturing > General Business services sector	13,400	t	2	2%
Electricity production and distribution > Electricity production and distribution > General Business services sector	12,400	t	3	2%
Mechanical machinery and equipment > General Business services sector	11,000	t	2	2%
Electricity production and distribution > Legal, consultancy and other business services > General Business services sector	7,630	t	3	1%
Coke ovens, refined petroleum & nuclear fuel > General Business services sector	7,560	t	2	1%
Plastic products > General Business services sector	5,420	t	2	1%
Air transport > Legal, consultancy and other business services > General Business services sector	5,140	t	3	1%
Renting of machinery etc > General Business services sector	4,300	t	2	1%
Other service activities > General Business services sector	3,960	t	2	1%
Inorganic chemicals > General Business services sector	3,510	t	2	1%
Motor vehicle distribution and repair, automotive fuel retail > General Business services sector	3,370	t	2	0.5%
Post and telecommunications > General Business services sector	3,350	t	2	0.5%
Public admininstration and defence > General Business services sector	3,000	t	2	0.4%
Computer services > General Business services sector	2,780	t	2	0.4%
All other paths	147,680	t		21%
Total	**691,000**	**t**		**100%**



Indicator	SW BS	Total UK Sector Intensity 2001	Unit	SW BS as % of Total Sector UK
Ecological footprint	0.54	0.35	g-m²/£	54%
Carbon dioxide, CO_2	112	69	g/£	62%
Energy consumption	0. 00004	0. 00003	toe/£	33%

Box 5: Spider diagram SW Business services

8.5 BENCHMARKING

Compared to the UK average , the SW Business Services sector performs worse in terms of ecological footprint (54%), CO_2 (62%) and energy consumption (33%), as can be seen in Box 5. These results may be somewhat exacerbated by the peripheral and dispersed nature of the region.

8.6 SUMMARY AND CONCLUSIONS SW BUSINESS SERVICES SECTOR

In terms of total impacts the main CO_2 contributors in the SW Business Services supply chain are the sector itself, road transport services and electricity production and distribution. 39% of the CO_2 emissions occur on-site and are mainly from electricity use (71%). Most indirect impacts come from direct suppliers to the SW Business Services, especially from road transport and electricity consumption.

Hence, the priorities should be to assess the potential of switching to more renewable energy and to see where energy consumption in offices can be reduced, for example for lighting, heating, use of office machinery (e.g. switching off computers instead leaving them in stand-by mode), and air conditioning. An increased use of video and teleconferencing and, where possible given geographical circumstances, a modal shift from road to rail transport should be achieved.

9 Overall CO_2 emissions for all five sectors

In terms of the carbon footprint, for the South West, the Food and Drink sector has the highest overall emissions of the sectors considered, followed by Business Services, Transport Equipment manufacture, Motor Vehicle production, and finally Hotels and Catering services (Table 28).

Table 28: Overall CO_2 emissions for all five sectors

Rank	SW Sector	CO_2 (t)
1.	Food and Drink production	779,000
2.	Business Services	691,000
3.	Transport Equipment incl. aerospace	527,000
4.	Motor Vehicle production	490,000
5.	Hotels and Catering services	318,000

9.1 ABSOLUTE AND RELATIVE IMPACTS PER £ SPENT

In absolute terms, per £ spent, the SW Motor Vehicle sector has the highest CO_2 emissions followed by Food and Drinks production, Transport Equipment manufacture, Hotels and Catering services, and Business Services. Apart from SW Motor Vehicle manufacture, all other SW sectors emit more CO_2 per £ spent compared to their respective UK sectors (Figure 13). These values do not account for business-specific efficiencies, such as processes inherent to a particular industry, or regional differences.

Looking more closely at the efficiency ratios between the SW and UK sectors, relative to the sector-specific UK average benchmark, SW Business Services were the least efficient in terms of CO_2 per £ spent, followed by Transport Equipment, Hotels and Catering services, and Food and Drinks production. The SW Motor Vehicle manufacturing sector was the most efficient, performing 35% better than its UK sector (in other words emitting 65% per £ spent compared to the UK average) (Figure 14). Hence, while taking into account regional circumstances, a first aim should be to bring the relative efficiencies of these SW sectors closer in line with their respective UK sectors.

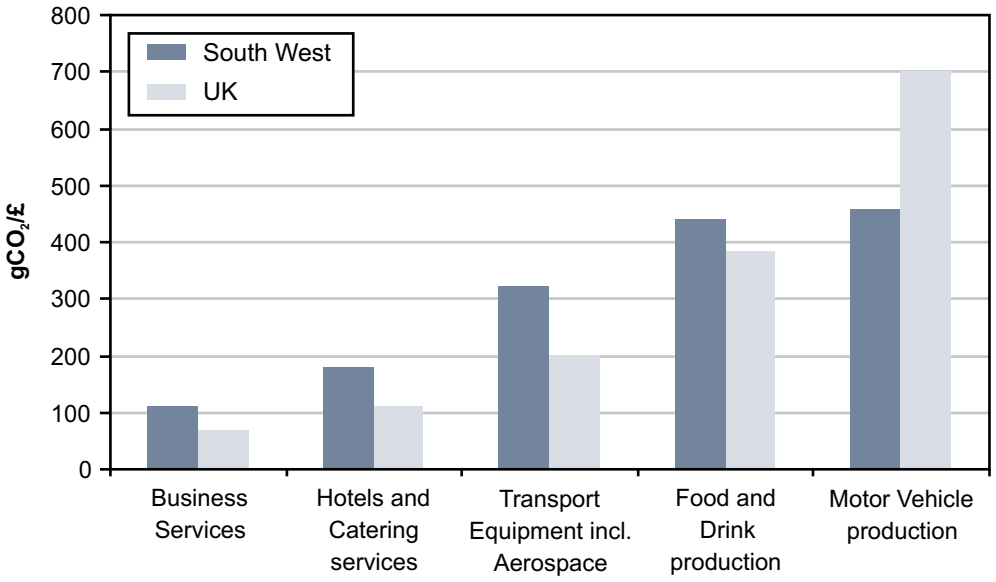


Fig 13: Impacts per £ spent - SW relative to UK sector

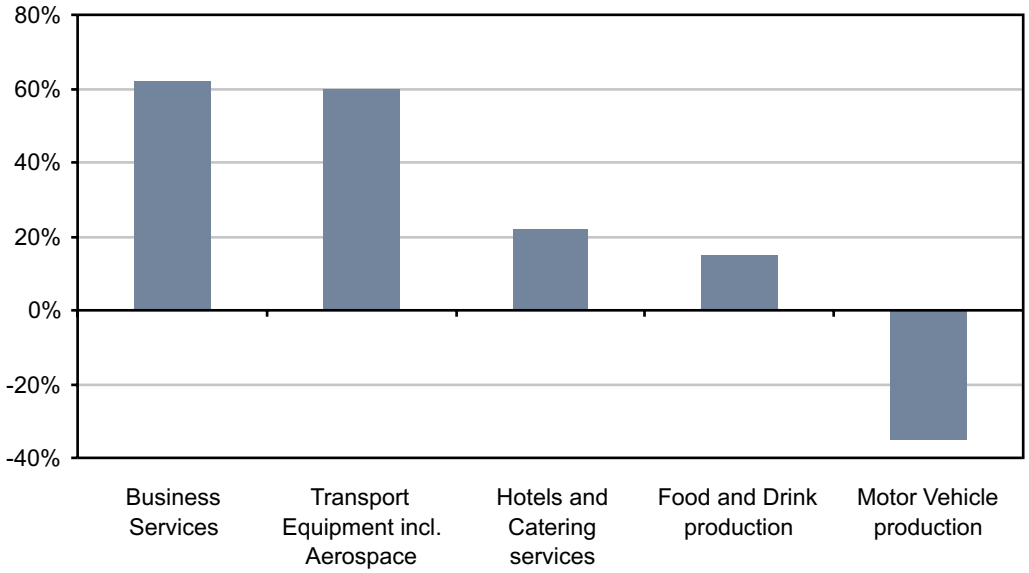


Fig 14: CO_2 efficiency ratios for SW and respective UK sectors (impacts per £ spent)

9.2 IMPACT PER £M GROSS VALUE ADDED

Gross Value Added (GVA) is a measure of the value of the goods and services produced in the economy. It is used by the Office of National Statistics to measure the economic well-being of an area. In terms of CO_2 emitted per £m of GVA, the SW sectors are less efficient compared to the UK average UK sectors (Figure 15). Here the emissions by the SW sectors exceed the UK average sectors as follows:

- Business sector services, 95%
- Hotels and catering services, 35%
- Transport equipment manufacture, 5%
- Food and Drink production, 1%
- Motor vehicle manufacture, 185%

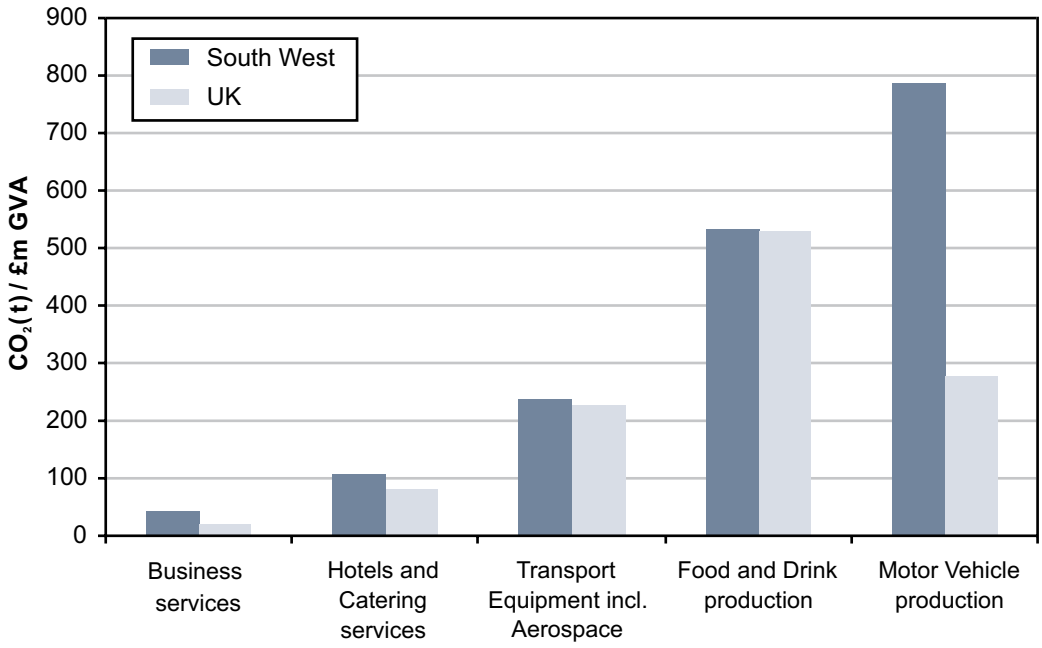


Fig 15: Comparison of CO_2 emissions in tonnes per £m GVA

Table 29: All five SW sectors and breakdown of main impacts

SW Sector	CO_2 by Commodity Group	CO_2 by Supply Chain Layer	CO_2 by Path Value
Transport Equipment manufacture	Transport equipment manufacture itself (layer 1)	2 (direct suppliers to SW sector)	Transport equipment manufacture itself
Motor Vehicle manufacture	Motor Vehicle manufacture itself	2	Motor Vehicle manufacture itself
Hotels and Catering services	Hotels and Catering services itself (layer 1)	1 (layer 2 for methane and nitrous oxide)	Hotels and Catering services itself (Agriculture sector for methane and nitrous oxide, layer 2)
Food and Drink manufacture	Food and Drink production itself (layer 1)	1 (layer 2 for methane and nitrous oxide)	Food and Drink production itself (Agriculture sector for methane and nitrous oxide, layer 2)
Business Services	Business Services itself (layer 1)	2	Business Services itself

From figures 13, 14, and 15 the SW Motor Vehicle sector, for example, appears very resource efficient compared to its UK sector in terms of expenditure (impacts per £ spent). However in terms of impacts per £m GVA (which includes profit, wages, salaries, and taxes, less subsidies) the sector appears the least efficient - or its economic performance could be better given the emissions generated. This is only an indication, however, and would require a much more detailed economic analysis, including additional factors, before it can be interpreted robustly.

9.3 SUMMARY OF SECTORS AND BREAKDOWN BY MAIN IMPACTS

Table 29 lists the five SW sectors and provides an overview of the breakdown of the highest emissions by commodity group, supply chain layer, and structural path value. The commodity groups and paths with the highest impacts in terms of CO_2 are all located in the manufacturing or service sector itself (i.e., layer 1). With regard to methane and nitrous oxide, the highest emissions occurred in the agricultural sectors directly supplying the SW sectors Hotels and Catering, and Food and Drinks production. Apart from Hotels and Catering, and Food and Drink, broken down by supply chain layer, the direct suppliers (layer 2) to the SW sectors contributed most of the emissions.

For all five economic sectors that were analysed in this report, the largest single proportion of CO_2 emissions in the supply chain is associated with the direct operations of the manufacturing or service sites. This is good news as direct circumstances, manufacturing and service operations can be easier influenced than operations more remote in the supply chain. For the mitigation of direct impacts, a range of recommendations can be made based on the results of this analysis. However, for many industrial operations, further process analyses should be employed which are outside the scope of this study and require a different approach. The finding that most indirect impacts are located in supply chain layer 2 is also promising since trade agreements with a sector's direct suppliers are more transparent and less difficult to implement. Hence, first suggestions from this research are to look further into the direct and indirect trade operations that are carried out in the South West region.

10 Discussion and conclusions

In all five manufacturing and service sectors, electricity provided the main energy source. Especially with regard to the development of a Regional Sustainable Energy Strategy[18], this could provide an opportunity to improve the region's energy mix with a higher share of renewables and the implementation of renewable technologies. For the SW Transport Equipment manufacture sector, all electricity use was allocated to aerospace equipment production. This suggests a further analysis into how the plants and machinery are operated, switching to a different electricity or fuel mix, and considering decentralised power generation for manufacturing sites. The direct suppliers to the SW Transport Equipment sector are mainly heavy industries like electricity and metal production. A first suggestion is to influence these suppliers with regard to a "greener" electricity mix and the implementation of environmental management systems.

To a degree, this also applies to the SW Motor Vehicle manufacturing sector, with most layer 2 suppliers emitting the lion's share of CO_2 in the supply chain (i.e. other motor vehicle or parts manufactures, and iron and steel producers). However, SW Motor Vehicle manufacturing was the most efficient compared to its UK average sector.

For the SW Hotels and Catering sector, and also the Food and Drink industry, first suggestions to reduce the on-site CO_2 emissions are to assess the energy efficiencies in buildings, for space and water heating, kitchen and food preparation procedures, and striving for a decentralised and less fossil-fuel based energy supply. Relative to the other sectors analysed in this study, the SW Hotels and Catering and the Food and Drink sector had the highest proportion of CO_2 emissions associated with on-site operations. For indirect impacts, agriculture caused significant CO_2 emissions in both sectors. Agriculture and fishing had the highest ecological footprint in the SW Food and Drink sector; partly explained by the use of fossil fuels – possibly due to the dispersed geographic circumstances and thus longer distances for driving - and land used for pasture (30 and 17% of the ecological footprint). Sea catch accounted for 46% of the total footprint for the SW Food and Drinks sector and for 60% in the SW Hotels and Catering sector and can be explained by a high turnover of seafood in the region. The presence of methane and nitrous oxides in the more remote supply chain layers suggest complex and circular trade patterns in the livestock and meat trade. These chains should be explored in more detail, in particular with a focus on transport distances, more localised and shorter supply chains, and in line with the Strategy for Sustainable Food and Farming[19].

For SW Business Services, most emissions associated with on-site operations were form electricity use, suggesting a screening of energy use in offices including the use of IT equipment. This is supported by the high impacts from electricity production and distribution in layer 2. High impacts from road transport services suggest exploring a better use of ICT as an alternative to road based transport.

The overall emissions of a sector relate to its size and economies of scale; here, the SW Food and Drinks industry ranked top followed by Business Services, Transport Equipment manufacture, Motor Vehicle manufacture and Hotels and Catering services. These overall emissions do not relate to efficiencies. For example, although the Food and Drinks sector is one of the most efficient sectors per £ spent or unit of output, this sector has the highest overall emissions. Absolute impacts per £ spent measure how polluting a sector is per unit expenditure but do not account for processes inherent to a specific sector – for example different processes associated with car manufacturing or providing legal services. This becomes clearer when relating efficiencies within a sector – expressed as a sector's impact per £ spent in relation to the efficiency of the average UK sector to which it

18 www.sustainabilitysouthwest.org.uk

19 http://www.defra.gov.uk/farm/policy/sustain/index.htm

belongs. Here, SW Motor Vehicle manufacture was the most efficient followed by Food and Drink production, and Hotels and Catering services. Transport Equipment manufacture and Business services were around 60% less efficient than their average UK sectors. However, the more dispersed geographical conditions of the region also have to be taken into account.

In terms of CO_2 per £m GVA as a measure of economic well-being or profit, the sectors Motor Vehicle manufacture and business services created the highest emissions followed by Hotels and Catering Services. Transport Equipment manufacture and Food and Drink production were the most efficient sectors per £m GVA. However, before drawing robust conclusions about resource efficiencies and economic performance a more detailed economic analysis of the sectors with additional variables is necessary.

Based on the results of this analysis, the SW sectors **Transport Equipment manufacture, Business Services,** and **Motor Vehicle production** should be the first targets for identifying and improving potential resource efficiencies. This should involve a closer inspection of manufacturing and business practices on-site, the implementation of environmental management systems, a further exploration of regional supply chains, and improving supply chain management. As a first step to help addressing the identified impacts, businesses can seek specialist advice through Government sources such as Business Link[20], Defra's BREW programme[21], or NetRegs[22].

With regard to the environmental limits debate it is important to bear in mind that these limits cannot be discussed by looking at the production side alone. Since demand is a driver for production, any environmental limits debate also needs to be placed in the context of consumption and demographic issues. Although the RES intends to improve resource efficiency and use of renewable energy, it prioritises ambitious infrastructure projects such as motorway extensions, the expansion of Bristol airport, and is devoid of CO_2 reduction targets. In the light of the projected growth figures for the region these policies are likely to put additional pressures on resource and energy use, and will induce an increasing demand for infrastructure development. For the region as a whole this means that although efficiency gains may be achieved by the industrial sectors, these gains could be outweighed through an increased final demand for resources in the region. Secondly, not all goods produced in the South West will be solely consumed there. Rather, this first study identified potentials for improving resource efficiency in the chosen economic sectors, and also benchmarked the region's sectors against their UK averages. Better on-site and supply chain management is a prerequisite for increasing resource efficiency, which in turn can strengthen the competitiveness of the South West. In addition, improved resource productivity can reduce the sectors' carbon footprint and the release of toxic substances into the environment. In this sense, the results of this study can support the RES delivery framework's strategic objectives in terms of supporting business productivity, innovation, and through competing in the global economy.

20 http://www.businesslink.gov.uk/

21 http://www.defra.gov.uk/Environment/waste/brew/

22 http://www.netregs.gov.uk/

11 References

Foran, B., Lenzen, M. and Dey, C. (2005a) "*Balancing Act: A triple bottom line analysis of the 135 sectors of the Australian economy*". CSIRO Technical report, CSIRO Resource Futures and The University of Sydney, Canberra, ACT, Australia. http://www.cse.csiro.au/research/balancingact and http://www.isa.org.usyd.edu.au.

Foran, B., Lenzen, M., Dey, C. and Bilek, M. (2005b) "Integrating sustainable chain management with triple bottom line accounting". *Ecological Economics* 52(2): 143-157. http://dx.doi.org/10.1016/j.ecolecon.2004.06.024.

Orlitzky, M., Schmidt, F. L., & Rynes, S. L. 2003). Corporate Social and Financial Performance: A Meta-Analysis. *Organization Studies*.2003; 24: 403-441

Wiedmann, T. and Lenzen, M. (2006) "Sharing Responsibility along Supply Chains - A New Life-Cycle Approach and Software Tool for Triple-Bottom-Line Accounting". *The Corporate Responsibility Research Conference 2006*, 4-5 September 2006, Trinity College, Dublin, Ireland. http://www.isa-research.co.uk/docs/Wiedmann_Lenzen_2006_CRRC_paper.pdf, http://www.crrconference.org/downloads/2006wiedmannlensen.pdf

Wiedmann, T. and Minx, J. (2007) *A definition of "Carbon Footprint"*. ISA UK research report 07-01. www.isa-research.co.uk

12 Appendix SIC Classifications

Transport Equipment:

Building and repairing of ships and boats; other transport equipment; aircraft and spacecraft; bicycles, UK SIC 2003: 35 The primary activities are >> 35.11 Building and repairing of ships; 35.12 Building and repairing of pleasure and sporting boats; 35.20 Manufacture of railway and tramway locomotives and rolling stock; 35.30 Manufacture of aircraft and spacecraft; 35.41 Manufacture of motorcycles; 35.42 Manufacture of bicycles; 35.43 Manufacture of invalid carriages; 35.50 Manufacture of other transport equipment not elsewhere classified

Motor Vehicles:

Motor vehicles, trailers and semi-trailers, UK SIC 2003: 34 The primary activities are >> 34.10 Manufacture of motor vehicles; 34.20/1 Manufacture of bodies (coachwork) for motor vehicles (except caravans); 34.20/2 Manufacture of trailers and semi-trailers; 34.20/3 Manufacture of caravans; 34.30 Manufacture of parts and accessories for motor vehicles and their engines

Hotels and Catering:

Hotels, catering, pubs etc, UK SIC 2003: 55 The primary activities are >> 55.10/1 Hotels and motels with restaurant (licensed); 55.10/2 Hotels and motels with restaurant (unlicensed); 55.10/3 Hotels and motels, without restaurant; 55.21 Youth hostels and mountain refuges; 55.22 Camping sites, including caravan sites; 55.23/1 Holiday centres and holiday villages; 55.23/2 Other self-catering holiday accommodation; 55.23/9 Other tourist or short-stay accommodation; 55.30/1 Licensed restaurants; 55.30/2 Unlicensed restaurants and cafes; 55.30/3 Take-away food shops; 55.30/4 Take-away food mobile stands; 55.40/1 Licensed clubs; 55.40/2 Independent public houses and bars; 55.40/3 Tenanted public houses and bars; 55.40/4 Managed public houses and bars; 55.51 Canteens; 55.52 Catering

Food and Drink

Production, processing and preserving of meat, fish, fruit, vegetables, oils, fats, dairy products, grain mill products, starch products, animal feeds, bread, rusks, biscuits, pastry goods, cakes, sugar, cocoa, chocolate, confectionery and other food products; alcoholic beverages, mineral waters and soft drinks, UK SIC 2003: 15 The primary activities are >> 15.11/1 Slaughtering of animals other than poultry and rabbits; 15.11/2 Animal by-product processing; 15.11/3 Fellmongery; 15.12 poultry meat; 15.13/1 Bacon and ham production; 15.13/9 Other meat and poultry meat processing; 15.20/1 Freezing of fish; 15.20/9 Other fish processing and preserving; 15.31 potatoes; 15.32 fruit and vegetable juice; 15.33 fruit and vegetables not elsewhere classified; 15.41 crude oils and fats; 15.42 refined oils and fats; 15.43 margarine and similar edible fats; 15.51/1 Liquid milk and cream production; 15.51/2 Butter and cheese production; 15.51/9 other milk products; 15.52 ice cream; 15.61/1 Grain milling; 15.61/2 breakfast cereals and cereals-based foods; 15.62 starches and starch products; 15.71 prepared feeds for farm animals; 15.72 prepared pet foods; 15.81 bread; fresh pastry goods and cakes; 15.82 rusks and biscuits; preserved pastry goods and cakes; 15.83 sugar; 15.84/1 cocoa and chocolate confectionery; 15.84/2 sugar confectionery; 15.85 macaroni, noodles, couscous and similar farinaceous products; 15.86/1 Tea processing; 15.86/2 coffee and coffee substitutes; 15.87 condiments and seasonings; 15.88 homogenised food preparations and dietetic food; 15.89/1 soups; 15.89/9 other food products not elsewhere classified; 15.91 distilled potable alcoholic beverages; 15.92 ethyl alcohol from fermented materials; 15.93/1 wine of fresh grapes and grape juice; 15.93/2 wine based on concentrated grape must; 15.94/1 cider and perry; 15.94/9 other fermented fruit beverages; 15.95 other non-distilled fermented beverages; 15.96 beer; 15.97 malt; 15.98 mineral waters and soft drinks

Business Services:

Legal, consultancy and other business services, UK SIC 2003: 74 The primary activities are >> 74.11/1 Activities of patent and copyright agents; 74.11/2 Barristers at Law; 74.11/3 Solicitors; 74.11/9 Other legal activities not elsewhere classified; 74.12/1 Accounting and auditing activities; 74.12/2 Book-keeping activities; 74.12/3 Tax consultancy; 74.13 Market research and public opinion polling; 74.14/1 Public relations activities; 74.14/2 Financial management; 74.14/3 General management consultancy activities; 74.14/9 Business and management consultancy activities not elsewhere classified; 74.15/1 Management activities of wholesale holding companies; 74.15/2 transport holding companies; 74.15/3 construction holding companies; 74.15/4 catering holding companies; 74.15/5 motor trades holding companies; 74.15/6 service trades holding companies; 74.15/7 retail holding companies; 74.15/8 production holding companies; 74.15/9 other non-financial holding companies; 74.20/1 Architectural activities; 74.20/2 Urban planning and landscape architectural activities; 74.20/3 Quantity surveying activities; 74.20/4 Engineering consultative and design activities; 74.20/5 Engineering design activities for industrial process and production; 74.20/6 Engineering related scientific and technical consulting activities; 74.20/9 Other engineering activities; 74.30 Technical testing and analysis; 74.40/1 Sale or leasing activities of advertising space or time; 74.40/2 Planning, creation and placement of advertising activities; 74.40/9 Advertising activities not elsewhere classified; 74.50 Labour recruitment and provision of personnel; 74.60/1 Investigation activities; 74.60/2 Security and related activities; 74.70/1 Traditional cleaning activities; 74.70/2 Window cleaning services; 74.70/3 Disinfecting and exterminating services; 74.70/4 Specialised cleaning services; 74.70/5 Furnace and chimney cleaning services; 74.70/9 Other cleaning activities not elsewhere classified; 74.81/2 Portrait photographic activities; 74.81/3 Other specialist photography; 74.81/4 Film processing; 74.81/9 Photographic activities not elsewhere classified; 74.82 Packaging activities; 74.85 Secretarial and translation activities; 74.86 Call centre activities; 74.87/1 Credit reporting and collection agency activities; 74.87/2 Speciality design activities; 74.87/3 Activities of exhibition and fair organisers; 74.87/4 Activities of conference organisers; 74.87/9 Other business activities not elsewhere classified

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