Are supply chain emissions really the ‘essential, but impossible’ metric?

Supply chain emissions are an unavoidable component of a company’s climate change impact and as such fall within an organisation’s area of environmental responsibility. The convention that companies are responsible for their supply chain impacts of every kind has been firmly established in the public consciousness through a series of controversies over many other environmental and social impacts over the last few decades. Examples include sweat shops, child labour, deforestation and most recently horse meat. This substantial case history of public reaction to other types of supply chain impact suggests that supply chain greenhouse gas emissions are likely to be viewed as an organisation’s responsibility in a similar manner.
For many organisations, including BT, supply chains account for the largest component of their greenhouse gas emissions ‘footprint’. However, they are also the most complex part of the picture. In fact carbon or greenhouse gas ‘footprints’ are so complex that they have sometimes been referred to as the “essential, but impossible metric”.

The reason that supply chain emissions are so difficult to measure is there is mathematically no limit to the number of pathways that contribute in some small way to the total supply chain emissions attributable to a company, product or service. For example, if a company which makes Product A buys Product B in order to run its operation, and product B devalues over time, it is clear that some of Product B’s embodied carbon needs to be attributed to each unit of Product A that is created. However, Product B in turn has its own chains in exactly the same way as Product A does. So the process starts again and looking at Product B has taken us no closer to getting to the end of Product A’s supply chain.

As we look further and further down the chain, the number of pathways grows so it is of little comfort that individually they become very small and eventually infinitesimal. This complexity inevitably leads to a level of uncertainty in any emissions metrics and in the past this has often been used a justification for organisations to pay little attention to their supply chain emissions.

However, the challenge of producing supply chain carbon metrics does not need to be seen as requiring perfect understanding. The real necessity is to achieve ‘good enough’ and sufficiently meaningful information in order to enable effective and well-targeted emissions management. Seen in this way, with care, the impossible metric can be made to become not only achievable, but practical. BT is at the leading edge of this approach.

2 What are the methodological options for estimating supply chain emissions

In broad terms there are two central approaches to estimating embodied or supply chain carbon.

The most popularly understood is called Process Based Life Cycle Analysis (PBLCA). This ‘bottom up’ approach entails mapping out the supply chain, estimating the emissions that take place at each stage of every pathway and proportionately allocating them to the product, service or organisation that is being assessed.

An alternative approach is to use Environmentally Extended Input-Output Analysis (EEIO). This works from the ‘top down’ using a macro economic analysis to track the way embodied emissions flow through the economy in trade between industries and using this to estimate the emissions associated with goods, services and organisations.

There are difficulties associated with each of these methods, but these can be mitigated by combining the two in some kind of hybrid methodology. There are many ways of doing this, none of which are perfect, but all of which seek to improve the quality of management information that can be achieved within a given resource.
3 What are the pros and cons of PBLCA?

As well as being conceptually simple to understand, this method has the advantage that it is possible to have a bespoke and detailed look at the particular supply chain of the entity in question, and this can be important for enabling well founded identification of the hotspots and the priorities for emissions management. However, there are also two problems with this approach.

The first problem is that it is never possible to map every pathway. With a finite resource it is always necessary to miss many pathways out of the analysis. Furthermore, it is not simple to determine how collectively significant the omitted, or ‘truncated’ pathways are, whether they represent just a few percent of the total or, as may well be the case for some products and services, an overwhelming majority. What can be said is the PBLCA has a systematic tendency to underestimate by a significant amount and that the seriousness of this problem varies greatly between types of products and between industries. Often termed ‘truncation error’, it cannot be solved by throwing a larger resource at the analysis.

Even with hundreds of pathways traced, it is still often not obvious whether even, for example, 50% of total supply chain emissions have been mapped. Nor, as has been advocated in the PAS 2050, is it possible to resolve the problem by standardising the criteria upon which each pathway can be excluded on the basis of its expected significance, because a large number of small pathways can have the same significance as a small number of larger pathways.

PBLCA, therefore, is generally not a suitable technique for estimating in absolute terms the emissions associated with the provision of a product or service. For the same reason it is generally not suitable for comparisons between different types of products. An exception to this rule is in the comparison of simple products from emissions intensive primary industries, such as, for example cast iron, electricity and beef production. In the ICT industry the problems of truncation are particularly extreme because the supply chains are so complex.

A second problem with PBLCA is that doing it properly is highly resource intensive. To make the analysis more manageable, it is common to use generic data sets of emissions factors to account for some materials and processes within the supply chain. However, it is important to understand that this inevitably compromises the bespoke nature of the analysis, which is the core advantage of PBLCA.
Figure 1: Different industries achieve tolerable 'system completeness' at different rates. In the telecommunications industry, only 72% of emissions are covered by direct emissions plus the first four supply chain tiers whilst in the agriculture industry, a greater proportion of total emissions are captured by direct emissions plus the first tier of suppliers.

Figure 1 uses EEIO to illustrate the proportion of all supply chain emissions that are typically captured at different tiers of the supply chain within different industries. In the case of the agriculture industry, a clear majority of total emissions are direct and the majority of the remainder take place within the first and second tiers of the supply chain. It is realistic to think that truncation error could typically be reduced to well below 20% in a PBLCA of an agricultural product. However, in the 'Telecommunications' industry, typically less than 60% of emissions are captured even when supply chains have been traced through three tiers, by which time the number of pathways is almost certainly unfeasibly large even for wellresourced studies.

4 What are the Pros and Cons of EEIO?

An alternative method to PBLCA is Environmentally Extended Input Output Analysis (EEIO). This technique uses financial information about trade between industries combined with information about the direct emissions from industries to make estimates of supply chain emissions. The biggest downside of EEIO is that it incurs inaccuracies of generalisation, especially by making the sweeping generic assumption that every unit of expenditure on each industry has the same emissions intensity. There are various ways of mitigating this weakness somewhat by introducing elements of PBLCA into the methodology.

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1 As defined by NIC codes.
However, EEIO has the important advantage that it does not incur truncation error: it does not omit elements of the supply chain. Furthermore, since it is based on financial information which is typically readily available, it usually requires dramatically less resource than PBLCA.

This is clearly not the case. Across the whole economy, the overestimates should equal the underestimates. Even within a business, the averaging out effect is likely to improve the overall accuracy of the footprint estimate, compared to the estimates of the carbon embodied in each procured item. EEIO also incurs other sources of inaccuracy which are difficult to quantify and are sometimes omitted from quantitative estimates of uncertainties in EEIO. These include the problems with the macro-economic data sets that they rely on to understand the trade between industries and the emissions from each industry. Worldwide, such data does not exist in a comprehensive and reliable form. Approximations therefore need to be made. Currently BT makes the approximation that the global economy is structurally similar to the UK economy.

5 What has BT has done so far to estimate supply chain emissions?

For the upstream Scope 3 supply chain component, BT begins by using EEIO as its methodology and then improves the accuracy of the analysis by employing hybrid techniques. Specifically we are refining the EEIO-based assessment by substituting suppliers’ scope 1 and 2 emissions data as reported to CDP into the model, and where we can, further adjusting the results to take account of specific emissions savings as identified by suppliers through BT’s Better Future Supplier Forum.

Since we are still using EEIO as the core basis of the assessment, we need to recognise the following points:

• The estimates we make are based primarily on generic assumptions about the carbon intensity of procurement of different categories of goods and services. In the first instance there is no basis for differentiating between the carbon intensities of any two expenditures within the same industry category.
• Because the methodology does not incur truncation error, it is likely to be markedly higher than the figures that would be produced by a PBLCA and higher than competitors using such a methodology, even if the carbon intensity of the operations were the same.

6 Why does BT use the EEIO approach?

BT has used the EEIO approach because it enables looking at entire supply chains, despite their complexity. Although this approach contains inherent uncertainties, it is possible to apply it consistently and transparently. EEIO enables practical and meaningful comparisons.
over time and, with caution, between organisations. Some of the crudeness of a pure EEIO approach can be mitigated by introducing elements of PBLCA into the model.

7 Are there any notes of caution to be associated with this approach?

Yes. The results are carefully derived ‘best estimates’. They help to identify where the emissions lie and how they change over time. Provided a consistent methodology is applied, and the results are interpreted as part of a richer context, they can even help to enable comparison between organisations. However, the numerical results should not be compared with those of other organisations that have used a different methodology, especially where the treatment of supply chains has been truncated, as is always the case in PBLCA.

8 How is BT using hybrid techniques to improve accuracy of its supply chain estimates, run scenarios and reflect changes?

It is possible to improve the accuracy of EEIO somewhat by substituting in more accurate estimates for parts of the supply chain. BT now uses operational Scope 1 and 2 emissions data as declared by suppliers through the CDP. This technique enables BT to reflect carbon efficient practices adopted by its immediate suppliers. Encouragingly, when aggregated over twenty or so suppliers, the estimates derived tally closely with those derived from EEIO, despite the radical differences in the two methodologies.

It is, in theory, possible to apply the same technique to the suppliers’ suppliers, and even to further tiers in the supply chain, although the work involved goes up and the returns become more limited. If company reporting to the CDP becomes the industry norm alongside a consistent approach to supply chain emissions reporting in which companies routinely adopt this substitution technique, it may be possible to move towards a position in which BT’s own emissions are mainly drawn from CDP data, with EEIO accounting for only a minority remainder of emissions.

Another potential means of mitigating the inaccuracies of generalisation is to make bespoke adjustments to elements of the supply chain estimate wherever it is felt that there is a defendable case to estimating a difference between the supply carbon intensity and the economy’s average for supply chains between those industries. This year BT has used this approach to refine its estimate of emissions relating to the provision of TV content.
9 Why are BT’s estimates of emissions per unit of revenue likely to be higher than those reported by other organisations in the ICT sector?

BT is at the leading edge of its industry in having adopted a comprehensive treatment of its operational emissions in which all supply chain pathways are included. This is relatively unusual and is very likely to lead to higher carbon intensity estimates than those reported by other companies in the sector. However, comparisons between organisations are not meaningful unless differences in boundaries and methodologies are fully understood.

Comparisons of carbon intensities between organisations should be treated with extreme caution and are not relevant unless the boundary criteria for the inclusion of emissions is the same and the methodology for estimating emissions similar enough to afford a comparison.

Since EEIO does not incur truncation error and provides a complete treatment of all supply chain pathways, the total estimates for BT’s emissions per unit of company revenue are likely to be higher than for companies with a similar business model, but that calculate their supply chain emissions using PBLCA.

Since supply chain emissions are much larger than BT’s Scope 1 and 2 emissions combined, it is also the case that the total emissions figure per unit of revenue that is obtained through our analysis is likely to be many times greater than a carbon intensity figure for a similar organisation which is only including Scope 1 and 2 in its emissions estimates.

10 Why is BT’s supply chain footprint so large compared to its Scope 1 & 2 emissions?

It is true of most companies that their supply chain carbon is greater than the footprint of their own energy use. The more complex the products of a company, the more this is likely to be the case. Each of BT’s products and services requires it to purchase an array of goods and services from other companies that in turn have to buy from other companies and so on. The nature of the ICT industry dictates to a large extent that BT has particularly dispersed supply chains to which it adds only a relatively small final component to the ‘footprint’ of its output.

BT’s supply chains also include the creation of products that are sold, but not used by BT. These product add to the supply chain emissions but not to BT’s scope 1 and 3 emissions, increasing the ratio between the two.

11 How can BT cut its Scope 3 carbon emissions?

All carbon footprint assessments are about assessing the ‘bang for buck’. BT’s Scope 3 carbon should be assessed in relation to the goods and services that it offers. One simple
way of doing this is by monitoring the carbon intensity of its revenue. This will have three components: Scope 1, Scope 2 and supply chain Scope 3. Of these, Scope 3 will be the largest.

BT is employing three key routes to managing the Scope 3 supply chain carbon:

- **Engaging suppliers** at different tiers in the chain, beginning with immediate suppliers (Tier 1) and encouraging them to:
  - report their scope 1 and 2 emissions to the CDP (Carbon Disclosure Project)
  - encourage their suppliers to do likewise
  - set and meet operational carbon reduction targets
- **Efficient Procurement.** This means wasting less and designing operational efficiencies that minimise wastage of procured goods and services. This route achieves cost efficiencies proportional to the carbon efficiencies.
- **Evolving the business model** so as to increase the value added per unit of procurement and to reduce the carbon intensity of the industries that BT procures from.

To give a simple example, £1 spent on computer services typically has only a third of the emissions associated with it as the same expenditure on postal services and only one thirtieth of the emissions associated with each pound spent on aviation.

12 Why doesn’t the inclusion of supply chain emissions lead to double counting issues?

If all the Scope 1, 2 and supply chain emissions reported by every organisation in the world were added together, the total would indeed be much higher than the emissions from the world’s industries since each company’s emissions would also be counted by each downstream tier in the supply chains to which they contribute.

However, each company’s output typically meets a mixture of intermediate demand (supplied to other organisations to enable their production) and final demand (sold directly to consumers). If every organisation in the world were to proportionally distribute its emissions according to the proportion of its output that meets final and intermediate demand, then the sum of the final demand components should exactly equal the scope 1 and 2 emissions from the entire world’s industry, without double counting.

13 How is BT seeking to improve its estimates?

We will continue to explore hybrid solutions that bring together the best of both approaches – Process Based Life Cycle Analysis and Environmentally Extended Input-Output Analysis. This will allow us to substitute in actual energy use data from points in the supply chain where this is available and also to track the impact of specific carbon management actions in the business.