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Bio-based and safe

Governments are promoting greater production of bio-based fuels, materials and substances. Is there scope to combine this with SVHC substitution?



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Geraint Roberts
Briefing & Global Content Editor

A common criticism of government is that it doesn't look to see if there are cases where conflicting policy goals can and should be realigned, or where opportunities exist for synergies. Complaints are heard of too little "joined-up thinking" and a failure by governments to see how one broad objective affects another.

A case in point relates to the goals of the EU and its member states to increase the use of bio-based fuels, materials and chemicals, and to phase out most uses of substances of very high concern (SVHCs). The former, urged by the need to cut dependency on fossil fuels, is mainly driven by government departments responsible for energy and agricultural/forestry policy; the latter often by ministries leading on environmental affairs. But is there a case for greater collaboration between the two points of view, aimed at the very least at avoiding conflicts?

A bio-based economy

The European Commission's enterprise and industry directorate has been trying to boost demand for bio-based products through its "lead market initiative". A 2009 report from its ad-hoc advisory group for bio-based products - which it described as including bio-based plastics, bio-lubricants, bio-fibres for textiles, composites for the construction and automotive industries, and chemical and pharmaceutical building blocks - said indicative, or binding, targets should be considered for some product categories. Its recommendations included ensuring that legislation and policies made sure the biomass feedstock needed to make bio-based

products would be available in sufficient volumes at a competitive price, and for member state public procurement rules to give them preference in tender specifications.

Three years later, the Commission's bioeconomy action plan said that although a large number of pilot biorefineries had been built, there were very few demonstration plants and increased investment was needed through public-private partnerships, financial instruments and regional funds.

In response, the European Chemical Industry Council (Cefic) said that in addition to traditional bio-based products, such as enzymes, vitamins, organic acids, amino acids and polymers made from sugars and starches, new opportunities were emerging including bio-petrochemical feedstocks for making

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plastics like polyethylene and PET. However, they said major barriers stood in the way, in particular ensuring access to biomass and bio-based building blocks at global market prices; financial support for pilot and demonstration facilities; and ensuring that standards and labelling criteria for bio-based products are founded on "sound science and reliable data".

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In 2013, the Commission announced a €3.8bn public-private partnership with the Bio-based Industries Consortium, which includes chemical companies such as DSM, Solvay, Clariant and Kemira, as well as food, forestry and energy companies, to build biorefineries and biomass supply systems, and create new value chains between sectors.

Like Cefic, the Swedish chemical industry trade body Ikem, which is drawing up a national strategy for a bio-based economy, says there is no single comprehensive policy, or legal framework, on how the biomass feedstock for bio-based products should be shared out, at either the national or European level. But the Swedish government's long-term goal of moving to a bio-based economy is encouraging chemical companies to explore the possibilities (see box).

Future chemicals policy

Meanwhile, the basis of Europe's chemicals policy for the next decade has been set out in the EU's seventh Environmental Action Programme (7EAP), adopted by the European Parliament and Council of Ministers last year. This calls for the development by 2018 of an EU strategy for a "non-toxic environment" (a phrase borrowed from the Swedes and Danes) that is "conducive to innovation and the development of sustainable substitutes, including non-chemical solutions". The key areas it highlights are combination effects of chemicals, endocrine disruptors, nanomaterials and minimising exposure to chemicals in products. It also includes a paragraph on bio-based products which says "the growing market for bio-based products, chemicals and materials may offer advantages such as lower greenhouse gas emissions and new market opportunities." This goes on to warn that "care needs to be taken to ensure that the full lifecycle of such products is sustainable and does not exacerbate competition for land or water, or increase emission levels" - but it doesn't caution that they should not be equally, or more, toxic than the fossil fuel-based alternatives.

Indeed, there seems to have been few attempts by the Commission or EU member states to tie these two goals together. A rare example is the Swedish Chemicals Agency's 2010 report [Chemicals and Climate](#). This called for a "synergistic goal" to work towards both reducing climate impact and creating a non-toxic environment, and gave examples like cutting gasoline use to reduce emissions of carcinogenic substances. It also highlighted conflicts between the two goals, such as the use of cadmium in some photovoltaic cell production ([GBB March 2010](#)). The report was only intended to prompt discussion and wasn't commissioned by the government, so most of its recommendations have not been taken up. However, its call for a national green chemistry centre to promote "non-toxic, resources lean and climate neutral solutions" may yet come to fruition as Sweden's recently adopted national chemicals policy, *Towards a non-toxic everyday environment*, commits the government to exploring the idea of establishing a national centre of knowledge for increased substitution of hazardous substances.

More recently, the issue was raised by the consultancy Royal HaskoningDHV at the ChemCon Europe conference in Istanbul last April. In a presentation on the bio-based economy, Wim Van Doorn said the transition from fossil fuels to bio-based production offers opportunities to eliminate, or reduce, the risks

posed by substances of very high concern (SVHCs). A [report](#) it produced earlier this year for the Dutch National Institute for Public Health and the Environment (RIVM) said three bio-based production processes - hydrolysis/fermentation, anaerobic digestion and the use of algae - produce fewer and less toxic emissions and are more energy efficient than the fossil fuel route, while gasification, pyrolysis and transesterification/hydrogenation were comparable with conventional methods. It also compared the environmental impacts of two bio-based chemicals, bioethylene and glycerol, with the conventional production methods.

Due to the increased availability of glycerol, which is a byproduct of soap production, as well as from biodiesel, more applications for it are being developed, says the report, such as the



The Hållbar Kemi 2030 chemical cluster is based at Stenungsund in Sweden

The [Hållbar Kemi 2030](#) chemical cluster comprising Akzo-Nobel, Perstorp, Borealis, AGA and Ineos ChlorVinyls in the Stenungsund region of Sweden hopes to base its operations on renewable feedstocks and energy by 2030. With funding from the Swedish Innovation Agency, Vinnova, the companies discussed with the forestry industry whether the main substances in wood - lignin, cellulose and hemicelluloses - could be used to make speciality chemicals, fibre products and bioethylene. Not far from Stenungsund, Gothenberg Energy has recently inaugurated a 20MW demonstration gasification plant that produces biomethane from forestry raw materials, and hopes to start building an 80-100MW commercial plant by 2016.

However, in his presentation at PVC2014 in Brighton, Lars Josefsson, chairman of Ineos Sweden, which hopes to use biomass to produce bioethylene for PVC production, said that given the recent surge of interest in the attractiveness of shale gas, the economic sustainability of such a venture should not be overestimated. "This won't happen soon for all PVC, but it will start," he told the conference. "There needs to be a lot of research, innovation and collaboration. And it will be more expensive - at least to start with."

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Issue report – the bio-based economy

replacement of prioritised petrochemical plasticisers. Not all bio-based processes are inherently “environmentally friendly”, of course, and a bio-based product may not be easy to recycle or biodegrade, for example, or the production of its biomass feedstock may lead to increased pesticide use. Therefore, a more detailed evaluation of all the health and environmental factors involved is needed, if policymakers are to be able to decide which trade-offs to make and technologies to support.

Here the Dutch are leading the way, as part of their efforts to cut emissions of substances on their national list of priority substances (known as the ZZS list) to below a “negligible risk level” (CW 16 January 2014). In 2013, RIVM presented a report to the country’s environment ministry on bio-based alternatives to ZZS substances, and their potential in substitution. RIVM also examined which methodologies exist for assessing their health, environmental and sustainability impacts and investigated how they are affected by REACH.

That report says bio-based substitution of ZZS substances can be done in three ways:

- » replacing a ZZS with a bio-based substance with the same structural formula, and which is also a priority substance;
- » replacing a ZZS with a bio-based substance with the same structural formula, but without the impurities that made the other substance a ZZS; or
- » using a bio-based alternative that has the same functional properties as the substance it is replacing, but without the characteristics that make it a ZZS.

Although RIVM concluded that substitution was possible, it was unable to discover the extent to which it was happening, or to assess the potential for bio-based substances replacing ZZS substances that were not involved in the study. And even if a substitute existed, its adoption would also depend on factors such as availability of biomass feedstock at a competitive price.

The institute found a large number of methodologies for assessing a bio-based substance’s environmental, health and sustainability impacts. However, the report says that what is lacking is a flexible methodology that can be used to conduct either a quick, or an extended assessment, and which allows the practitioner to select criteria for human and environmental health, safety and sustainability. It also discovered confusion in the market about the effects of REACH, with some firms believing it hampers the introduction of bio-based substances. There are no specific requirements in the Regulation relating to bio-based substances, but they are covered by its general definition of chemical substances and may, therefore, need to be registered. It remains unclear if, in cases of direct substitution with a bio-based substance, a producer can use the registration and information of the petrochemical equivalent.

One of the report authors, Charles Bodar, says RIVM is now working with Wageningen University (WUR) to further assess the potential of bio-based substances to replace certain ZZS substances, and this work will form the basis of a Dutch government workshop at the end of this year. With stakeholders, RIVM will also develop a methodology for weighting the health, safety, environmental and sustainability aspects of bio-based chemistry, because the many existing methodologies for lifecycle



Picture: © BIC/BBi

The bio-economy

assessment (LCA) “can be very data demanding”.

However, there is only so much the government can do, says an official at the Ministry of Infrastructure and Environment. “This is an issue for industry. We are trying to get different industries together, but they have been very reluctant to do something: they say that if they invest a lot of money, someone else will step in to reap the benefit.”

There is no doubt that the chemical industry sees opportunities in the bio-based economy. Cefic says it “will play an increasingly significant role” in the industry in the future, while the American Chemistry Council (ACC) says “many of the benefits of this

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Ministry of Infrastructure and Environment

maturing industry have yet to be realised”, and recently set up a Bio-based Chemistry Network comprising 19 of its member companies, including big names like ExxonMobil, Dow, DuPont and Eastman, to advise policymakers on regulatory programmes. (However, it is notable that the ACC’s list of potential benefits – lower greenhouse gas and volatile organic compound (VOC) emissions, less energy consumption, job creation and energy diversity and security – does not include substituting priority chemicals in the list.) Bio-based chemical facilities are being built not only in Europe and the US, but also in Brazil, China and southeast Asia. It would be a shame if the opportunity for priority chemicals substitution is overlooked.

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