Using supplier reported emissions information to enhance an EEIO model to estimate the GHG emissions of businesses

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1 Abstract

Many businesses recognise the contribution of scope 3 emissions to their Greenhouse Gas (GHG) emissions footprint and are often in a powerful position to positively influence the GHG policies of their supply chain partners. Estimates of their supply chain GHG footprint obtained by the application of environmentally extended input output (EEIO) models can form an important part of strategic decision making. In collaboration with LEC and SWC and using an EEIO model of the UK, an international telecommunications company estimated its supply chain GHG footprint for the past three financial years (April 2010-March 2013).

The existing EEIO model was found to be limited by the aggregated data it contains which typically reflects the emissions and technology of an industry sector within one economy. It had no capability to capture the emissions performance of individual suppliers. However since 2011, the company has also been actively encouraging supply chain partners to participate in the Carbon Disclosure Project's (CDP) climate change reporting programme. As a consequence, supplier reported information on recent supply chain emissions was available and the model was enhanced by incorporating scope 1 & 2 emissions intensity data.

This paper reports on: 1) how supplier reported emissions intensities were integrated into an adapted EEIO model; and 2) the preliminary results arising.

While at the aggregate level only a small and non-significant difference in the estimates of the supply chain GHG footprint was found, interesting supplier level differences between high and low performing suppliers were identified. As more businesses engage in emissions reporting and methodologies for estimating footprints become standardised, it is argued that such supplier level insights could support more environmentally responsible purchasing; allow businesses to predict the impact of supplier's emission reduction targets on future emissions; and support the monitoring of supplier progress towards such targets over time.

2 Introduction

As the UK continues its transition to being a services based economy, the country has become increasingly dependent on imported materials and goods. This move has meant that the UK's production emissions have declined since 1990. However consumption based metrics have indicated the footprint of consumption in the UK is going up(Minx*, et al.*, 2009). Not all consumption is by household in 2010 for example the national accounts of the UK report intermediate consumption by industry as £1,360,227 million, compared with final consumption expenditure of £1,276,577 million (ONS, 2012). The goods and services that businesses consumed clearly constitute a potentially high source of embodied emissions. Furthermore large companies can have a substantial impact upon embodied emissions by controlling their expenditure to influence their trading partners. These companies can gain a competitive advantage on at least two levels, one by controlling emissions they potentially reduce cost. Secondly by demonstrating leadership on climate change the attractiveness of their goods and services is enhanced and revenue increased.

This paper considers an international telecommunications company that has reported its scope 1, 2 and 3 emissions for the last 3 years. The estimates of supply chain scope 3 emissions are derived from an Environmentally Extended Input-Output (EIO) model. Whilst allowing estimates to be made quickly and with relatively little resource, this method of estimating emissions has a number of drawbacks:

1) The estimate is based upon UK national accounts and Greenhouse gas (GHG) inventories and hence is not representative of global supply chains;
2) The industry sectors covered by the national accounts are highly aggregated and hence emissions intensities are averaged over a wide range of products.

In parallel with the reporting of its emissions footprint, the company has encouraged its major suppliers to engage with the Carbon Disclosure Project and report on their carbon mitigation policies, targets and achievements. The 2012-13 emissions data for the company was combined with surveys of scope 1 and 2 emissions arising from tier one suppliers for the same reporting year to make an estimate of supply chain emissions.

Comment [RDEF1]: Must get in Wiedmann and minx 2008 and ghgp

3 Method

3.1 Data

The Carbon Disclosure Project is an independent not for profit organisation that facilitates the sharing of environmental information amongst organisations including companies. Companies who have signed up for the project complete an extensive on-line questionnaire that covers climate change considering governance, strategy, climate change targets, emissions methodology, and emissions made in the reporting year. There are two variants of the questionnaire one which is intended for large organisations and another which is for small medium enterprises (SME). Methods for calculating scope 1 emissions (directly from operations) and scope 2 (emissions arising from purchased or acquired electricity, steam, heating or cooling) are generally quite consistent and uncontentious. Scope 1 and 2 emissions from suppliers constitute part of an organisation's scope 3 emissions, and this raised the possibility of using the data from CDP reports in place of estimates of emissions obtained using EIO modelling. The relevant data to be included in the hybrid model was the supplier's reported scope 1 and 2 emissions intensity – the amount of emissions per unit of currency revenue and the total scope 1 emissions and total scope 2 emissions. For those suppliers who agree to public disclosure of the data, an Excel™ spreadsheet can be downloaded that presents the responses in a consistent manner and this data could be incorporated in the model with a high degree of automation. For those suppliers who do not agree to public disclosure, data can be obtained from their questionnaire responses which are available to subscribed companies, this data was inputted manually to the model.

Comment [RDEF2]: Evidence for this required

The EIO model that was used was derived from the UK national accounts as published by the Office of National Statistics (ONS), combined with emissions data also published by the ONS which in turn is derived from the National Atmospheric Emissions Inventory (NAEI). Using a method first proposed by Leontief (Leontief, 1986) and subsequently adapted by others particularly Lenzen (Lenzen, 2001), and Berners Lee (Berners-Lee*, et al.*, 2011) a model of the impact of purchases of goods and services on the greenhouse gas emissions of an organisation was constructed. This model was combined with data on company expenditure to produce an estimate of the supply chain Scope 3 emissions.

Some publicly reported financial data was used to verify or modify the scope 1 and 2 emissions intensity factor as reported in the CDP data. This data was taken from the relevant company websites and consisted of a download of the audited publicly available accounts that many organisations are obliged to report by the jurisdictions in which they operate. Finally some currency conversion data was required to convert reported emissions per unit currency to emissions per GB Pound (GBP). The currency data was obtained from the website www.oanda.com.

3.2 Methods

The EIO model is adapted to make an estimate of the scope 1 and 2 emissions for tier 1 suppliers (suppliers who supply directly to the company), and this estimate is replaced by an estimate based upon CDP reported emissions intensity and expenditure with the company. This estimate can be compared with the scope 1&2 emissions reported by tier 1 suppliers via the CDP. Where the estimate from CDP data was self-consistent according to criteria outlined later, this information was used to form an estimate of the scope 1 & 2 emissions which replaced the estimate arising from EIO modelling.

The data from CDP was not suitable to be inserted directly into the EIO Model and a process of alignment and verification had to be carried out in order to integrate the two approaches. The process that was followed is described below.

1. The name that was reported by the supplier in the CDP data and the reference used by the purchasing company were aligned in order to correctly assign emissions.
2. The Scope 1&2 emissions intensity figure $\epsilon_{scope1\&2}^{(CDP)}$ for each supplier was extracted from CDP data. This figure is measured in tonnes CO_2e per unit currency total revenue. A common sense approach was taken that the combustion of 1 unit currency's worth of material should not result in 1 tonne of GHG emissions and accordingly emissions intensity figures that exceeded 1 tonne CO_2e per unit currency revenue were noted for checking.
3. A GB pound to supplier currency conversion figure C_S was calculated from the average historical exchange rate reported on http://www.oanda.com/currency/historical-rates/ over the 12 months 1/1/12 to 31/12/12.
4. The total scope 1 and 2 emissions arising $T_{12}^{(CDP)}$ from the company's spend S with the supplier was calculated using the formula:

$$T_{12}^{(CDP)} = \epsilon_{scope1\&2}^{(CDP)} \times S \times C_S$$

5. This figure was then compared with the supplier CDP reported total scope 1 and total scope 2 emissions (T_{1S} and T_{2S} respectively). For those suppliers where the calculated scope 1 and 2 emissions arising from the company's spend with the supplier exceeded the total of their reported scope 1 and 2 emissions i.e. :

$$T_{12}^{(CDP)} > T_{1S} + T_{2S}$$

   Then the emissions intensity $\epsilon_{scope1\&2}^{(CDP)}$ was checked.

6. For data that passed both sense checks then the scope 1 and 2 emissions estimate arising from the EIO model was replaced by that estimate arising from CDP data.
7. For those suppliers where the emissions intensity figure $\epsilon_{scope1\&2}^{(CDP)}$ failed the sense checks in steps 2 and 5, further research was carried out to verify the reported revenue upon which the figure was based taking into account the organisational boundaries that applied to CDP figures. Many suppliers were calculating their emissions intensity based upon a common multiplier of unit currency e.g. thousands, millions or Lakh rupees. For those suppliers where it was possible to establish a unit currency revenue figure (R_S) then a revised emissions intensity $\epsilon_{scope1\&2rev}^{(CDP)}$ was calculated was calculated using the formula:

$$\epsilon_{scope1\&2rev}^{(CDP)} = \frac{T_{1S} + T_{2S}}{R_S}$$

8. This revised emissions intensity was then used in steps 2 to 6 above.

9. In order to compare emissions intensity amongst suppliers, the emissions intensity per unit currency $\epsilon_{scope1\&2}^{(CDP)}$ was converted to emissions intensity per pound sterling $\epsilon_{scope1\&2£}^{(CDP)}$ calculated using the formula:

$$\epsilon_{scope1\&2£}^{(CDP)} = \epsilon_{scope1\&2}^{(CDP)} \times C_s$$

4 Results

4.1 CDP Data Quality

An assessment of the data quality from CDP respondents was carried out and the emissions intensity factors classified in one of five categories summarised at Table 4-1

Description of Category	Proportion of respondents in category (%)
1. Suppliers who have supplied information that passes a sense check of scope 1&2 emissions arising from the company spend < supplier total scope 1&2 emissions based on CDP figures	17.1
2. Suppliers who have miscalculated emissions intensity exponent based on comparison of CDP reported revenue with emissions intensity calculation	19.0
3. Suppliers for whom an emissions intensity was derived based on their total scope 1&2 emissions as reported to CDP and financial figures available online e.g. from annual reports, Form 10-K etc.	4.2
4. Suppliers who have supplied partial information about emissions but not sufficient to calculate or estimate an emissions intensity.	6.0
5. Non-respondents	53.7

Table 4-1 Assessment of Data Quality from CDP respondents

The suppliers who had responded to the CDP questionnaires were in the top 200 suppliers by spend to the company, and those who provided sufficient information to make an estimate of their emissions covered 39% of the total spend. If all suppliers in the survey responded then 56% of the spend would be covered.

4.2 Impact on Supply Chain Scope 3 Emissions in 2012-13

	Total (Tonnes CO_2e)	Proportion (%)
Total of Scope 3 Emissions arising from Purchased Goods and Services	2,760,392	100
Tier 1 Supplier Scope 1 and 2 emissions estimate from EIO model	324,506	11.8
EIO model Scope 1 and 2 emissions estimate from suppliers included in CDP survey	135,015	4.9
Estimate of scope 1 and 2 emissions arising from CDP data from suppliers included in CDP survey	162,349	5.9

Table Error! Use the Home tab to apply 0 to the text that you want to appear here.**-2 Impact of substitution of CDP data on total footprint**

The difference between the estimate arising from the EIO model and from the CDP data was 27,334 tonnes which was not regarded as significant.

4.3 Sectoral Differences

The companies reporting to the CDP are self-classified using the Global Industry Classification Standard (GICS) and the emissions intensities from IO model and CDP data at GICS Sub-Industry level are compared at Figure 4-1

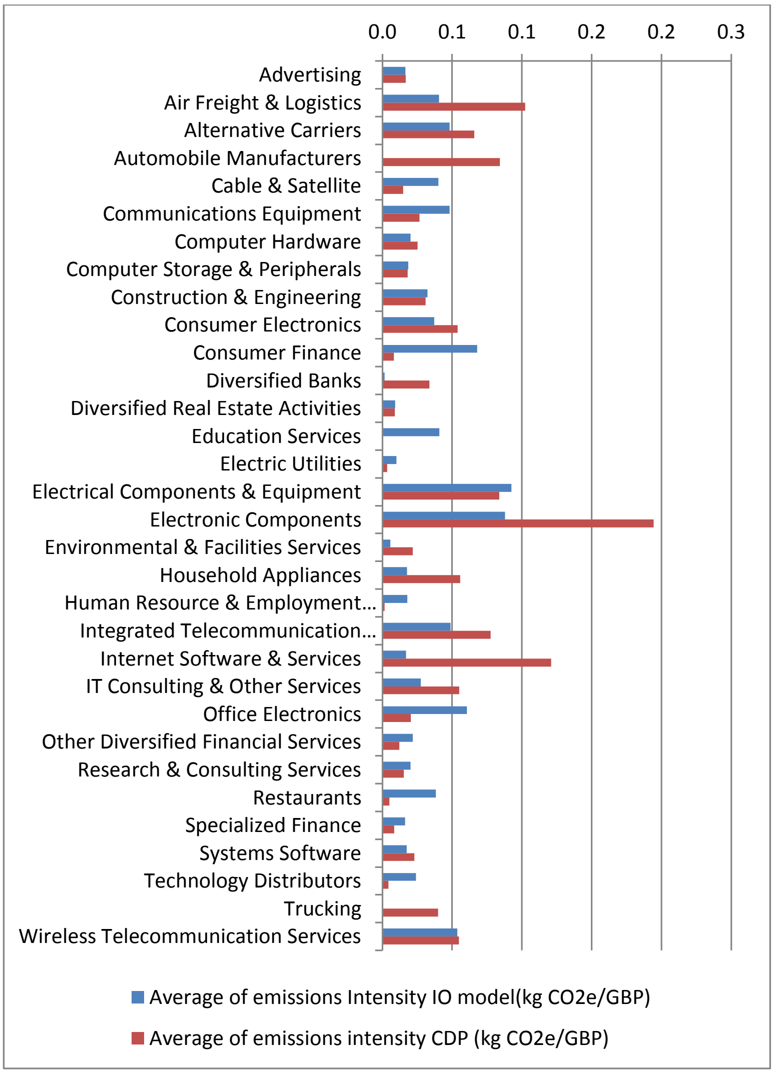
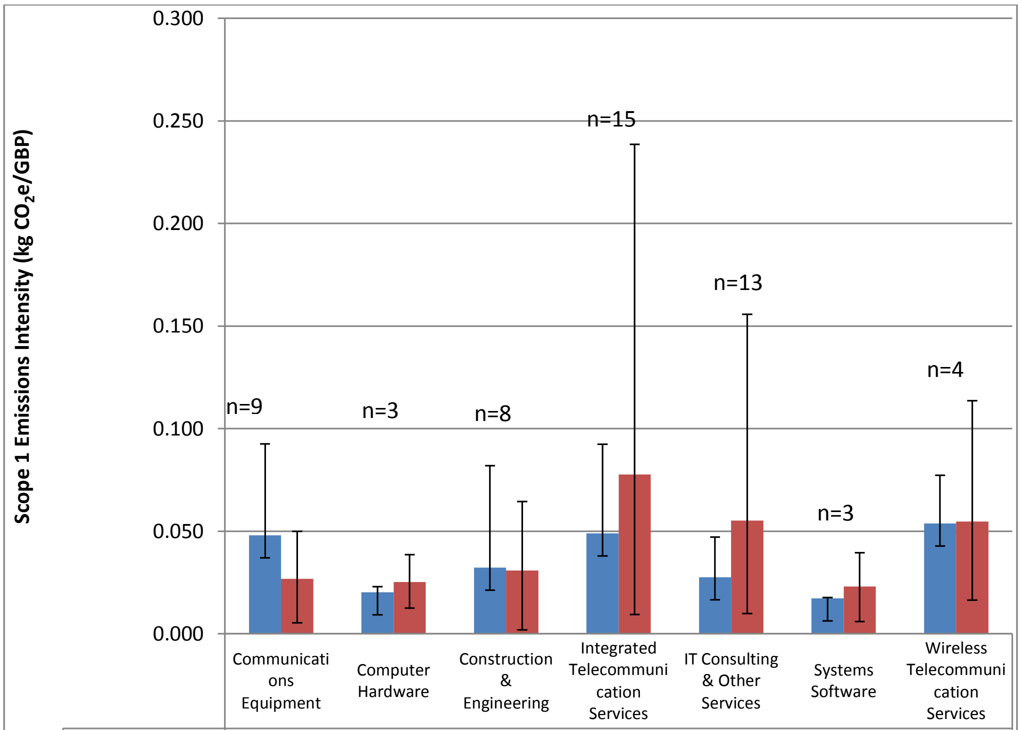


Figure 4-1 Comparison of scope 1&2 Emissions intensity IO Model and CDP data

Restricting the comparison to those sectors where there are 3 or more suppliers represented resulted in the analysis presented at figure 4-2.



	Communications Equipment	Computer Hardware	Construction & Engineering	Integrated Telecommunication Services	IT Consulting & Other Services	Systems Software	Wireless Telecommunication Services
IO Model Estimate	0.048	0.020	0.032	0.049	0.027	0.017	0.054
CDP data	0.027	0.025	0.031	0.078	0.055	0.023	0.055

Figure 4-2 Comparison of emissions intensity (kgCO_2e /GBP) between EIO model and CDP data, where number of suppliers in GCIS Sub-Industry sector, n, is greater than 2, bars indicate high and low emissions intensity in sector.

5 Discussion

The method showed some potential although there are some issues to overcome. The use of supplier-specific data to replace broad-based industrial sector data should result in a more representative estimate of supply chain emissions. The increasing awareness amongst leading companies of the importance of the emissions embedded in supply chains and their ability to do something about it should enhance the spreading of best practice. It can be seen from figure 4.2 that within GCIS sectors there was a considerable variance amongst the emissions intensities reported. If the company were able to use these variances to drive purchasing performance then their supply chain footprint could be reduced.

There are issues with the data for example alignment with companies reporting schedules and particularly with complex multinational entities the attribution of emissions within organisational boundaries. Whilst in principle the scope 1 and 2 emissions estimates made by suppliers should be more reliable than those arising from EIO model estimates, there is the possibility that data has been calculated according to different methodologies and thereby is not suitable for substitution. Although the sources of scope 1 and 2 emissions are well defined, their calculation may be carried out using several methods. For large emitters it is possible that calculations of these emissions are based upon physical measurements of processes, but as the complexity of processing increases methods of calculation may depend upon estimates and generic factors.

There is also a limit to the impact that scope 1 and 2 emissions of suppliers have upon an estimate of upstream scope 3 emissions – in this case it is estimated that 11.8% of the total are due to supplier scope 1 and 2 emissions. If the analysis could be extended to tier 2 and further than more coverage can be obtained but the impact of a company on tier 2 suppliers is weaker, and the effects are more diffuse.

The currency conversion rate that is used in this estimate is quite crudely derived and it may be possible to use an organisation's own data to make a better estimate of the spend in currency. However this data may not be available or the supplier may quote its results in one currency but trade with its customers in several currencies thereby assuming the currency risk themselves. There is an argument for using purchasing parity currency exchange rates rather than a direct estimate of the exchange rate.

If a supplier is targeted on its scope 1 and 2 emissions then there would be a temptation to move those emissions out of that company and into another one. This could result in carbon leakage. The obvious extension would be to attempt to calculate scope 3 emissions intensity for the supplier and substitute this into the EIO model. However whilst definitions of scope 1 and 2 emissions are well understand and the processes of estimating them are understood and can be investigated, calculations on scope 3 emissions are subject to a wide variety of potential exclusions, considerable differences in calculation methods, and sizeable uncertainties. This methodology therefore may reach its maximum efficacy at companies whose tier 1 suppliers are the largest users of energy for example steel or cement manufacturers, and so as a result their scope 1 and 2 emissions form a significant part of the scope 3 emissions.

The technique has been shown to be effective in making alternative estimates of a subset of supply chain emissions and incorporating supplier specific data into hybrid models. This increased awareness of where emissions occur in a supply chain allows targets to be set for companies. As more years of data are reported, then trends and improvements in performance can be tracked. It is suggested therefore that this method with further refinement could be another tool for tracking the greenhouse gas footprints of organisations.

6 Acknowledgments

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