Increasing Renewable Content with the Mass Balance Approach

Bio-based products, in contrast to fossil-based products, are at a disadvantage when it comes to their market uptake. One of the difficulties is that for many producers, making the switch is just not economically viable. Sustainable supply chains need to be built up, but small volumes and comparatively expensive feedstocks can make transitioning uncompetitive and the business risk can be too high.

Establishing new dedicated biorefineries remains challenging due to the substantial capital investment required. Therefore, it seems practical to make use of existing oil refineries to process renewable raw material instead. However, oil refineries operate at scales far beyond the possible supply of renewable raw materials and so integrating renewable raw materials alongside fossil materials in refineries is at least a step towards increasing the scope of the bio-based industries.

Nevertheless, using a relatively small amount of renewable alongside non-renewable raw material will as a result lead to insignificant amounts of renewable content in the vast array of subsequent materials originating from the small selection of initial base chemicals. Creating products without any meaningful proportion of renewable content due to this dilution somewhat eliminates the motivation for incorporating it in the first place.

The concept of mass balance is based on the principle that mass inputs to a system are equivalent to the outputs. Therefore, mass balance in this context allows for the allocation of renewable content to specific products in order for manufacturers to benefit from the ability to make a meaningful product claim. A link is made between product and raw material, which highlights the amount of fossil feedstock that has been displaced, even if physically the product contains a lower renewable content, as shown in figures 1 and 2. Products that can demonstrate this link to renewable material can attract additional market value.

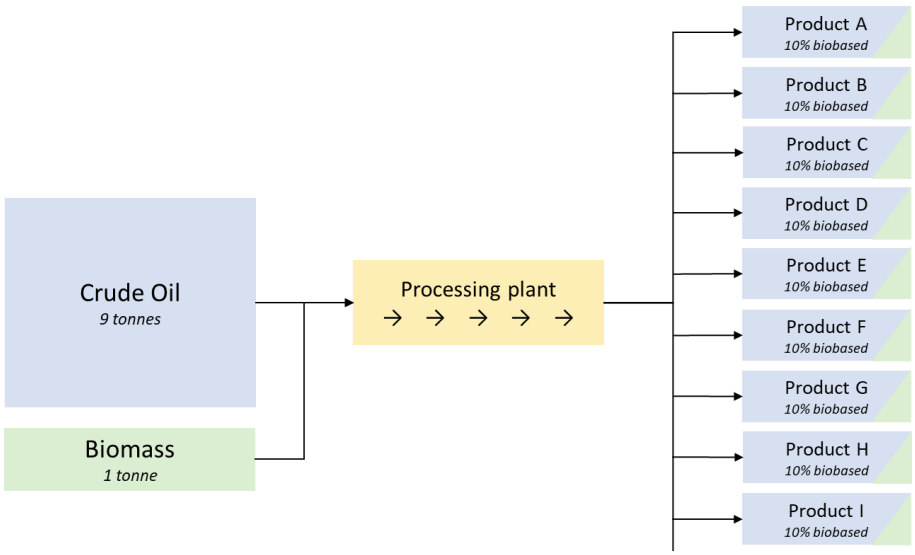

Figure 1: Simplified diagram showing distribution of biobased content in a variety of products, assuming equal distribution.

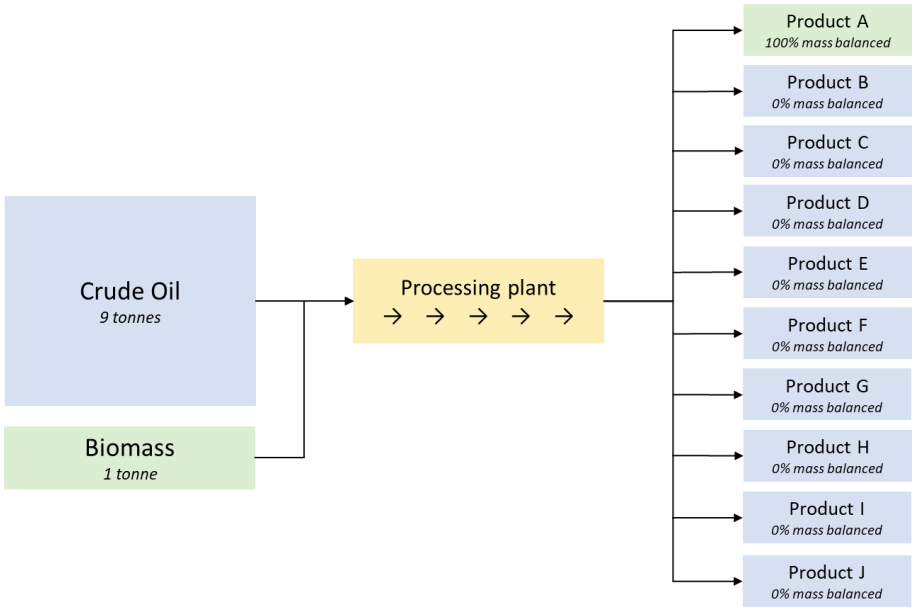

Figure 2: Simplified diagram showing a mass balance approach to allocation of renewable content across a variety of products, 1 tonne of Product A is allocated as 100% Mass balanced.

While this approach has multiple advantages, it can provide added complications. In the short-term, it increases the share of renewable resources used as a feedstock because it's easy to adopt and can raise awareness of the potential for producing chemicals and materials from biomass. Though on the flip side, it is also easy to drop and therefore perhaps won't support a permanent transition to using renewable raw materials. In addition, some stakeholders point out that the consumer could be buying products labelled as 'renewable', or 'bio-based', but physically there could be some, or no renewable content. As the term bio-based is reserved for products with renewable content this calls into question what the correct terminology for these mass balanced products should be. With potentially no physical renewable content, mass balanced products rely on an audit to demonstrate their link to renewable raw materials. Regardless, communicating the mass balance approach successfully to the consumer is necessary to avoid misinterpretation, which could result in a loss of trust in the bio-based industry.

Several companies are utilising the mass balance approach to increase the amount of renewable content in their feedstocks. For example, BASF have taken steps to replace fossil feedstocks with renewable. At BASF's steamcrackers, the point at which its base chemicals are produced and numerous supply chains begin, renewable material is integrated. This allows a variety of their end products to be mass balanced renewable, including superabsorbents, dispersions, plastics and intermediates and certified by the third-party body REDcert.

Producers of renewable raw materials can supply the chemical industry who can then benefit from their renewable supply chains. Neste for example, produce 'MY Renewable Naphtha' utilising vegetable oils and waste fats and UPM's 'BioVerno naphtha' uses crude tall oil, a residue of pulp making process. These feedstocks are finding increasing use, for example Borealis, a polyolefin manufacturer, is to employ Neste's naphtha for mass balanced renewable polypropylene production.

LyondellBasell too are using Neste's feedstocks and are to produce bio-based polypropylene and low-density polyethylene in parallel. For an example closer to home for the consumer, IKEA have also taken advantage of Neste's renewable hydrocarbons to make polypropylene and polyethylene on a commercial scale, opting for 20% renewable content.

Multiple players in the chemicals and polymer industry are also following suit and finding supply chains that incorporate renewable materials. Inovyn has recently launched a new PVC product that is certified by the RSB as delivering a 100% substitution of fossil feedstocks in its production system.

Sabic are also using the mass balance approach to increase the amount of renewable content in their materials. Sabic have introduced a polycarbonate based on the incorporation of renewable feedstock, which is in addition to their current collection polyolefins. Their polycarbonate uses renewable raw materials in combination with virgin fossil sources, co-processed and audited by the ISCC. CEPSA – the Spanish multinational oil and gas company is a key supply chain partner. Also verified by the ISCC, some of Sabic's current collection includes certified circular polymers, which uses pyrolysis oil produced by Plastic Energy Ltd, originating from plastic waste.

Certification is key. Without a proper audit there is no way to demonstrate a link to renewable materials. There are several third-party certification schemes, including the ISCC (International Sustainability and Carbon Certificate), the RSB (Roundtable on Sustainable Biomaterials) and REDcert, which have been mentioned previously. The ISCC measures sustainability for food, feed, products and energy across their supply chains, with the option to extend the scope of certification to specific market requirements, such as non-GMO and phasing out hazardous chemicals. Similarly, the RSB ensures supply chains in the bioeconomy are socially responsible, environmentally sustainable and credibly sourced and the REDcert was initially created for the analysis of biofuels and liquid biomass, but the scope was extended to include sustainable agricultural raw materials in 2015 and the chemical industry in 2018. All three schemes offer different types of certificate depending on the area of focus. For example, the RSB EU RED Standard is specific to biofuel producers in the EU and the REDcert² scheme applies to the chemical industry.

The mass balance approach is used as a tool in order to increase the share of renewable content used as a feedstock, and it has done just that – there are multiple example of products and materials that have been certified as displacing fossil feedstocks. It is a valuable way to make biobased feedstocks more accessible. However, in the future when the bioeconomy hopefully thrives, the mass balance approach should become obsolete, therefore it's use should not undermine efforts to fully substitute fossil sources.