Estimating CO2 Emissions at the Product Level : A Practical Approach

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The Challenge

What do a Swiss Air flight from Zurich to San Francisco, a bag of Blue Circle cement and a Wasa biscuit have in common? In each case the company can tell the consumer how much CO2 was emitted for that particular service or product. Pharma companies are a long way from having that capability.

At first the healthcare industry played the trump card of "we produce life-saving medicines" to overcome objections to its CO2 emissions. Climate change, however, itself has become a healthcare issue. Every year, environmental factors take the lives of around 13 million people[1]. In 2019, The Lancet published a report showing a potential net increase of 529,000 adult deaths per year by 2050 due to climate change[2]. So now pharma companies are producing figures for corporate level emissions and corporate level targets, often showing a reduction to net zero by 2035 or 2040. That, however, is not enough. There are now more stakeholders wanting to know the CO2 emissions footprint for particular products. These include healthcare insurers, hospitals – whose scope 3 emissions are heavily influenced by pharma companies – and financiers. Recent tenders from the National Health Service in UK and the Norwegian Procura+ included questions on product-level CO2 emissions.

In short there is pressure to be able to be able to print on a box "CO2 emissions of xxx grams." There has been understandable caution by pharma companies in publishing figures : genuine scientific disagreement on emission factors, concern over different starting points, particularly further back in the supply chain; intellectual property concerns. But the pressure will not go away so it is important to make a start.

How To Do It

The authors directed a project at Roche from May 2022 called the **"Product Carbon Footprint".** Our objective was to estimate the tonnage of CO2 emitted by selected products at Scope 1, 2 and 3 level, to identify abatement levers and associated timelines for execution as well as a communication package for the affiliates (country selling entities) on Roche sustainability efforts.

[1] WHO: Climate Change impact on world's health
[2] The Lancet: Global and regional health effects of future food production under climate change: a modeling study (link)

We selected products representative of the total portfolio. There were two classical monoclonal antibodies, two small molecules and a pre-clinical stage oligonucleotide. The aim was to test a methodology that would allow us to quickly move from analysis to action. With a description of the key process parameters, geography of the production facilities and volumes, we should be able to quickly point towards the carbon dense areas. Then we could map out the five or six key levers to pull that would significantly reduce the emissions for the molecules. The key data to assemble are the process flow diagram for the production, the bill of materials and recipe and the routings of products sold in the markets that accounted for 80% of the volume.

We applied **emission factors** to the main elements of the products across the value chain:- drug substance / API, drug product, finished product and then distribution to the markets. We started with a **spend** based approach – where one allocates weight according to the annual financial expenditure on different materials and services. This however can produce misleading figures, for example where the company has above or below average purchasing power. Where possible we then used an **activity** approach. The most detailed approach is to carry out a mass-balance or process intensity calculations. This however was only used selectively. Although the emissions factor databases are improving all the time, often assumptions had to be made for materials that were not in the database, so analogous materials has to be used.

Key Findings

Typically, a consumer or health authority procurement team will only see the packet of medicine. So natural questions are “do you use recyclable cardboard?” or “what steps have you taken to reduce plastic?” The packaging, however, accounts for less than 5% of total CO2 emissions. The key findings are that the overwhelming weight of CO2, around 60 to 70% is produced at the drug product or API stage from processes such as fermentation and distillation. Location of the plant is important due to the “greeness” of a country’s energy supply. The real levers to pull are around the source of electricity supply, the efficiency of the process (titer, yield) and mundane elements such as the heating and ventilation regime in a plant.

A roadmap needs to include elements that show quick progress – recyclable packaging – to give particpants a sense of optimism that something is being done. The “heavy lifting” elements however are what will really reduce the emissions. Product specific recommendations have to be aggregated to the plant or even corporate wide level. For example, introducing a solvent recovery process will be a plant wide initiative. **Designing in** sustainability is crucial. As a molecule progresses through clinical trials there

is an increased reluctance to make process changes that could slow down the registration, particulaly in phase 3.

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