

Guiding principles More Sustainable Leather Chemistry

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The project "More Sustainable Chemistry along the Leather Supply Chains" at the Darmstadt University of Applied Sciences (h_da) aims to support the leather industry in its transformation towards more sustainable chemistry.¹ It is based on a co-creative collaboration between actors within the leather context² and the interdisciplinary university team³. In the project, the actors developed together an optimistic future scenario for the year 2035, in which the industry – on a global scale - successfully masters the challenges of a more sustainable leather chemistry. To specify the desired future scenario, some actors developed a mission statement "More Sustainable Leather Chemistry" in a further process step.

This document contains in section 1 the mission statement, which consists of an introductory preamble (section 1.1), definitions of important terms related to the subject matter of the mission statement (1.2) and the actual goals (1.3). An annex explains the context for the mission statement, which consists of existing normative requirements and those that may change in the context of the Green Deal (2.1), established conceptual approaches to sustainable chemistry (2.2) and previous project steps (2.3).

The following organisations have contributed to the development of the mission statement:



The organisations want to work together on the goals of the mission statement in line with the preamble. The 2035 scenario and the implementation strategies developed for it create a framework for this.

¹ See <https://sne.h-da.de/umsetzungsvorhaben/nachhaltigere-lederchemie>.

² Chemical producers, tanneries, manufacturers and traders of products made of leather or with leather components, associations and initiatives from the business community, NGOs.

³ process chemistry, law, design, environmental science, business administration and psychology.

1 Guiding principles "More sustainable leather chemistry"

1.1 Preamble

The 2020s shed light on environmental disasters and social upheavals triggered by global production and consumption patterns. All over the world and at all levels of society, there is a desire for Sustainable Development and thus also for clean, resource-preserving products that have been produced under fair conditions and at the same time enable the producing companies to make a good living.

Sustainable Development

There are different approaches to defining the concept of "Sustainable Development". According to a famous formulation in the so-called Brundtland Report of 1987, the concept essentially means "development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs".⁴

The "Agenda 2030" adopted by the United Nations in September 2015 as Resolution⁵ operationalises this basic principle via 17 Sustainable Development Goals (SDGs). Central with regard to a more sustainable chemistry along the leather supply chains is SDG 12, which aims at "ensur[ing] sustainable consumption and production patterns", with among others sub-goals like

- manage natural resources sustainably and use them efficiently by 2030 (12.1),
- by 2030, "encourages businesses, especially large and transnational companies, to adopt sustainable practices and integrate sustainability information into their reporting cycle " (12.6) and
- already by 2020 to achieve "environmentally sound management of chemicals and all wastes throughout their life cycle [...] and to significantly reduce their release to air, water and soil in order to minimise their harmful effects on human health and the environment" (12.4).

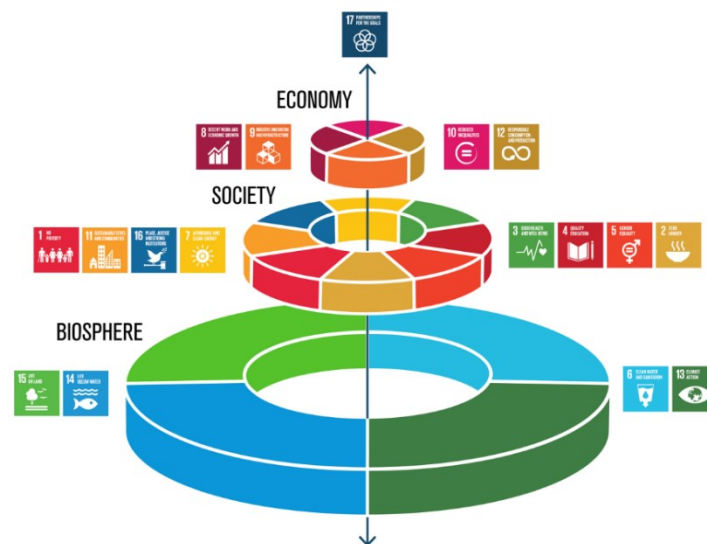


Figure 1: The SDGs are related to each other

(Source: Azote for Stockholm Resilience Centre, Stockholm University (CC BY 4.0)).

The SDG 12 targets can only be achieved through global partnerships for sustainable development (SDG 17). The SDG 12 targets are also directly linked to SDGs on more specific goals for the protection of human

⁴ World Commission on Environment and Development (1987), [Our common future](#), paragraph 27.

⁵ United Nations 2015, [Transforming our world: the 2030 Agenda for Sustainable Development](#), New York.

health and natural resources, including SDGs 3 (A healthy life for all), 6 (Availability and sustainable management of water), 13 (Combat climate change and its impacts), 14 (Conserve and sustainably use the oceans, seas and marine resources for sustainable development) and 15 (Protect, restore and promote the sustainable use of terrestrial ecosystems).

In addition, SDGs with social targets that have gained importance in the course of the project through inputs from the actors from the field as well as legal developments (see below) are to be considered, i.e. in particular SDGs 1 (End poverty), 2 (End hunger), 5 (Achieve gender equality) and 8 (Promote sustainable, inclusive and sustainable economic growth, full and productive employment and decent work for all).

Figure 1 shows the relationships between the SDGs. It illustrates that the "planetary boundaries"⁶ define the - finite - frame for all activities in social and economic terms. It also shows that SDG 17 should be underlined as the axis of the whole system: cooperation and its governance are the basic requirements for achieving the SDGs. Science is beginning to define these "planetary boundaries" in terms of chemical production and use, and concludes that humanity is already operating outside the safe operating space.⁷ This is one of the reasons for the need to develop a more "sustainable chemistry".

Box 1: Overview of the concept of sustainable development

From the point of view of resource conservation, leather is an advantageous material - against the background of current, but also predicted consumption patterns: the raw hides used as a basis are by-products from food production. In the sense of a circular economy approach, waste is thus avoided by transforming hides as a biobased raw material ideally into long-lasting surface materials. This also reduces the need for other raw materials - such as petroleum-based ones - to produce the same amount of material. Moreover, leather is particularly durable, depending on how it is produced and cared for and in most cases it is easily repairable. These material properties open up potential for longer product life cycles and optimized recyclability - for example through immediate secondary use, reprocessing or repurposing.

At the same time, leather is the subject of an industrial supply chain. It takes a large number of very effective and therefore often classified as "hazardous" or at least perceived as problematic chemicals to process raw leather into a durable material - which also meets technical requirements such as elasticity, tear resistance, hydrophobicity. In order to minimise the negative impacts on people and the environment, production sites therefore need effective environmental and safety management: in Europe, strict regulations already exist to protect the environment and consumers as well as workers. These result, among other things, from chemicals legislation (REACH) and industrial plant legislation.

In recent decades, however, significant parts of global leather production have shifted from Europe to other countries. The reasons for this are the comparatively high labour costs in Europe and the already existing leather industry in the destination countries, which had motivated a relocation. Standards in the EU also contributed to the cost differences. Against this background, the environmental impact of the global leather industry is also a topic that e.g. TV programmes regularly report on. The focus is then on motifs from "problem tanneries" from non-European regions where leather is produced under sometimes

⁶ Rockström et al. 2009, Planetary Boundaries: Exploring the Safe Operating Space for Humanity. *Ecol. Soc.* 2009, 14 (2), no. 32.

catastrophic conditions for the safety and health of the workers involved in the process as well as for the local environment.

As part of the Green Deal, the EU plans to make the regulatory framework for products manufactured or placed on the market in the EU even more demanding. For example, eco-design requirements for leather clothing and footwear or leather furniture are to be expected. In addition to durability, chemicals in products play an important role. These are also to be the subject of a tightening of chemicals legislation (see in the annex, section 2.1.2). At the same time, EU policy is also about communication with consumers, for whom "more sustainable" products must be more easily recognisable.

The planned regulatory measures create opportunities for pioneers such as suppliers of chemicals of less concern. At the same time, they increase the pressure on an industry that is in a difficult situation; and not only because of ecological concerns: In large parts of the public, the - false - impression has been created that "animals are slaughtered for leather", and to a considerable extent. The consequence is that the importance of material alternatives advertised as "vegan" is increasing. A use without leather is considered a contemporary fashion statement by an increasingly (environmentally) conscious population - at least in certain regions (e.g. Germany, England, USA).

This document formulates a mission statement "More Sustainable Leather Chemistry". At its core, this stands for a problem awareness of the companies to continuously scrutinise their own processes and products with regard to the goals of sustainable development and, if necessary, to proactively take measures to compensate for identified shortfalls, to improve performance and to strengthen sustainability and the location. The mission statement aims to recognise the positive developments of the European leather industry in recent years with regard to the protection of people and the environment and at the same time outline an ambitious mission statement for further progress towards sustainable development. It also wants to set impulses for an internationally valid "level playing field" with fair competitive conditions: In the long term and in a global perspective, production conditions must converge at a high level. Therefore, it is necessary that actors along the leather supply chains and across continental borders take action together to work towards the goals of the SDGs. The SDGs provide orientation for the vision. According to these, sustainable and socially just economic activity is only possible within the framework of ecological ("planetary") boundaries (see Box 1).

Leather as a material offers advantages for Sustainable Development. Leather will continue to be produced in the future - the only question is where and under what conditions. Policymakers must be aware that further tightening of regulations in Europe can harm the domestic production if these regulations do not have an indiscriminate effect on all products manufactured here and imported. Furthermore, the effects of the policy must also be measured against the benchmark of Sustainable Development. In this context, it is particularly important to assess undesirable effects through relocation in the production chains out of the EU.

Es sollte deshalb Ziel sein, Möglichkeiten zu schaffen die „Frontrunner“ die schon fast „Alles erreicht haben“ nicht zu überfordern zugunsten derer, die bei 60% oder weniger der möglichen Nachhaltigkeit günstiger produzieren zu bevorteilen. Dies würde zur Folge haben, dass das Niveau der Nachhaltigkeit sinken würde, was nicht Ziel dieses Projektes sein kann.

1.2 Definitions of the terms of the mission statement

The guiding principle "More Sustainable Leather Chemistry" refers not only to leather chemicals in the strict sense, but also to chemical care products in the use phase and chemical auxiliaries at the end of the product's life. Table 1 defines these and other relevant terms.

Table 1: Terms of the mission statement "More Sustainable Leather Chemistry"

1. Leather chemistry
<p>The term leather chemistry covers all chemical reactions and products (substances and mixtures in REACH terminology) involved in the production of leather. In relation to leather manufacturing processes, this includes, for example, speciality chemicals, auxiliaries and "bulk chemicals" such as salts. Chemical substances that intentionally or unintentionally come into contact with leather during the manufacturing route, e.g. in machinery, are also covered.</p> <p>The term leather chemicals does not include feed, medicines and other chemical products used in the rearing of animals. However, it should be noted that the quality of the raw hides influences the use of chemicals.</p>
2. Leather care products
<p>The term refers to the chemical products (sprays, creams, greases) used in the use phase by consumers or professionals to care for and preserve leather products.</p>
3. Chemical auxiliaries at the end of the product life
<p>The term refers to chemicals that are used at the end of a product's life cycle, for example to support the recycling of materials. The importance of this class of substances will increase in view of the growing requirements for a "circular economy".</p>
4. Product
<p>The term refers both to leather as a material and to marketable articles (articles in the terminology of REACH) made entirely or partly of leather (e.g. shoes, handbags).</p>
5. Product ecosystem
<p>The term here refers to products in their marketing and use context, including related products, services, business models, usage practices, actors, roles and further frameworks that are indirectly and directly related to the product.</p>

1.3 Goals

Table 2 contains the concrete goals of the mission statement "More Sustainable Leather Chemistry".

Table 2: Goals of the mission statement "More Sustainable Leather Chemistry"

No.	Goals of the mission statement "More Sustainable Leather Chemistry"

1	Learning process	The guiding principle of a More Sustainable Leather Chemistry describes a learning process, i.e. whether a product or e.g. a production process is "sustainable" cannot be defined conclusively, but always depends on existing knowledge and its normative evaluation.
2	Fair cooperation	A More Sustainable Leather Chemistry requires that companies along the supply chains work together fairly, horizontally and vertically, towards the goals of the mission statement.
3	Sustainable management	A More Sustainable Leather Chemistry strives to resolve the trade-offs often associated with a sustainable economy. It enables companies to operate under fair competitive conditions while building resilience and generating profits. At the same time, business models are based on more sustainable production methods (No. 6).
4	Fulfilment of legal obligations	A More Sustainable Leather Chemistry defines the fulfilment of local (production or marketing) legal requirements in the areas of environment, occupational health and safety, and social welfare as a minimum qualitative requirement.
5	Legal development	For a More Sustainable Leather Chemistry, companies need to respond to regulatory developments and prepare where necessary to ensure that they comply with future legislation (No. 4).
6	More sustainable production methods	A More Sustainable Leather Chemistry is based on the iterative review of more sustainable production methods with the least or no negative impacts of processes and products (throughout the life cycle) in terms of environment, health and safety and social aspects.
7	Life cycle approach and product ecosystems	A More Sustainable Leather Chemistry means that all impacts related to functionality (comfort, durability, etc.), environment, health and safety, social and economic aspects - as well as their interactions - are considered throughout the life cycle of products within their product ecosystem.
8	Chemicals Management (CM)	I. A More Sustainable Leather Chemistry requires that companies adopt and implement effective chemical management that ensures that risks identified using standardised procedures (e.g. OECD) are (1) adequately controlled with regard to human health and the environment throughout the life cycle, and at the same time (2) measures are taken to avoid risks (risk prevention). The following also applies to the CM:
		II. The CM must at least refer to all substances for which the respective applicable law (No. 4) standardises requirements.
		III. CM is also a learning process (No. 1). CM must therefore refer to all substances that (may) be identified as problematic in the foreseeable future due to legal developments (No. 5).
		IV. The CM basically examines the particularly effective and at the same time costly "hazard-based" approach, i.e. the aim is to substitute substances on the basis of the known problematic properties, provided that preferable alternatives are available.

9	Environmental management	I. A More Sustainable Leather Chemistry requires, as far as not covered by <u>No. 8</u> , to ensure through appropriate environmental management that, as far as possible, no or only minor negative impacts on the environment (resources) occur, taking into account: ⁸
		<i>II. Use of pesticides and fertilisers</i>
		<i>III. Water consumption</i>
		<i>IV. Water pollution</i>
		<i>V. Waste generation</i>
		<i>VI. Circular Economy: product-related longevity, reparability, recyclability, reusability</i>
		<i>VII Air pollution</i>
		<i>VIII. Direct and indirect greenhouse gas emissions (including climate change)</i>
		<i>IX. Energy consumption</i>
		<i>X. Deterioration of the soil</i>
		<i>XI. Deforestation</i>
		<i>XII. Destruction of biodiversity and ecosystems</i>
10	Ensuring human health	A More Sustainable Leather Chemistry requires, as far as it is not covered by <u>No. 8</u> , that appropriate measures are taken to ensure that there is as little or no negative impact on human health as possible, taking into account:
		<i>Safety and health at work</i>
		<i>Consumer protection</i>
		<i>Protection of the environment and health</i>
11	Transparency in the supply chain	Commercial customers need information on all substances in the product/process, but at least on the (potentially) regulated substances in the product/process, to be able to meet future customer requirements and legislation related to <u>points 8, 9 and 10</u> (and 12 and 13, if applicable).
12	Low social impact	A More Sustainable Leather Chemistry requires companies to adopt and implement effective management that has minimal or no negative social impact on the people who produce or handle chemicals, taking into account the following factors: ⁵ <ul style="list-style-type: none"> • Child labour • Coercion/Forced Labour

⁸ Overview according to UNECE 2021, [Business Process Analysis for Sustainability and Circularity in the Leather Value Chain](#), 15 (adapted; see further references op. cit.).

		<ul style="list-style-type: none"> • Trade unions and collective bargaining rights • Discrimination (women and minorities) • Sexual harassment • Exploitation of homeworkers • Working conditions: Wages, working hours, contracts (with employees and/or subcontractors), fixed-term employment relationships • Recruitment practices • Lack of social security
13	Low "ethical" impact	<p>A more sustainable leather chemistry requires as little or no negative "ethical" impacts of business activities as possible:⁵</p> <ul style="list-style-type: none"> • Bribery and corruption • Land rights • Animal welfare
14	Product development	<p>A product development whose material selection and requirements for processing and functionality (also) explicitly take the qualitative aspects mentioned in <u>Nos. 6 - 13</u> as a benchmark requires a more sustainable leather chemistry.</p>
15	Transparency towards consumers	<p>A more sustainable leather chemistry requires that communication and information at the PoS is designed in such a way that consumers can make an informed purchase decision.</p>

2 ANNEX: Selected contextual aspects for the proposal of the mission statement

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2.1 Normative guidelines

An important impetus for the concept of the leather project was (and is) the perception that the global leather industry does not fully meet the requirements of the UN Sustainable Development Goals (SDGs) of the "Agenda 2030" (see already the preamble). Furthermore, the requirements of European law (2.1.1) and their future developments (2.1.2).

2.1.1 Requirements of EU law

EU law contains relevant requirements with regard to a more sustainable leather chemistry, which will be briefly discussed here. For example, emissionimmission control law defines basic obligations for operators of larger industrial plants, such as those for the production of chemicals or leather, with regard to precautions against environmental pollution and energy efficiency.⁹ In addition, the plants must apply the "best available techniques", which were last defined for the tannery in 2013.¹⁰

With regard to the product-related requirements of EU law, particular reference should be made to the REACH Regulation.¹¹ REACH formulates requirements for chemicals (substances and their mixtures) as well as chemical-related requirements for "articles", i.e. materials such as leather and articles made of leather or containing leather components.

According to Article 1, the aim of REACH is to ensure a high level of protection for humans and the environment while contributing to innovation and competitiveness. The provisions of the regulation are based on the precautionary principle.¹³ According to recital 4, REACH is a contribution to the "Johannesburg Goal" of chemicals policy, the content of which SDG 12.4 has taken over almost unchanged.

Table 3: Selection of requirements from REACH Annex XVII relevant for leather chemistry

Use	Name of the substance (CAS number)
Solvent	1-Ethyl-2-pyrrolidon (2687-91-4)
	1-Methyl-2-pyrrolidon (872-50-4)

⁹ Art. 11 of Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control), <http://data.europa.eu/eli/dir/2010/75/oj>.

¹⁰ Joint Research Centre, Institut für technologische Zukunftsforschung, Rydin et al. 2013 Best available techniques (BAT) reference document for the tanning of hides and skins: Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control), Publications Office, , <https://data.europa.eu/doi/10.2788/13548>.

¹¹ Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), <http://data.europa.eu/eli/reg/2006/1907/oj>.

¹² See Führ et al. 2019, Integrating "Green Chemistry" into the Regulatory Framework of European Chemicals Policy, sofia-Studien 19-2, Darmstadt, <https://doi.org/10.46850/sofia.9783941627727>, for the product law frameworks that only exceptionally formulate concrete chemical-related requirements.

¹³ See Führ and Schenten 2021, [Advancing REACH: Strengthening control of emerging risk](#), in: Umweltbundesamt (ed.), UBA-Texte 132/2021.

	Chlorinated aromatic compounds (various)
	Formamide (75-12-7)
	Furan (110-00-9)
	N,N-dimethylacetamide
Preservative	3-Iodo-2-propinylbutylcarbamate (55406-53-6)
	Aromatic compounds of coal tar (various)
	Dinoseb (88-85-7)
	Diocetyl tin compounds (various)
	Organic tin compounds (various)
	Triclosan (3380-34-5)
PFCs	Perfluorooctanoic acid (335-67-1)
	Perfluorooctanoic acid, ammonium salt (3825-26-1)
Heavy metals and their compounds	Arsenic (various)
	Boron (various)
	Cobalt (various)
	Copper (various)
Chrome	Chromium VI, chromates, dichromates (various)
Plastics, additives and polymer raw materials	Dimethylformamide (68-12-2)
	Phenol (108-95-2)
	Polycondensates of formaldehydes and aniline (24214-70-4)
	UV-327 (2,4-di-tert-butyl-6-(5-chloro-benzotriazol-2-yl)phenol) (3864-99-1)
	(UV-350 (2-(2H-benzotriazol-2-yl)-4-(tert-butyl)-6-(sec-butyl)phenol) (36437-37-3)
	UV-320 (2-Benzotriazol-2-yl-4,6-di-tert-butylphenol) (3846-71-7)
Plastics, additives and polymer raw materials	UV-328 (2-(2H-Benzotriazol-2-yl)-4,6-di-tert-pentylphenol) (25973-55-1)
	Vinyl chloride (75-01-4)
Surfactants	Alkylphenol ethoxylates (various)
	Alkylphenols (various)
	Nonylphenols (various)
	Nonylphenol ethoxylates (various)

The focus of REACH is on risk management. Manufacturers and importers of quantitatively relevant substances may only place them on the market if they have previously determined the physicochemical, toxicological and ecotoxicological properties as well as information on safe use and registered them with the European Chemicals Agency (ECHA). Certain substances are subject to manufacturing bans or use restrictions in mixtures or articles (Art. 67 ff. in conjunction with Annex XVII). The following table shows a

selection of substances whose use in leather is restricted under Annex XVII REACH and which, at the same time, according to the assessment of a tannery from Germany, are "likely to occur in leather".¹⁴

Member State authorities are currently preparing further leather-related restrictions. The focus is on a variety of skin-sensitising substances.¹⁵ There is also the intention to (further) restrict bisphenols, which are very common in leather chemicals.¹⁶ Since April 2022, a longer-term overview of possible future restrictions has been available in the form of a "roadmap".¹⁷

In addition, Article 33 of REACH standardises the obligation to notify the presence of "substances of very high concern" (SVHC) to purchasers in the supply chain (paragraph 1) and to consumers upon request (paragraph 2). From January 2021, distributors of articles will have to report the information on SVHCs according to Article 33 (1) REACH to an official database (SCIP) so that the information can be used by recyclers.¹⁸

In July 2022, the semi-annually extended list of substances of very high concern contains 224 entries.¹⁹ At the same time, the SCIP database contains 114,555 entries on articles with at least one material component "leather" containing one or more substances of very high concern above the tonnage threshold. The substances identified include lead and its compounds, siloxanes, phenols, phthalates; but there are also 2,000 entries on glutaraldehyde (glutaral) in leather.²⁰

In addition, the use of substances of very high concern may be made subject to authorisation (Art. 55 ff. in conjunction with Annex XIV). REACH is flanked by further chemicals legislation, including a regulation on the (harmonised) classification, labelling and packaging of substances and mixtures (CLP)²¹ and a special regulation on the control of persistent organic pollutants.²²

2.1.2 Possible legal developments around the Green Deal

In December 2019, the European Commission published the "European Green Deal".²³ This "Communication" from the authority outlines goals and envisaged - primarily regulatory - measures to shape the EU's

¹⁴ See Lederfabrik Josef Heinen GmbH & Co KG 2018 [Liste der eingeschränkt verwendbaren Substanzen in unse-rem Leder](#), Vers. 4.0, valid as of May 2018.

¹⁵ See the [proposal](#) submitted by France and Sweden (15.07.2022).

¹⁶ See the original [German proposal and ECHA's Communication](#) on Further Regulatory Needs (15.07.2022).

¹⁷ [SWD\(2022\) 128](#).

¹⁸ This provision is found in Art. 9(1)(i) of the Waste Framework Directive 2008/98/EC of 19 November 2008 on waste and repealing certain Directives, as amended by Directive (EU) 2018/851 of 30 May 2018, <http://data.europa.eu/eli/dir/2008/98/oj>.

¹⁹ See <https://echa.europa.eu/de/candidate-list-table> (17.7.2022).

²⁰ See <https://echa.europa.eu/de/scip-database> (17.07.2022).

²¹ Regulation (EC) No 1272/2008 of 16 December 2008 on classification, labelling and packaging of substances and mixtures, <http://data.europa.eu/eli/reg/2008/1272/oj>.

²² Regulation (EU) 2019/1021 of 20 June 2019 on persistent organic pollutants, <http://data.europa.eu/eli/reg/2019/1021/oj>.

²³ [COM\(2019\) 640](#).

transformation towards an environmentally friendly, resource-saving and climate-neutral "Circular Economy". The Green Deal triggers regulatory innovations in a number of legal areas,²⁴ which also have a significant impact on the leather industry. In the following, some areas that are particularly relevant to the topic of leather chemistry are discussed. It should be emphasized, however, that the legal innovations mentioned are still under discussion and must first undergo the usual legislative procedures in the interaction between the European Parliament, the Council of the EU and the European Commission.

The Chemicals Strategy for Sustainability of October 2020 formulates a longer-term vision for EU chemicals policy based on a new "hierarchy of pollution-free" for chemicals management, following the pyramid of waste management. It prioritises the promotion of safe and sustainable chemicals over exposure reduction and risk control, and the last resort of disposal (e.g. of contaminated waste) and remediation.²⁵ This change is seen as problematic by large parts of the industry. According to this, chemicals should have a function, i.e. trigger or influence a chemical reaction. This is almost always associated with a more or less serious "hazardousness" in the chemical law sense. It is therefore necessary to be aware of the danger of chemical reactions, to weigh up whether they are needed and in this case to minimize the risk. On the other hand, the industry generally rejects bans that are linked to dangerousness..²⁶

Against this background, the Commission, embedded in a multi-stakeholder dialogue, is developing EU criteria for "inherently safe and sustainable chemicals" and is considering the introduction of an "ecological footprint of chemicals".²⁷

In addition, the strategy announces a number of adaptations to REACH and CLP. One example is the intention to make the "generic risk approach" the standard for the regulation of consumer products, according to which the use of certain problematic chemicals in widely used products is prohibited "in general", i.e. irrespective of a specific consideration of the concrete risk (as a function of hazard and exposure). In this context, the strategy aims to introduce a concept of "essential use", allowing the use of certain problematic chemicals only when necessary for health, safety or the functioning of society.²⁸ In addition, the strategy focuses on problematic properties of chemicals with different measures that have not been addressed or not sufficiently addressed in the regulatory framework so far, including endocrine disruptors, PBTs/vPvBs, immunotoxicity and neurotoxicity, persistent, mobile and toxic substances, and very persistent and very mobile substances.

On 30 March 2022, the Commission concretises its vision of a "circular economy" in the area of product policy with a package of proposals "to make sustainable products the norm". At the centre is the proposal for a regulation establishing a framework for ecodesign requirements for "sustainable products"

²⁴ See also the timetable in COM(2019) 640 ANNEX.

²⁵ See Führ and Schenten 2021, footnote. 13, 18 ff.

²⁶ Siehe z. B. VDL 2022, [Aktuelle chemikalienrechtliche Aktivitäten der EU-Behörden und die damit verbundenen Konsequenzen für die Lederindustrie](#) [07.10.2022].

²⁷ [COM\(2020\) 667](#), 25 (German version); see also Caldeira et al. 2022, Safe and Sustainable by Design chemicals and materials - Review of safety and sustainability dimensions, aspects, methods, indicators, and tools, Publications Office of the European Union, Luxembourg, doi:10.2760/879069.

²⁸ [COM\(2020\) 667](#), 12 f.

(Ecodesign for Sustainable Products Regulation - ESPR).²⁹ The Ecodesign Regulation is intended to remove the restriction of the current regime (Directive 2009/125) to "energy-related products" and thus create the possibility, with a few exceptions (e.g. food and feed, medical devices), to set eco-design-related requirements in principle for all physical product groups in specific legal acts (implementing regulations) - and thus also for leather products.

For example, the "EU Strategy for Sustainable and Recyclable Textiles", also published on 30 March, which addresses a broad "textile ecosystem" including the clothing, leather and footwear industries,³⁰ foresees the adoption of a legal act with binding eco-design requirements. These are to target, among other things, longer durability, preferred material compositions and the presence of problematic chemicals.³¹ A "digital product passport", as required by the ESPR draft for announced product-related eco-design regulations,³² is intended to provide actors in the value chains and consumers with relevant information on substances of concern, repair or material composition for the first time, so that they can make better decisions.³³

In addition, a legislative proposal from February 2022 aims to improve the due diligence obligations of brand manufacturers ("brands") and retailers with regard to the environmental and social impacts of activities along supply chains.³⁴ Compared to the German law on due diligence in the supply chain, the draft is likely to put more companies under obligation. This is especially true for companies in a "high-risk sector",³⁵ which is supposed to include, for example, the production/wholesale of textiles, leather and footwear.

The above-mentioned measures within the framework of the Green Deal require far-reaching changes in many sectors and companies, up to and including the restructuring of entire industries. The taxonomy directive³⁶ is intended to strengthen the financial possibilities for this change process by setting incentives for investments in more sustainable products and processes and defining clear criteria for this.³⁷

²⁹ [COM\(2022\) 142](#).

³⁰ [COM\(2022\) 141](#), 8.

³¹ [COM\(2022\) 141](#), 3.

³² Art. 7 (1) of the draft provides that the implementing regulations must contain information requirements. Paragraph 2 goes on to say: "The information requirements shall (...) include at least requirements relating to the product passport in accordance with Chapter III and requirements relating to substances of concern in accordance with paragraph 5".

³³ [COM\(2022\) 141](#), 5.

³⁴ [COM\(2022\) 71](#).

³⁵ See Art. 2 para. 1 lit.b) of the draft: Companies based in the EU with an average of more than 250 employees and a worldwide net turnover of more than EUR 40 million would be affected, provided they achieve at least 50% of this net turnover in a high-risk sector.

³⁶ Regulation (EU) 2020/852 of 18 June 2020 establishing a framework to facilitate sustainable investment, <http://data.europa.eu/eli/reg/2020/852/oj>.

³⁷ The Sustainable Finance Platform supports the European Commission in shaping this sustainable finance policy. The [proposals](#) presented in March 2022 also refer to leather products. However, the draft criteria for leather apparently do not yet take into account the future eco-design requirements and are therefore likely to be incomplete.

Furthermore, the Green Deal recognises the leverage effect of public procurement for more sustainable products and processes.³⁸ This is significant in that it paves the way for niche solutions with initially low demand to enter the mainstream. Furthermore, procurement criteria, especially of the public sector, can lower the weighting of price over qualitative features.

2.1.3 Kritische Würdigung aus Sicht der Industrie

Any criticism of these initiatives by the industry³⁹ does not refer to the good intentions but to the high bureaucratic effort and dirigisme to be expected in their perception, which also harbors risks. In addition, the legislator must keep other aspects in mind. In particular, on the one hand, it is a question of the enforcement possibilities of the planned - but also of already existing - legal requirements. Due to the notorious "enforcement deficit", especially with regard to imported goods from third countries, companies manufacturing in the EU in compliance with the requirements would be at a competitive disadvantage. On the other hand, the question arises as to what extent consumers can support the transformation driven by product policy. At present, consumer behavior does not show any great interest in particularly "sustainable" products. The reasons for this are many and varied, but certainly include the issues of recognizability of "sustainable" products and the willingness to pay a correspondingly higher price for better quality. In this respect, the industry welcomes the efforts of the European Commission within the framework of the Green Deal to strengthen transparency for consumers⁴⁰. However, if this is insufficient, further measures must be taken.

2.1.4 Conclusions

Two main conclusions can be drawn with regard to the normative requirements: On the one hand, due to holistic strategies such as the Green Deal ("sustainable products" including eco-design, chemicals, etc.) and also the 2030 Agenda (see sec. 1.1), there is an increasing integration of regulatory aspects and policy fields that were previously considered separately. On the other hand, there is a constant - and not unchallenged - momentum in updating requirements to meet the demands of sustainable development.

³⁸ [COM\(2019\) 640](#), 10.

³⁹ Siehe z. B. Fußnote 26.

⁴⁰ Siehe etwa die "[Initiative on substantiating green claims](#)" (08.10.2022).

2.2 Conceptual approaches with reference to sustainable chemistry

Green Chemistry	x		x	x	x	x	x	x			x
Green Engineering	x	x	x	x	x	x	x	x			x
Cefic "Responsible Care"	x	x		x	x	x	x	x	x		x
UBA "Sustainable Chemistry"	x	x	x	x	x	x	x	x	x	x	x

Table 4 summarises Overlaps and differences of selected concepts on "sustainable chemistry".

The guiding principle of "Green Chemistry" or Greener Chemistry (GC) is an early concept that became known in the scientific community mainly through the work of Anastas and Warner (1998) and aims to avoid rather than manage risks associated with chemical substances.⁴²

Green Chemistry (GC)
Definition ⁴³
"Green chemistry is the application of a set of principles that reduce or eliminate the use or generation of hazardous substances in the development, manufacture and use of chemical products. "
Criteria ⁴⁴
<ol style="list-style-type: none"> 1. Waste prevention 2. Atomic efficiency 3. Safer chemical conversions 4. Development of safer substances 5. Safer solvents and excipients 6. Energy efficiency 7. Renewable resources 8. Reduce derivatives 9. Catalysts 10. Naturally degradable 11. Real-time monitoring of waste prevention 12. Basic risk avoidance

Since these 12 principles of GC are strongly tailored to laboratory development, but the challenges that actually arise are in the technical field, Anastas and Zimmermann (2003)⁴⁵ have additionally formulated the guiding principle of "Green Engineering" (GE) with 12 principles for the design of products, processes and systems, which have gained validity far beyond chemical developments.

Green technology (GE)

⁴¹ See the comprehensive report on this in Caldeira et al. 2022, footnote. 27.

⁴² Anastas and Warner 1998, Green Chemistry: Theory and Practice, Oxford University Press: New York, 16.

⁴³ Anastas and Warner 1998, 11.

⁴⁴ Anastas and Warner 1998, 30

⁴⁵ Anastas and Zimmerman, Design Through the 12 Principles of Green Engineering, Environ. Sci. Technol., 2003, 37, 94A.

Definition
Green engineering "focuses on how sustainability can be achieved through science and technology" ... " in the development of new materials, products, processes and systems that are harmless to human health and the environment". ⁴⁶
Criteria
<ol style="list-style-type: none"> 1. All material and energy inputs and outputs must be as low-risk as possible. 2. Avoid waste before it happens. 3. Separation and cleaning processes should be designed to minimise energy and material consumption. 4. Products, processes and systems should be designed to save as much mass, energy, space and time as possible. 5. Products, processes and systems should be "output pulled" rather than "input pushed" through the use of energy and materials. 6. Embedded entropy and complexity must be considered as an investment when making decisions about recycling, reuse or beneficial recovery. 7. The desired longevity, not immortality, should be a design goal. 8. The development of unnecessary capacities or capabilities (e.g. "one size fits all") should be considered a design flaw. 9. Material diversity in multi-component products should be minimised to promote disassembly and value retention. 10. The design of products, processes and systems must include integration and networking with the available energy and material flows. 11. Products, processes and systems should be designed to function in a commercial "afterlife". 12. Material and energy use should be renewable and not depleting.

The principles of Green Chemistry and Green Engineering, which aim to avoid negative impacts on people and the environment and to contribute to sustainable development, are widely recognised in both academia and the chemical industry.⁴⁷

GC and GE are also inherent components of the later formulated approaches to "Sustainable Chemistry", to this extent as these relate to the impacts of chemistry and chemical processes on humans and the environment. However, sustainability-related approaches also include other normative, economic and social aspects.

⁴⁶ Anastas and Zimmerman, Design Through the 12 Principles of Green Engineering, Environ. Sci. Technol., 2003, 37, 94A.

⁴⁷ Yue 2022, Green process intensification using microreactor technology for the synthesis of biobased chemicals and fuels, Chemical Engineering & Processing: Process Intensification 177 (2022) 109002.

The Federal Environment Agency (UBA) has been working on sustainable chemistry for almost two decades. UBA presented a first conceptual approach as early as 2004 in cooperation with the OECD and others.⁴⁸ Subsequently, UBA has continued to shape the discourse through scientific publications⁴⁹ and application-oriented guidelines⁵⁰, most of which were produced in cooperation with think tanks such as the Öko-Institut. These publications update the guiding principle in line with social and legal developments and thus illustrate the "learning process" that sustainable development requires. A study from 2020 concretises Sustainable Chemistry as follows:

Federal Environment Agency (UBA) ⁵¹	
Definition	Nachhaltige Chemie trägt zu einer positiven, langfristig nachhaltigen Entwicklung bei. Mit neuen Ansätzen, Technologien und Strukturen stimuliert sie technische und soziale Innovationen und entwickelt wertschöpfende Produkte und Dienstleistungen
Criteria	<ul style="list-style-type: none"> - Inherently safer chemicals (design and use) - Substitution - Reducing emissions and impacts to avoid negative effects on health and the environment throughout the life cycle of a substance. - Resource conservation, i.e. conserving natural resources by using energy and raw materials as efficiently as possible. - Circular economy, i.e. promoting the reuse and recycling of materials by avoiding the introduction of substances of concern into material flows. - Increasing market opportunities for alternative innovative solutions - Fair working conditions in the supply chains - Transparency and accessibility of data for comprehensive assessment of product sustainability - Ambitious and enabling legislation - Education and training - Consumer awareness - Internalisation of costs (according to the polluter pays principle)

The industry has also presented comparable and thus ambitious concepts, such as the "Responsible Care management framework for Europe" initiated in 2017 by the European umbrella organisation of the chemical industry Cefic.

⁴⁸ OECD, 2004. International Workshop on Sustainable Chemistry - Integrated Management of Chemicals, Products and Processes, Joint Workshop of UBA, OECD, BAUA and BMU, <https://doi.org/10.1039/B404170B>.

⁴⁹ E.g. Blum et al. 2017, The concept of sustainable chemistry: Key drivers for the transition towards sustainable development, *Sustainable Chemistry and Pharmacy* 5 (2017) 94-104.

⁵⁰ Reihlen et al. 2016, [Leitfaden Nachhaltige Chemikalien](#), in: Umweltbundesamt (ed.), 15.

⁵¹ Bunke et al. 2020, [Driving REACH forward - REACH and sustainable chemistry](#), in Umweltbundesamt (ed.), UBA-Texte 147/2020, 27; 30 ff.

Cefic

Definition

"Responsible Care is the global chemical industry's voluntary initiative, which – beyond legislative and regulatory compliance – commits companies, National chemical industry Associations and their partners to:

- Continuously improve the environmental, health, safety and security knowledge and performance of their technologies, processes and products over their life cycles to avoid harm to people and the environment;
- Use resources efficiently and minimise waste;
- Report openly on performance, achievements and shortcomings;
- Promote and share good practices;
- Listen, engage and work with people to understand and address their concerns and expectations;
- Cooperate with governments and organisations in the development and implementation of effective regulations and standards, and to meet or go beyond them;
- Provide help and advice to foster the responsible management of chemicals by all those who manage and use them along the product chain."⁵²

Criteria for responsible care⁵³

- Promoting innovation and stimulation of breakthrough technologies development in energy efficient chemical processes
- Offering market solutions consistent with low carbon requirements
- fostering the development and use of sustainable and renewable raw materials
- forstering the use of sustainable and renewable energy and raw materials with focus on cost and accesibility
- Innovation for chemical energy storage
- developing fuels and building blocks built on CO₂
- designing sustainable solutions needing fewer resources over the entire life cycle and allowing easy reuse and recycling
- maximising material recovery and reuse
- Promoting adoption of Circular Economy principles to prevent waste and to achieve a low carbon economy and enhance resource efficiency
- Preventing harm to humans and the environment throughout the entire life cycle
- mitigate risks, including assessment of substitutes
- promoting uptake of safe substances, materials and solutions
- minimising negative environmental impacts on biodiversity and ecosystems
- facilitating reuse, recycling and recovery with steady information flows on products

⁵² Cefic 2022, [Responsible Care management framework](#), 5.

⁵³ Cefic "[Sustainability Charter](#)".

Publications by organisations with leather expertise also occasionally provide references that formulate a generalisable view of "sustainable chemistry". For example, a paper from UNIDO on the "sustainable production of leather" provides the following criteria.

UNIDO ⁵⁴	
Criteria	
-	Lower water consumption
-	Improved absorption of chemicals
-	Avoidance of hazardous and/or prohibited substances
-	Better quality/reusability of solid waste and lower content of certain pollutants such as heavy metals and electrolytes contained in it.

Table 4 summarises the conceptual approaches presented in an overview table and shows whether they cover selected aspects that are particularly relevant against the background of the project.

	Life-cycle approach	Circular Economy	Hazard-based approach	Energy Efficiency	Environmental impact	Greenhouse Gas Mitigation	Renewable Resources	Sustainable management	Social Aspects	Transparency along Supply Chains	Waste prevention
Green Chemistry	x		x	x	x	x	x	x			x
Green Engineering	x	x	x	x	x	x	x	x			x
Cefic "Responsible Care"	x	x		x	x	x	x	x	x		x
UBA "Sustainable Chemistry"	x	x	x	x	x	x	x	x	x	x	x

Table 4: Overlaps and differences between selected concepts of sustainable chemistry

⁵⁴ Bulvan and Král 2019, [The framework for sustainable leather production](#) (2nd ed.), ed. by UNIDO.

2.3 Context of the project

The normative specifications and the mission statement of a More Sustainable Chemistry form the starting points - or the "problem impulse" - for the Darmstadt Leather Project. With regard to the mission statement to be developed, the following milestones in the course of the project so far are relevant:

- (1) October 2018: A kick-off workshop shows the need to develop a systemic understanding of the challenges of a More Sustainable Leather Chemistry.
- (2) March - July 2019: In a three-stage [scenario process](#), the stakeholders develop a common understanding of the problem (in the system context) in the status quo and, based on this, a common target scenario for leather chemistry in 2035.

In summary, the scenario describes the target state in 2035, according to which process innovations have led to high-quality leather being produced everywhere in a resource-conserving manner. The customer markets for leather produced in this way are stable. The risks of chemicals in the processes and products are largely eliminated or under control. As a result, third-party sites, for example in the Asian region, also consciously and safely use high-quality and, above all, less problematic chemicals. In the case of leather, two trends will have prevailed by 2035: on the one hand, "more natural" leather with less use of chemicals in finishing and, on the other hand, leather as an innovative, highly functional material, i.e. based on chemical functionalisation. The scenario does not further define sustainable leather chemistry in qualitative terms, but in terms of the management processes required for this (cooperation in the supply chain, systems for traceability and thus control of chemicals).

- (3) September 2019: In a strategy workshop, the stakeholders develop from the perspective of the scenario story. Implementation strategies in the form of four roadmaps. The roadmaps answer the four central research questions raised by the scenario.⁵⁵

How can transparency and traceability be implemented under competitive conditions?

How can standards (working conditions, information and communication, chemistry, etc.) be harmonised, controlled, sanctioned and implemented?

How can sustainable production methods be implemented economically?

How can knowledge and awareness of the value of sustainably produced leather be created among consumers?

- (4) Turn of the year 2019/2020: The university team develops ideas for concrete implementation projects from the approaches in the roadmaps. A "[Theory of Change](#)" (ToC) illustrates these project ideas in a change process from the present to Vision 2035.
- (5) Spring 2020: Based on the guideline, the practitioners selected those project ideas that they expected to have the greatest impact in terms of the vision.
- (6) Autumn 2020: Four [sub-projects](#) on the ideas with the greatest expected impact start work: [IT tools and governance for chemical traceability](#), [chemical and process innovation](#) focusing on chemical and process assessment, [leather design guidelines for sustainable development](#) and [harmonisation of standards for a "sustainable leather industry"](#). Any interested organisation that shares the goals of the vision can participate in the sub-projects.

⁵⁵ A second strategy workshop in November 2019 served to review the results.