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CAN Europe's transformation pathway recommendations for the chemical industry

Climate Action Network (CAN) Europe is Europe's leading NGO coalition fighting dangerous climate change. With over 185 member organisations active in 38 European countries, representing over 1.700 NGOs and more than 40 million citizens, CAN Europe promotes sustainable climate, energy and development policies throughout Europe.

Executive Summary

The chemical industry is one of the central energy-intensive industries (EIIs) to be targeted in EU efforts to reduce environmental and social impacts through the European Green Deal. As a dynamic and heterogeneous sector, it features considerable potential to help address climate-related and wider environmental and social crises. Opportunities to transform the industry to reduce its negative impacts are significant and this transformation must go beyond pure decarbonisation to make it a pollution and toxic-free, net zero emission, circular, and socially just industry.

The sector's transformation needs are various, not least because of its extreme dependency on fossil fuels and its unsustainable product profiles – whether as pesticides, chemicals or plastics, many of its products are problematic. The transformation that began with a sea-change revolution in chemicals management legislation is complex and explains why the EU has published a Chemicals Strategy for Sustainability while also introducing a chemicals chapter to an EIIs transition pathway process to be published in late 2022. Instead of addressing key negative impacts at the heart of its business activities - especially its fossil fuel dependency for both energy and feedstock, its pollution profile and the hazardousness of most of its products - the sector continues to resist profound structural changes needed to achieve its transformation.

For the chemicals industry to truly contribute to wider efforts to step back from several environmental and social brinks - from climate and habitat destruction, to pollution and impacts on human and non-human health - a transformation pathway is needed. The issues to address are systemic and horizontal in relation to the different policies involved and the sector's creativity and dynamism must be harnessed to:

- **Phase-out hazardous chemicals and their export**
- **Reduce material and energy use**
- **Design plastic for clean circularity and reduce plastic production**
- **Improve product design to extend its lifetime**
- **Mainstream circular business models in the chemical industry**

Policy priorities:

● **Transformation plan:** Several legislative and non-legislative processes set out roadmaps, plans or pathways for the sector, industrial ecosystem, company or installation. For the sake of effectiveness, ideally one tool taking an integrated approach to transformation will act as the reference for all policies requiring industry to develop (with societal scrutiny and acceptance) and publish its transformation actions and targets, and monitor, evaluate and report publicly upon performance at regular intervals.

● **Funding the transformation:** A healthy balance between private investment and public funding must be ensured, with private investment representing the larger share of total funds received. Public funding should be conditional upon acceptance of the transformation plan, and its public reporting.

● **Ecodesign of products and processes:** The Ecodesign of Sustainable Products Regulation (ESPR) and the Industrial Emissions Directive (IED) are tools that could help complete an industrial policy toolbox that remains weak. The landmark Fit for 55 package addressed industry weakly only through the market mechanisms of the EU ETS and the carbon border adjustment mechanism (CBAM). Alongside corporate responsibility legislation, the ESPR and IED need to strengthen requirements on chemicals and plastics in products and take an integrated approach to pollution prevention including greenhouse gas emissions, materials and circularity.

● **Chemicals management:** REACH revision must not be delayed and must align this chemicals management tool with other tools mentioned above, integrating climate, resources and circularity aspects in data provision while allowing for general risk assessment and strengthening precautionary approaches to ongoing health challenges such as endocrine disruption, mobility and persistence.

This briefing provides recommendations and directions to develop an effective, integrated chemical industry transformation. These are necessary to contribute to the achievement of the objectives of the European Green Deal (EGD) underpinned by the 8th Environment Action Programme (EAP) where a toxic-free environment, the protection of the citizen's health, reducing both climate and environmental pressures related to production processes and accelerating the transition to a circular economy are identified as priorities.

Background

In early 2022, the scientific community declared that another planetary boundary – the 6th of nine – had been crossed: "chemical pollution and release of novel entities" are now over-burdening natural systems at the global level[1] [1,2,3]. The scientific assessment leading to this conclusion was based on several elements: the rising rate of production of chemicals, their rising and quickening release into the environment, and the negative effects of some chemicals along their lifecycle. The weight of evidence pointed to the surpassing of the planetary boundary.

The European chemical industry remains one of the highest users of energy and emitters of greenhouse gases (GHGs). The chemical and petrochemicals industries feature as the top energy consumer for all industry sectors (18.5% of all industry final energy use) and as they

[1] This is the sixth of nine planetary boundaries to be exceeded, alongside climate change, the loss of biodiversity, changes in the land system, green water changes and the alteration of the nitrogen and phosphorus biogeochemical flows.

are highly dependent on natural gas as both feedstock and energy for their processes, they account for 40% of the EU's industrial natural gas demand [4]. In addition, despite the Emission Trading System (ETS) being in operation since 2005, the sector is the third largest emitter and its reductions have been limited to around 145 million tonnes of CO_2 (2019) compared to 1990 levels, and with no significant reductions since 2013 [5,6]. The industry is also extremely exposed and vulnerable in the context of Russia's invasion of Ukraine and the EU's decision to divest itself from Russian petroleum product dependence.

The urgency of the industry's transformation needs to ensure that over time it ends its over-reliance on fossil fuels whilst ensuring its activities make no further harm to the environment and human health[2] [7,8,9,10,11]. This latter point is central to its transformation. Despite EU legislation aiming to reduce production and use of hazardous substances, 75% of chemicals on the market proved to be hazardous to the environment and/or human health, and 62% of the chemicals used in the EU in 2016 were hazardous to human health [7,12,13]. This is the case despite an important paradigm shift in chemicals legislation - called REACH - being introduced in 2008[3].

Through the European Green Deal, the European Commission launched several policy processes targeting chemicals and the chemicals industry as a whole. The 2020 Chemicals Strategy for Sustainability (CSS) aims to help implement a goal "to protect better human health and the environment as part of an ambitious approach to tackle pollution from all sources and move towards a toxic-free environment". It is also meant to shape the development and deployment of "the sustainable chemicals that enable the green and digital transitions and to protect the environment and human health". Through the CSS, a couple of processes have been launched. One is the establishment of the High Level Roundtable on the Chemicals Strategy for Sustainability (HLRT), a multi-stakeholder group (made up mostly of NGOs – including CAN Europe - and industry and academics) that is developing approaches to guarantee a toxic-free environment where safe and sustainable chemicals will drive the EU industry as a quality benchmark at the global level. Another is the elaboration of a policy approach called "Safe and Sustainable by Design"[4] (SSbD), meant to help industry design their chemicals along societal needs and benefits. This is being developed at the same time as EU chemicals legislation is being updated for improved effectiveness and to elaborate an "essential use" concept.

Through industry policy processes, a "transition pathway" for the chemicals sector, as part of a transition pathway for energy-intensive industries, is being developed to set out more details on next steps to guide these industries towards achieving elements of the EGD objectives.

[2] Due to these growing concerns, the scientific community is calling for the creation of a dedicated body to monitor the chemical pollution resulting from chemical industrial processes and therefore its mitigation similar to the Intergovernmental Panel on Climate Change and efforts on climate change.

[3] Within the EU, chemical substances are regulated through REACH and CLP regulations based on categorisation of substances according to toxicity and with subsequent management options possible, ranging from banning of specific substances to their restricted use. Substances of very high concern include those that are endocrine disrupting chemicals (EDCs); persistent, bioaccumulative and toxic (PTB); very persistent and very bioaccumulative (vPvB); persistent, mobile and toxic (PMT); and very persistent and very mobile (vPvM).

[4] According to the Chemicals Sustainability Strategy, SSbD "can be defined as a pre-market approach to chemicals that focuses on providing a function (or service), while avoiding volumes and chemical properties that may be harmful to human health or the environment, in particular groups of chemicals likely to be (eco) toxic, persistent, bio-accumulative or mobile. Overall sustainability should be ensured by minimising the environmental footprint of chemicals in particular on climate change, resource use, ecosystems and biodiversity from a lifecycle perspective."

For the chemicals industry, objectives focus on climate, energy, environment and health, and circularity. All these processes need to provide clearer direction and prioritisation for the chemical industry towards delivering sustainable chemicals to society.

Through our contribution to these processes and others, our recommendations are set out in the following priorities:

➢ Phase-out hazardous chemicals and their export

Almost 75% of chemicals produced in Europe are hazardous to human health and/or the environment, and the European Environment Agency declared that "the majority, around 70,000 substances, have hardly any information on their hazards or exposures" [12,13]. Given that chemicals are found in all products – not all of which are necessarily hazardous – this means we are all exposed to chemicals wherever we are. Hazardousness is a key priority for this industry's transformation, and this explains the strong focus on the SSbD approach being developed. Several drivers require a safe and sustainable approach: from the public's concern about chemical impacts on human health and the environment, limitations of chemicals risk assessment tools, to the reality of the presence of specific chemicals in products being problematic and the unknown effects of exposure to multiple chemicals.

Phasing out hazardous substances has the dual benefit of addressing both hazardousness as well as levels of chemicals' production, helping ideally to reduce fossil fuels use. A first step is to phase out chemicals of concern from consumer products, starting with those for which safer alternatives already exist [14]. Determining the safety of multiple exposures represents a major burden to overcome indeed and the SSbD approach could constitute the basis to move forward to a safer and more sustainable design, compatible with both the zero pollution and circular economy action plans. SSbD aims to provide a set of criteria to design safe chemicals and materials that can be produced and used without being harmful to human and/or environmental health. This approach will also be helpful for delivering a design that is suitable for recyclability as materials can be recycled for different uses as they do not include hazardous substances.

Therefore, stopping the production of known hazardous substances, and designing new hazard-free chemicals would eliminate an element of pollution while improving the ecological profile of end-products that no longer are made with hazardous chemicals. Continuing to export hazardous substances, including pesticides no longer allowed on the EU market, must also stop for the sake of coherence with transformation of the sector.

➢ Reduce material and energy use

Unsustainable use of resources is an economy-wide challenge and the chemical industry's resource challenges are substantial. The industry uses a wide range of resources[5] including biomass and mostly fossil fuels (oil, natural gas, coal), which have well-known and considerable negative impacts. Extracting and producing resources are in fact energy intensive processes presenting severe impacts on human health, local communities, and the environment (e.g. pollution, habitat destruction and disruption of biodiversity, depletion of resources, climate change) [15].

[5] For example, oil, biomass, sulfur, salt, water, air, precious metals, limestone, phosphates, etc.

Public data [16] on the sector and in particular on European feedstock use are scarce and outdated[6], but what is available shows that the raw material used is overwhelmingly mineral oil (61 million tonnes) and natural gas (19 million tonnes), with only 9% of the overall amount being renewable materials (8.5 million tonnes)[7].

On energy use, in 2018 the chemical and petrochemical industry was the top energy consumer for all industry sectors - 52,605 ktoe, or 18.5% of all industry final energy use [17]. This covers more than just chemicals and plastics production, but the chemical and petrochemical industry is interlinked and production can shift between different products. Nonetheless, energy from renewables and biofuels represented 0.6% of total energy consumption [18].

The massive presence of fossil fuels in the chemical sector both as feedstock and as an energy source naturally causes GHG emissions at every step including the end-product end-of-life. Electrification of the sector will automatically increase energy needs, driving up demand for energy and hydrogen. Reducing material and energy input and more efficient resource management must be priorities in order to reduce overall environmental impacts as well as dependencies on foreign supplies [19], and to be in line with the Paris Agreement targets[8]. Forecasts on electrification, hydrogen and biomass use point out that efficiency needs to be coupled with the concept of sufficiency, or setting limits to resource/energy use.

The chemical industry suggests replacing part of their fossil fuels use with biomass for energy or feedstock. However, in our view, this is a controversial replacement for several reasons. As for biofuels, use of biomass does not automatically represent a reduction in environmental impacts and its future availability is overestimated [20]. Limitations continue to exist on sustainability criteria, on an appropriate public policy framework guiding biomass through cascading uses as materials and on a level of use that does not shift considerable impacts elsewhere (such as land use change, habitat destruction and degradation of soil). Furthermore, developing and boosting the renewable feedstock use while working on circular models to recover materials such as precious metals[9], polymers, rubber, textile and creating value from them due to the Circular Economy Action Plan (CEAP**)** are parallel steps to undertake to address this situation [21,22].

The commitment to reduce the energy and electricity inputs is not enough if not coupled with cutting materials' use and systemically integrating circular processes within the chemical industrial scenario.

➢ Design plastic for clean circularity and reduce plastic production

Plastic has received significant media and political attention in recent years, due to its persistent and damaging effects on nature. Add to this to its increasing presence in marine environments, it being found in the guts of marine animals, and more recent discoveries of

[6] These data refer to 2011 and they are not complete as public statistics regarding the inorganic raw materials use are not available.
[7] These values correspond to the total amount of produced and consumed chemicals in 2011 of 280 million tonnes (Eurostat).
[8] See CAN Europe/EEB Paris Agreement Compatible (PAC) energy scenario at https://caneurope.org/content/uploads/2020/06/PAC_scenario_technical_summary_29jun20.pdf
[9] This concept is strengthened by the current state of the art concerning the critical raw materials(CRMs) that clearly shows that the development of the recycling technologies is not ready yet to allow a circular management of the CRMs.

micro-plastic presence in drinking water and human blood. Plastic pollution is also part of the "novel entities" related to the most recent planetary boundary being overshot [1].

The plastic sector is reported to produce more than 29 million tonnes (Mt) of plastic waste responsible for the emissions of around 132 Mt of CO_2 every year in Europe and its overall production rate is forecasted to keep growing [23,24,25]. Only around 32% of this was collected for recycling, 25% was landfilled and 43% was incinerated, so the actual amount recycled must be less than one-third [26,27]. The most recent estimates report the existence of a gap between reported volumes of produced plastic and related waste statistics. Between 8 and 15 Mt of plastic remains unaccounted for in annual reported waste statistics, meaning that the plastic waste generated is likely higher than reported [25].

Part of the reason for these poor recycling rates is the disconnection between plastic design which is increasingly complex (evolving from single polymers to composites), recycling systems that can treat more simple polymers and technical difficulties in treating mixed and/or contaminated plastic streams that can also contain hazardous chemicals. Furthermore, collecting, sorting and properly managing different plastic streams costs more than buying virgin plastics [28].

This situation results in the demand for recycled plastic currently accounting for only around 6 % of plastic demand in Europe. It has been estimated that fossil fuel-derived plastics account for over 90% of global production, meaning that decoupling plastic production from fossil-based feedstocks is not possible at large scale [26,29,30]. Oil and gas used in plastic production are more or less divided equally between that used for feedstock and that used as fuel [31], a situation not compatible with the phasing-out of fossil fuels required to keep the global temperature below 1.5°C.

The [2018 EU Plastic Strategy] set out a new plastics economy, "where the design and production of plastics and plastic products fully respect reuse, repair and recycling needs and more sustainable materials are developed and promoted." The Strategy identifies several ways of achieving these aims, ranging from design of plastics and end-products containing them, a more integrated value chain, better quality recycling of higher quality plastics, and alternative feedstocks. We support this focus as it is centred on reducing both the production and use of the material while also improving its environmental profile. The Plastic Strategy was very soon followed up by the [Single Use Plastic Directive], legislation aiming to prevent and reduce the impact on the environment of certain plastic products largely by banning them. Developments such as these are important in setting out a design centred on circularity with defined recycled content requirements for products.

The ratio between produced and recycled plastic is still very high and plastic producers cannot solely rely on technologies that do not have the capacity or are not at the development stage to be used as a large-scale solution. This situation is further exacerbated by the limited capacity to recycle and responsibly dispose of plastic, hence a net reduction of its production is required as soon as possible to diminish the dangerously high quantity of dispersed macro and micro plastic worldwide. Moreover, shifting the burden of mixed plastic waste to non-EU countries with lighter regulation should be avoided, as they are also moving legally to ban this practice and it is neither socially nor environmentally sustainable [32,33].

Reducing plastic production from fossil-based feedstocks consists of promoting renewably sourced feedstocks, alternative materials and enhancing the eco-design properties of the plastic products so that it will be possible to reuse and recycle them [30,34]. The chemicals industry supports the development of Chemical Recycling (CR), partly to overcome the issue of problematic substances found in secondary materials coming from mechanical recycling processes. CR technologies are still under development, and these should be fully funded by industry and must be able to accept all plastic types available on the market. In this way, extended producer responsibility can already be integrated into lifecycle management options [35,36].

➢ Improve product design to extend its lifetime

Chemistry can be a very powerful ally when it comes to "closing the materials loop" through its design for circularity, this young and emerging knowledge area has the potential to substantially contribute to the products' life-cycle extension and is very much in line with a sufficiency-driven approach [37]. The chemicals industry is well-placed to help advance expertise in the ecodesign of "clean" products and especially their circularity by working with designers to provide hazard profile data on substances beyond existing legislation rather than by insisting on the continuing need for hazardous substances in a climate-neutral and circular economy. Today, recycling materials that contain hazardous chemicals spread those chemicals more widely in society, including in childrens' toys and other products [38]. For this purpose, different platforms[10] are already aimed at the assessment of chemicals offering options for their substitution with existing safer alternatives.

For decades now, EU waste legislation has sought to reduce waste generation, support recycling and more recently to encourage reuse. However, this has not been effective enough to drive chemicals or plastics producers to design their products for reduced environmental impacts. This can be seen in the emergence and diversification of composite materials available on the market, and the mismatch between availability of these materials and their recycling profiles. It is therefore unsurprising that the most recent data about the European recycling rates published by the European Environment Agency (EEA) show that the percentages corresponding to different waste streams[11] [39] are not even reaching 50%. Considering that the annual waste generation from all economic activities in the EU amounts to 2.5 billion tonnes and that the chemical industry area of impact extends over its broad network of "customer" sectors and end-products, it should be also held responsible to address this situation [40,41,42].

The disconnection between plastic design and available recycling technologies creates further challenges to those that already exist due to the heterogeneity of the collected waste (products), the lack of cost-efficient technologies to drive the demand for recyclables, technological challenges still favouring virgin materials as input resources and the quality loss of recycled plastics [22,43].

The Safe and Sustainable by Design approach could provide policy orientation to reduce plastic's impacts. This approach could also be integrated into a new legislative proposal for an Ecodesign of Sustainable Products Regulation (ESPR), framework legislation addressing the environmental impacts of several product groups including chemicals and plastics aspects. Therefore, the improvement of the design phase from the start, paired with future ESPR

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[10] http://www.oecdsaatoolbox.org/Home/Tools#26,https://www.greenscreenchemicals.org/,https://sinlist.chemsec.org/

[11] For example municipal waste, packaging, and electricals and electronics.

implementation, should deliver safer and more durable products suitable for recycling, repairing, reuse, in such a way to keep the resources within the value chains.

➢ Mainstream circular business models in the chemical industry

The points highlighted throughout this briefing are cross-linked and converge in the extended adoption of circular business models to drive the chemical industries towards their goal to become climate neutral by 2050.

Linear business models characterise most of the chemicals industrial segments and yet chemical leasing remains an under-explored option as end-product manufacturers are usually seeking a function rather than a chemical itself. Developing circular approaches in line with the CEAP also means to systematically keep resources within the value chains as much as possible by acting at different stages of the production process, starting from the feedstock inputs and therefore reducing the amount of virgin materials needed for the production processes by deploying circular supply chains [44]. Besides the production process, products can be made available through sharing platforms and, by focusing on selling a service rather than the product itself, also employing the so called “product as a service” scheme, whose major cited example is represented by chemical leasing.

Conclusions

In a scenario where chemical pollution and the release of novel entities has been listed among the several planetary boundaries to have been crossed already, the commitment of the chemical industry to address the multiple environmental, climate and health-related crises through a climate neutral scenario by 2050 at the latest is necessary, but must be paired with a paradigm shift that goes beyond decarbonisation. The complexity of this framework is strengthened by the chemical industry being both among the energy intensive industries and the so-called “hard-to-abate” activities. The changes that this sector must embrace for an effective transformation towards a pollution and toxic-free, net zero emission, circular and socially just scenario cannot rely purely on techno-based solutions (e.g. CCS and chemical recycling) that in most of the cases are still far from being implemented at large-scale.

Several legislative and non-legislative processes such as the Chemical Strategy for Sustainability and the “transition pathway” for the chemicals sector are developing a framework to set the basis of this transformation but they are still hindered by the lack of common and coherent vision with each other in pursuing their objectives.

Phasing-out hazardous chemicals, starting with consumer products, is an essential step to undertake to provide a toxic free-environment where materials can be recycled regardless of their intended use, this is also the basis of the safe and sustainable by design approach of products essential to extend their life cycle. The design itself is essential but not sufficient to confront the massive use of energy and materials feeding the sector and the significant amounts of waste resulting from its activity stretching over the different end-products. For this reason the materials and energy inputs need to be reduced while extending the introduction of circular business models to boost the shift towards circularity with the plastic sector deserving a special mention for contributing alone to major environmental and climate crises. The dangerous lack of common vision and unwillingness to pursue the different challenges that must be addressed are still slowing down an effective transformation of the EU chemical industry; it is therefore necessary that all the stakeholders are determined to engage in this ambitious pathway.

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