Green Solutions

Translating the qualitative into quantitative: Advancements in sustainable cooling technology

Scientific Laboratory Supplies (SLS) and Grant Instruments

Having a clear and detailed understanding of laboratory product sustainability can, without question, help to guide purchasing decisions and be harnessed for climate action. But within a market peppered with different approaches to promoting the sustainability of products to customers, it does raise the question – what approaches work best?

The purpose of the following document is not to present an argument around the good (and the slightly less good) approaches to determining product sustainability. Instead, it aims to highlight some potentially important considerations to take into account when faced with a product sustainability question.

Setting the scene

National distributor *Scientific Laboratory Supplies (SLS)* and manufacturer *Grant Instruments* both recognise the importance of collaboration to advance data-driven sustainability. However, there first needs to be a clear and detailed picture of what product sustainability looks like. This can not only guide customer lab sustainability strategies, but can also help suppliers identify any impact, risk, or opportunities (IRO) associated with a product and its supply chain. That being said, the best approaches to a better understanding of product sustainability are those which can provide factual insight and transparency about the whole product lifecycle and are not subject to ambiguous or blanket claims.

As consumers thinking about sustainability, it is often easy to think almost exclusively about the use and end-of-life stages of a product – questions around energy efficiency and waste streams spring to mind. This is completely natural, as they are the stages of the product lifecycle to which are closest to us. But does that always mean that those stages of a products' lifecycle are always responsible for most of the environmental impact? Perhaps, but also perhaps not.

One of the most methodologically robust ways to determine the complete environmental footprint of an individual product is through a life-cycle assessment (LCA). However, fully comprehensive carbon data for laboratory products are currently few and far between, often due to the time and resource intensive process required by manufacturers.

SLS encourage and nurture their supply chain and customers to improve their levels of understanding of each product's sustainability. The sustainability attribute programme uses primary data provided by our suppliers to successfully paint a qualitative picture of individual product sustainability across the lifecycle and enable better-informed purchasing decisions by customers. Whilst this is an essential starting point, carbon data still plays a critical role in enabling climate action in laboratories. We set out to collaborate with manufacturers and support them in taking the first steps towards having some degree of quantitative product level carbon data - without an initial investment into LCAs. The following case study is presented as an example.

Where it began

Like many a great collaboration project, this one started over a cup of coffee. A lively and caffeine-fuelled discussion followed where *SLS* and *Grant Instruments* agreed that even just *estimated* carbon data could help make sustainability conversations with customers more relatable. The thought was simple; estimating carbon emissions for even just a few stages of a product's lifecycle could provide a more educational and consultative approach to procurement. Not to mention it would shine a light on opportunities for improvement, benefitting both manufacturer and customer. And so, the idea to put a (metaphorical) microscope on one product and its supply chain was born.

Driven by a shared determination (and a healthy dose of curiosity), *Grant* and *SLS* set out to calculate carbon data for the product across its lifecycle stages. The team started by defining the project's boundaries – what was going to be realistic and achievable for this pilot study. With *Grant Instruments* being a UK manufacturer with minimal reliance on long-distance and international suppliers, we were especially keen to understand the impact of upstream sourcing compared to other product lifecycle stages.

The goal was not just to crunch the numbers, but to make the results easily digestible and actionable. Therefore, an imperative outcome of the project was to convey any carbon estimates in relative terms, by comparing emissions to something universal or commonplace. This would make it easier to grasp the significance of what, to most, would otherwise be a rather abstract metric.

Meet the product

The product chosen for this more in-depth analysis was *Grant*'s 'ecocool' refrigerated circulating bath. From a qualitative attribute perspective, we can already determine a level of product sustainability; the unit has nine different attributes across four stages of its lifecycle which are indicative of a more sustainable product.

Sustainable Raw Material	• Uses materials which have a reduced environmental impact (e.g. refrigerant with a low global warming potential) • Designed to reduce the use of raw materials
Sustainable Product Manufacturing	• Measures were in place during the manufacture of this product to reduce energy consumption • Measures were in place during the manufacture of this product to generate less waste
Sustainable Distribution & Packaging	• Manufactured in the UK or Ireland • Plastic free packaging • Product reduces need for packaging
Sustainable Use	• Product contributes to a reduced energy consumption • Product contributes to a reduced water consumption

These attributes provide a more granular insight into product level sustainability and demonstrate the efforts made behind closed doors to increase the efficiency of the 'ecocool' unit across its lifecycle - be it in its use of raw materials, energy used, waste generated during manufacture, location of manufacture, packaging, and the amount of energy and water consumption during its use. This qualitative information about product lifecycle can enable more well-informed decision making when purchasing the piece of equipment.

Translating the qualitative into quantitative

To anchor these qualitative product insights into metrics, the team drew up the bill of materials of approximately 140-150 components to take a closer look at the varying distances each component needed to travel prior to assembly – a stage of the lifecycle which would contribute to the overall environmental impact.

Distance travelled by components	% of unit weight	Weight (kg)	Transportation method
<100 miles (local)	23%	6.2	Road
100-150 miles (regional)	40%	10.7	Road
150-200 miles (intermediate)	2%	0.66	Road
200+ miles (long distance and international)	35%	9.3	Road and sea freight

Almost a quarter of the unit's weight is sourced locally within 100 miles of *Grant*'s facilities near Cambridge, and the majority of the weight of the unit (63%) is acquired from within 150 miles. Whilst the remainder of the unit is sourced from beyond the 200-mile mark, there is minimal reliance on overseas sourcing; with just under 2kg of components are imported (see below).

Origin	% of unit weight	Weight (kg)	Transportation method
Domestic	93.7%	25.13	Road
International	6.3%	1.73	Sea freight

Grant's procurement team had previously conducted a consolidation exercise, ensuring that the imported components required for the unit (from Hong Kong, China, and the USA) only accounted for a total of five deliveries annually. This initial sourcing analysis of the 'ecocool' unit demonstrates a commitment to minimising upstream transportation emissions through proximity sourcing.

Assigning carbon estimates

Using the component sourcing data, the team were able to calculate some rough carbon metrics for upstream transportation costs associated with the first tier of suppliers for one 'ecocool' unit. This was done using distance travelled, the weight of the components, and mode of transportation, and then estimated for a single unit based on delivery consolidation. The estimated total upstream transportation footprint for the unit's components was 622.51kg of CO_2 equivalent – just over half a tonne. In relative terms, this is about the same emissions as the embedded emissions of an Apple MacBook Pro, or the annual emissions associated with owning a couple of house cats.

Distance travelled by components (kg)	% of unit weight	Weight	Transportation method	Estimated CO_2e (kg)	% of emissions
<100 miles (local)	23%	6.2	Road	11.05	2%
100-150 miles (regional)	40%	10.7	Road	94.30	15%
150-200 miles (intermediate)	2%	0.66	Road	9.76	1%
200+ miles (long distance and international)	35%	9.3	Road and sea freight	507.40	82%
Origin	**% of unit weight**	**Weight (kg)**	**Transportation method**	**Estimated CO_2e (kg)**	**% of emissions**
Domestic	93.7%	25.13	Road	199.47	32%
International	6.3%	1.73	Sea freight	423.04	68%

What was interesting to discover was that the emissions for those components travelling more than 200 miles represented over 80% of emissions, and within that category, the already minimised frequency of international freight accounted for approximately almost three-quarters of component transportation emissions. This indicated to *Grant* that a significant portion of overall potential lifecycle emissions of the product are a result of the transportation of international components.

Next, the team wanted to understand the emissions associated with manufacturing the unit at *Grant*'s facility near Cambridge. This calculation was focused solely on the assembly and build of the unit, making key data points for calculating emissions primarily related to onsite operations and the direct assembly process. The team analysed total electricity consumption during the assembly process (with relevant emissions factors for the source of energy used onsite), the duration of the assembly process, and the type and quantity of fuels used for assembly processes. The end result: the manufacturing (or build) of a single unit equates to approximately 3.1kgCO_2e – comparable to a 1 hour Zoom call on a Apple MacBook or the emissions of ironing one side of a shirt.

The downstream distribution emissions of the unit depend on the location of individual customers (and subsequent logistics agreements). However, through a distributor such as *SLS*, these emissions are integrated into the distributor's direct emissions through their van fleet. *SLS* have a target of halving those operational emissions before 2030 via fleet migration to lower emissions vehicles.

As for the usage phase of the unit's lifecycle, this was calculated using manufacture-tested energy consumption and then based on an estimated 10 years of use, across an average 253 working days in a year, for approximately 7 hours each day. As a result, this calculation was likely to be the maximum energy consumed in its lifetime. This came to an estimated 77.34kgCO_2e per year, comparable to staying a couple of nights at a bed and breakfast or using a smartphone daily. Across the span of a decade of use, this amounts to 773.4kgCO_2e.

Key takeaways

Distance matters – the carbon intensity of long-distance logistics becomes clear, with those components transported more than 200 miles contributing the majority of transportation emissions. On top of that, whilst 6.3% of the unit weight is sourced internationally, it is responsible for most of the transportation emissions.

Domestic advantage – domestic transportation makes up 32% of total upstream transportation emissions, even though domestic components constitute 93.7% of the unit weight, illustrating the benefits of sourcing locally. *Grant* has demonstrated a strong sustainability effort to reduce upstream transportation emissions by sourcing the majority of components locally or regionally. That being said, there are probably more opportunities for improvement as international sourcing contributes significantly to upstream transportation emissions. By exploring more local alternatives wherever possible, or failing that, optimising transportation methods with local suppliers, these emissions figures could be further reduced.

Energy efficiency is important – whilst energy usage is only one indicator of product sustainability, the usage phase emissions highlight the unit's relatively low energy consumption over its lifecycle, reinforcing its qualitative sustainability attributes and credentials. However, sourcing more energy efficient units is not all there is to consider when assessing product sustainability; this analysis was done on a unit with energy efficiency credentials and a more localised supply chain and for which the estimated emissions associated with use and upstream transportation are almost equal. This raises the question, if the unit had a more globalised supply chain with components coming from further afield, or if it was much less durable, or used significantly less than the calculations here account for, would any increased emissions outweigh the positives of having a more energy efficient unit?

Efficient manufacturing and renewable energy – the low emissions for the assembly process of the unit reflect *Grant*'s facility's energy-efficient operations and minimal reliance on high-carbon fuels.

Data-driven decisions – by roughly quantifying emissions across different lifecycle stages, we have illustrated the importance of detailed data in identifying emission hotspots to drive targeted sustainability improvements.

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Notable absences of data

You may have noticed that a couple of key lifecycle stage analyses are missing from this study, namely the raw material extraction, processing and production of individual components, as well as the end-of-life metrics for both the unit and its packaging.

The upstream cradle data points are something that *Grant* could potentially look at exploring in more depth through supply chain mapping and data extraction exercises. However, calculating an estimate of the product's end-of-life emissions (i.e. an analysis to grave) can sometimes have challenges due to variability in customer behaviour, waste management systems, and inconsistent emissions factors, to name a few – so any results of such a calculation would always remain approximations which would be sensitive to any assumptions made about typical end-of-life outcomes.

However, without the combined effort involved in this project, much of the carbon intensity within the supply chain for this product would have remained hidden. There may well be opportunities in future to once again pool together expertise and data to learn more about those missing lifecycle stages.

Conclusion

This case study highlights the resourcefulness required by manufacturers to balance the accessibility of raw materials, complexity of component sourcing, and the need to reduce emissions.

And whilst this case study may not provide a third-party verified full lifecycle assessment of the 'ecocool' unit, it nevertheless demonstrates how even an initial effort to gather carbon data can reveal actionable insights into a product and its supply chain emissions - whether it be a focus on local suppliers or optimising logistics for suppliers and manufacturers. It also demonstrates that energy efficiency alone cannot be the sole indicator of product sustainability and that optimised upstream transportation has a significant part to play in determining product sustainability.

What this study also hopes to do is to help drive the momentum amongst manufacturers and distributors to facilitate more informed purchasing decisions by laboratories - or at the very least, provide some food for thought around where the carbon intensity may sit across the lifecycles of different products. By focusing on accessible data points – such as component sourcing, transportation methods, and assembly emissions – this study provides a practical, scalable model for other manufacturers to begin their sustainability journey without the need for resource-intensive lifecycle assessments.

As data-driven sustainability emerges as an essential tool for gaining a clearer, more comprehensive picture of both product and supplier level sustainability, the role of industry collaboration – between manufacturers, suppliers, distributors, and consumers – becomes integral to achieving any net zero or sustainability goals.

Collaborators

Grant Instruments is a UK scientific equipment manufacturer, aspiring to be a global leader in high-quality, reliable, and user-friendly solutions.

SLS (Scientific Laboratory Supplies) is the UK's largest independent supplier of laboratory equipment, chemicals and consumables. We endeavour to be the scientist's supplier of choice by delivering the highest quality products and services to our customers - contributing to a healthier, smarter, and safer world.

Both companies are recognised by EcoVadis, demonstrating strong commitments to environmental, social, and governance practices.