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About the OECD

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The Environment, Health and Safety Division publishes free-of-charge documents in twelve different series: **Testing and Assessment**; **Good Laboratory Practice and Compliance Monitoring**; **Pesticides**; **Biocides**; **Risk Management**; **Harmonisation of Regulatory Oversight in Biotechnology**; **Safety of Novel Foods and Feeds; Chemical Accidents; Pollutant Release and Transfer Registers; Emission Scenario Documents; Safety of Manufactured Nanomaterials;** and **Adverse Outcome Pathways.** More information about the Environment, Health and Safety Programme and EHS publications is available on the OECD's World Wide Web site (https://www.oecd.org/en/topics/chemical-safety-and-biosafety.html).

This publication was developed in the IOMC context. The contents do not necessarily reflect the views or stated policies of individual IOMC Participating Organizations.

The Inter-Organisation Programme for the Sound Management of Chemicals (IOMC) was established in 1995 following recommendations made by the 1992 UN Conference on Environment and Development to strengthen co-operation and increase international co-ordination in the field of chemical safety. The Participating Organisations are FAO, ILO, UNDP, UNEP, UNIDO, UNITAR, WHO, World Bank, Basel, Rotterdam and Stockholm Conventions and OECD. The purpose of the IOMC is to promote co-ordination of the policies and activities pursued by the Participating Organisations, jointly or separately, to achieve the sound management of chemicals in relation to human health and the environment.

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Executive summary

1. The workshop discussions led to key recommendations for the OECD's follow-up actions, focusing on integrating sustainability considerations into chemical selection and substitution decision-making. Historically, discussions have centred on selecting safer chemicals and substituting hazardous ones, but there is now a growing focus on considering sustainability in these decisions. Participants emphasized the need for proactive risk management that prioritizes both safety and sustainability.

2. Several companies shared their practical experiences over the two-day event, providing insights into how businesses are balancing these priorities. These real-life examples highlighted the frameworks companies are using to make informed decisions about chemical selection. However, it was also clear that regulators and policy makers play a critical role in incentivizing sustainable solutions.

3. The workshop also identified several challenges. First, participants acknowledged the complexity of applying a systems approach to decision-making, given the multiple factors that influence such decisions, such as application, value chain position, and material impacts. There is also a lack of common language and measurement, as different sectors use varying definitions and metrics for sustainability attributes, making alignment difficult. Data availability for the metrics remains another issue, although participants stressed that data limitations should not deter progress, as availability is expected to improve over time.

4. Despite these challenges, the discussions provided valuable insights and opportunities for collaboration. Participants found value in learning from one another's approaches and identifying potential areas for alignment, such as the harmonisation of attributes like carbon footprint, as an example, across sectors.

5. Moving forward, participants encouraged the OECD to foster a common framework for defining and measuring sustainability attributes, support further sharing of best practices, and explore policy mechanisms that incentivise sustainable innovation. Regulators and policy makers should also consider how to combine sustainability factors with chemical safety assessment and consider lifecycle impacts when making risk management decisions. Additionally, there is a need for simplified tools and guidelines to support companies, especially SMEs, in conducting internal sustainability assessments.

6. Ultimately, the concepts raised at the workshop aim to further the integration of sustainability and safety in chemicals management, supporting both industries and regulators in making more informed and proactive decisions.

1 Introduction

Background

7. The OECD published guidance on "Key Considerations for the Identification and Selection of Safer Chemical Alternatives"[1] in 2021. The document focuses on comparative hazard and exposure considerations for the selection of chemicals including in the context of substitution. It was recognised at the time that safety is one aspect in a suite of information that drives decision making. Other aspects include performance, cost, availability and other sustainability considerations beyond hazard, exposure and risk.

8. In September 2022 a workshop on substitution was organised on incentivising substitution. It took stock of experience and lessons learnt from a range of approaches to incentivise substitution of chemicals of concern in products, articles and processes. Presentations and discussions covered both regulatory and non-regulatory measures and feedback from a variety of stakeholders on their implementation[2] [3] [4].

9. One of the points raised at the workshop highlighted the importance of sustainability considerations in the process of substitution, including the integration of both safety and sustainability considerations into the design phase. The participants at the workshop discussed the possibility to expand the OECD guidance on "Key Considerations for the Identification and Selection of Safer Chemical Alternatives" with additional sustainability considerations.

10. As a first step toward the inclusion of sustainability criteria in guidance, a project was initiated to develop a "Landscape Study on Additional Attributes Beyond Safer for Chemical Selection and Substitution". The study examined what attributes companies are using to support decision-making in order to capture what is currently actionable in practice[5]. The report highlights the complexity when considering chemicals and materials and also actors at different parts of the value chain. Because of the variety of contexts there is little apparent convergence on metrics or priority placed on different attributes. In addition, often the sustainability considerations are examined for corporate sustainability reporting rather than for chemical selection decision-making in its own right.

[1] OECD (2021), Guidance on Key Considerations for the Identification and Selection of Safer Chemical Alternatives, OECD Series on Risk Management of Chemicals, OECD Publishing, Paris, https://doi.org/10.1787/a1309425-en

[2] OECD (2023), Lessons Learned from Third-Party Approaches that Support Substitution of Chemicals of Concern, OECD Publishing, Paris, https://doi.org/10.1787/6a94280f-en.

[3] OECD (2023), *Lessons Learned from Third-Party Approaches that Support Substitution of Chemicals of Concern*, OECD Publishing, Paris, https://doi.org/10.1787/6a94280f-en.

[4] OECD (2023), Economic instruments to incentivise substitution of chemicals of concern – a review, OECD Publishing, Paris, https://doi.org/10.1787/d73c0786-en.

[5] OECD (2024), A Landscape of Sustainability Attributes Considered by Companies During Chemical and Material Selection, OECD Series on Risk Management of Chemicals, OECD Publishing, Paris, https://doi.org/10.1787/9475d147-en.

11. In the report, companies that identified themselves to be at the front end of the supply chain - chemical/raw material suppliers (N=21) – the percentage that responded that they 'always' considered the following sustainability attributes were as follows:

Greenhouse gas emissions	38%
Other air emissions (e.g., PM2.5, VOCs)	43%
Biodiversity impacts (including land use)	33%
Energy consumption	33%
Resource use (e.g., water, mineral, metal)	48%
Generation of waste (e.g., hazardous waste, water pollution, solid waste)	57%
Circularity (e.g., renewable feedstock, durability	29%
Social impacts (e.g., worker rights and conditions)	57%

12. Most often it was indicated that a lifecycle assessment (LCA) was used to assess the environmental sustainability metrics above, but the complexity and inconsistency of LCA approaches was also raised as a limiting factor in their use.

13. Consideration of sustainability for chemicals is not a new concept. Sustainable chemistry has been an established field for more than 25 years and has been championing these same concepts. The OECD, in 1998, articulated its concept for sustainable chemistry[6] ; in 2021 the UN released its Green and Sustainable Chemistry Framework Manual[7]; in 2023 an expert committee on sustainable chemistry was convened and released A Definition and Criteria for Sustainable Chemistry[8].

14. It is recognised that there has been considerable work conducted in recent years in the context of the European Commission's 'Safe and Sustainable by Design'[9] initiative. Also, initiatives in the nanomaterial area, such as OECD's Safe(r) and Sustainable Innovation Approach (SSIA)[10] and in plastics design – OECD"s guidance "A Chemicals Perspective on Designing with Sustainable Plastics: Goals, Considerations and Trade-offs"[11]. These are just to name a few in an area that is consistently expanding. The aim of this work is to also harness thinking that has taken place in these contexts but to begin to identify a smaller core of actionable and impactful sustainable attributes for further international alignment.

15. While guidance on chemical selection and substitution is directed at industry actors, government chemical assessment programmes are more and more often needing to

[6] Sustainable chemistry is the design, manufacture and use of efficient, effective, safe and more environmentally benign chemical products and processes. Within the broad framework of sustainable development, government, academia and industry should strive to maximise resource efficiency through activities such as energy and non-renewable resource conservation, risk minimisation, pollution prevention, minimisation of waste at all stages of a product life-cycle, and the development of products that are durable and can be re-used and recycled. ENV/JM/MONO(2002)12

[7] https://www.unep.org/resources/toolkits-manuals-and-guides/green-and-sustainable-chemistry-framework-manual

[8] https://static1.squarespace.com/static/633b3dd6649ed62926ed7271/t/63ed54f40173a27145be7f74/1676498167281/Defining-Sustainable-Chemistry-Report-Feb-2023.pdf

[9] https://research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/chemicals-and-advanced-materials/safe-and-sustainable-design_en

[10] https://www.oecd.org/en/topics/nanomaterials-and-advanced-materials.html

[11] https://www.oecd.org/en/publications/a-chemicals-perspective-on-designing-with-sustainable-plastics_f2ba8ff3-en.html

consider aspects of life-cycle assessment in certain chemical assessment and management contexts. Insights on where metrics are aligning can also help those programmes develop their methodology when the standard framing of chemical risk assessment and management evolves in different problem formulation scenarios.

Objective

16. During the workshop held by the Working Party on Risk Management various environmental sustainability attributes were considered beyond the question of safety (hazard/exposure) that could inform chemical selection decision-making. The objective was to identify convergent approaches towards a small core set of actionable and impactful sustainability attributes, and their associated metrics, to consider for international alignment in the context of chemical selection (including substitution). The objective of this report is to process the input from the workshop and make a synthesis focusing on possible convergence towards a subset of sustainability attributes that could potentially be harmonised in the context of chemical selection.

17. The program of the two-day workshop can be found in Annex A.

Methodology

18. The synthesis relies only on the primary data collection derived during the workshop. Eighty-five delegates from 21 delegations participated in the workshop along with key stakeholders from the industry.

2 Sustainability Frameworks related to chemicals

19. This section of the report provides a comparative analysis of five key sustainability frameworks related to chemicals that were presented during the workshop, focusing on sustainability goals, attributes, and metrics. The frameworks presented during the workshop include:

1. the EU Commission's Safe and Sustainable by Design (SSbD) Framework;
2. the European Chemical Industry Council (CEFIC) Safe and Sustainable by Design Guidance;
3. the European Non-ferrous Metals Association (Eurometaux) Industry Risk Management Options analysis (I-RMOa);
4. the World Business Council for Sustainable Development (WBCSD) Chemical Industry Portfolio Sustainability Assessment (PSA);
5. and the ChemSelect & Guide on Sustainable Chemicals.

20. The intent of this summary is not to present a fulsome analysis of each framework, but to provide information that could help to identify convergence in attributes and metrics regarding sustainability in the context of chemical selection. The reader is encouraged to follow the links for further information on the frameworks.

Comparison of goals, attributes and metrics

1. **EU Commission's** Safe and Sustainable by Design (SSbD) Framework **(2022) and** Methodological Guidance **(2024):**
    - Sustainability Goals: The EU SSbD Framework focuses on reducing harmful chemicals and shifting towards safer, sustainable alternatives. The overarching goal is to support the European Green Deal and a toxic-free environment by phasing out dangerous substances unless they are essential for society.
    - Sustainability Attributes: Key attributes include chemical safety, environmental sustainability (life cycle impacts like climate change and biodiversity), circularity, and social sustainability.
    - Sustainability Metrics: It emphasizes lifecycle assessments, material circularity (such as recyclability), and environmental indicators like global warming potential, resource use, and human health impacts
2. CEFIC's Safe and Sustainable by Design Guidance**:**
    - **Sustainability Goals**: CEFIC aims to support the chemical industry's transition by encouraging innovation in sustainable chemicals, while balancing safety, performance, and economic viability. It promotes chemicals that contribute positively to societal needs.

- **Sustainability Attributes**: Attributes include chemical hazard reduction, resource efficiency, circularity, energy efficiency, and minimal emissions.
- **Sustainability Metrics:** The framework proposes metrics tied to safety (e.g., minimizing toxicological impacts), circularity (material efficiency and recyclability), and energy use, aligning with green chemistry principles

3. Eurometaux Risk Management Options Analysis (I-RMOA):
    - **Sustainability Goals:** This framework is designed to manage the risks associated with metals in the EU while addressing sustainability challenges. Next to helping in identifying whether further regulation or action is needed for specific substances under REACH, its primary goals align with achieving a circular economy, mitigating climate change, and ensuring the secure supply of critical raw materials (4 Cs approach).
    - **Sustainability Attributes:** The framework evaluates impacts on circular economy performance, climate change mitigation, and the security of critical raw materials, emphasizing resource recovery and reducing environmental footprint.
    - **Sustainability Metrics:** Metrics include the recycling rates of metals, carbon footprint and energy intensity measurements, and the security of critical raw materials, assessing the resilience of supply chains and the reduction of material dependency.
4. WBCSD's Chemical Industry Portfolio Sustainability Assessment **(PSA):**
    - **Sustainability Goals**: The PSA framework evaluates the sustainability performance of chemical products and services in a company's portfolio, focusing on improving societal value.
    - **Sustainability Attributes**: It considers impacts on human health, environment, resource efficiency, and socio-economic benefits.
    - **Sustainability Metrics**: The methodology uses a tiered approach that includes qualitative and quantitative assessments of health and environmental impacts, resource efficiency, and contribution to sustainable development goals (SDGs)
5. ChemSelect & Guide on Sustainable Chemicals**:**
    - **Sustainability Goals**: This tool aims to guide formulators and end users toward choosing safer, more sustainable chemicals by providing clear criteria and decision-making support.
    - **Sustainability Attributes**: It emphasizes hazard reduction, chemical performance, and environmental sustainability.
    - **Sustainability Metrics**: It incorporates qualitative and quantitative evaluations of chemical hazards, recyclability, biodegradability, and energy use.

Points of overlap and key differences

The main four overlaps of the five sustainability frameworks are described below:

1. **Focus on Chemical Safety and Environmental Protection**:
    - All the frameworks emphasize reducing the harmful impact of chemicals on human health and the environment. They share a commitment to

minimizing the use of hazardous substances and promoting safer alternatives.

- Both the **EU Commission SSbD Framework** and **CEFIC Guidance** are aligned with the European Green Deal's goal of achieving a toxic-free environment, prioritizing chemical safety and innovation
- **Eurometaux RMOA** and the **WBCSD PSA** also prioritize the reduction of risks associated with hazardous chemicals, focusing on lifecycle impacts and minimizing toxicological effects

2. **Life Cycle Thinking (LCA)**:
   - Life cycle assessment is a recurring tool in these frameworks. Both the **EU SSbD** and **CEFIC Guidance** stress the importance of LCA for evaluating the environmental impact of chemicals across their lifespan
   - **WBCSD PSA** and **Eurometaux RMOA** similarly integrate LCA to assess resource use, environmental impacts the sustainability of material flows, and social contributions
3. **Circularity and Resource Efficiency**:
   - Promoting resource efficiency and circularity (e.g., reuse, recycling) is a shared focus. **CEFIC**, **EU SSbD**, **Eurometaux RMOA**, and **ChemSelect** all advocate for resource-efficient chemical production and materials
   - Circularity metrics, such as recyclability and biodegradability, are included in **CEFIC, Eurometaux RMOA** and **ChemSelect** frameworks
4. **Innovation and Transformation**:
   - **CEFIC** and **EU SSbD** both emphasize innovation as key to achieving safer and more sustainable chemical products. **CEFIC** highlights this as central to transforming the chemical industry, while **EU SSbD** aligns with broader policy goals like the European Green Deal
   - **Eurometaux's RMOA** complements these frameworks by focusing on the sustainable use of critical raw materials and climate action, key areas of transformation in the metals industry.

The four key differences of the five sustainability frameworks are described below:

1. **Regulatory Focus vs. Industry-led Initiatives**:
   - The **EU Commission's SSbD** and **Eurometaux RMOA** are more regulatory in nature. They focus on ensuring compliance with EU legislation and guide industries through risk management options
   - In contrast, **CEFIC** and **WBCSD** represent industry-led initiatives that encourage voluntary adoption of sustainable practices while balancing economic viability with sustainability goals
2. **Emphasis on Risk vs. Performance**:
   - **Eurometaux RMOA** is primarily concerned with risk management of harmful substances, particularly concerning the lifecycle and recycling of metals, aligning with regulatory requirements.
   - **WBCSD PSA** and **ChemSelect**, however, emphasize product sustainability performance, evaluating the overall contribution of chemical products to sustainability goals and helping users make informed choices
3. **Social and Economic Dimensions**:

- The **WBCSD PSA** uniquely incorporates social and economic sustainability assessments, ensuring that chemicals also contribute to broader societal goals such as equity and economic value. In contrast, frameworks like **Eurometaux** and **ChemSelect** focus more on the environmental and safety dimensions
- **EU SSbD** considers economic impacts but places greater emphasis on regulatory safety requirements and environmental sustainability

4. **Level of Detail in Metrics**:
    - **CEFIC** provides more detailed guidance on specific sustainability metrics, such as energy efficiency, material flows, and recyclability, offering more quantitative tools for evaluating chemicals
    - **Eurometaux**, with its focus on critical raw materials and climate action, offers specific metrics related to metal recycling rates, carbon footprint, and energy intensity
    - **ChemSelect** is more of a decision-support tool focused on formulator and end-user needs, providing criteria for choosing chemicals but not as robust a framework for lifecycle or systemic assessments

3 Examples from chemical producers and industry

21. A session at the workshop included examples of how chemical companies and industry are considering other attributes beyond safety in the context of chemical selection (new chemical innovation, chemical substitution etc.). They were asked to identify the top 2-4 attributes that they consider to be most easily measured consistently and that are the most impactful regarding sustainability outcomes. The following six organisations presented their approach:

1. Croda is a global company that creates and sells speciality ingredients for various industries and consumers.
2. Clariant is a global leader in specialty chemicals for various industries, such as mining, personal care, catalysis and plastics.
3. IFF is a world leader in food, beverage, scent, home and personal care, and health.
4. International Wrought Copper Council (IWCC) is the international association for the copper and copper alloy fabricating industry.
5. Advancion is a company that provides high-value consumables and ingredients for life sciences, personal care, and consumer markets.
6. BASF is a leading chemical company that offers solutions for various industries and applications.

Key sustainability attributes typically used by the industry

1. **Croda's Sustainability metrics**:
    - Biobased organic carbon content as a percentage of total organic carbon (ASTM D6866)
    - Product Carbon Footprint
    - Biodegradability
    - Cradle to grave LCA, predictive LCA for new technologies

2. **Clariant's Sustainability criteria**: (Clariant uses a Portfolio Value Program method, based on the WBCSD PSA framework)
    - Waste and pollution: waste generation throughout the lifecycle
    - Performance: material efficiency throughout the lifecycle; additional performance features
    - Social value creation: raw material sourcing impacts e.g. biodiversity, sustainable sourcing, traceability, scarcity, certifications, customer benefits, and value chain partnerships

- Safety: chemical hazards from raw materials and final product, hazardous waste from production, and uncontrolled emissions like solvents and VOC's during use
- Climate Action: GHG emissions throughout the lifecycle, and other emissions like dust, NOx and SO2 during the use phase
- Water: water footprint throughout the lifecycle
- Sustainable bioeconomy: use of renewable, non-food competing, sustainably certified raw materials, potential GMO involvement and biodegradability
- Circularity: use of recycled materials, reducing resource use, using circular packaging, enabling reuse or recycling

3. **IFF's Sustainability metrics/criteria**:
   - Climate: GHG emissions, energy use
   - Water use, land use
   - Material circularity, Renewability & biodegradability
   - Social impact: Health/Nutrition/Safety
   - Responsible sourcing
   - Biodiversity

4. **International Wrought Copper Council (IWCC) Sustainability metrics**
   - Circularity, enhancing recycled content
   - Climate and environmental impact
   - Diversion of primary and critical materials (metals) from other applications

5. **Advancion's Sustainability metrics**
   - Product Carbon Footprint: directional indicator between chemicals product families
   - Renewable Raw Material Content (natural origin index, ISO16128 for personal care products, ASTM D6866-22 for industrial products other than feed, food or fuel)
   - Performance: Chemical performance profile (market specific)
   - Corporate sustainability rating for suppliers

6. **BASF's Sustainability metrics**
   - Environmental protection: resource efficiency, climate change & energy, circularity, water protection, pollution reduction (air, soil, noise), biodiversity
   - Social engagement: health & safety, zero hunger & poverty,
   - Economic growth: cost savings downstream

Points of overlap and key differences in sustainability attributes

22. The main points of overlaps are described below:

1. **Climate and Environmental Impact**:
   - All the frameworks (Croda, Clariant, IFF, IWCC, Advancion, and BASF) emphasize reducing greenhouse gas (GHG) emissions, focusing on climate change mitigation across the lifecycle. Croda and Advancion use Product Carbon Footprints
   - Clariant and BASF also address GHG emissions, climate action, and circularity in reducing environmental impact. IFF focuses on energy use alongside GHG emissions, and IWCC targets circularity in recycling metals, which reduces environmental impact.
2. **Circularity and Resource Efficiency**:
   - Most frameworks focus on resource efficiency and circularity as critical sustainability metrics. Clariant emphasizes recycling, reduced resource use, and circular packaging, while IWCC prioritizes enhanced recycled content. Croda and IFF focus on biodegradability and the use of renewable materials, while BASF includes circularity in its environmental protection metrics.
3. **Water Usage**:
   - Water footprint is a shared concern across Clariant, IFF, and BASF's frameworks. Each addresses water usage and conservation throughout the product lifecycle, aiming to minimize water impact.
4. **Biodegradability and Renewable Resources**:
   - Croda, Clariant, IFF, and Advancion all highlight biodegradability and the use of renewable raw materials as essential criteria. For instance, Croda tracks biobased carbon content, and Clariant integrates renewable, non-food competing, and sustainably certified raw materials. Advancion uses standards like ISO 16128 for personal care products.

23. The key differences in sustainability attributes of the six organisations are described below:

5. **Industry-Specific Metrics**:
   - Each framework tailors certain metrics to their industry's specific needs. For example, Croda emphasizes chemical biodegradability and carbon footprint, which fits its product portfolio, while IWCC focuses on the circularity of metals and diversion of critical materials, which is unique to the metals industry. Advancion uses performance-based metrics tied to chemical profiles, which are more market-specific.
6. **Complexity in Lifecycle Assessment (LCA):**
   - Croda and Clariant incorporate cradle-to-grave LCA, with Croda also using predictive LCA for new technologies. Other frameworks like IWCC and Advancion, while considering lifecycle impacts, focus less on comprehensive LCA in comparison. BASF built a certified software system that calculates cradle-to-grate product carbon footprints.
7. **Corporate Sustainability and Supplier Assessments**:

- Advancion stands out by evaluating corporate sustainability ratings for suppliers as part of its overall assessment, which is less emphasized in the other frameworks that focus more on product-level attributes.

24. Veolia also provided input to the workshop as a chemical user, waste treatment operator and also a chemical producer/formulator focusing on depollution. It was highlighted that for a chemistry to be sustainable it also has to be **treatable** in terms of the substance or materials and that this consideration should be part of choosing the 'right' chemistry to authorise and use. This could be considered in the context of recycling/circularity but also water and other emissions to the environment.

4 Challenges regarding sustainability attributes

25. The workshop discussions revealed several critical challenges in integrating sustainability attributes across industries, focusing on both framework-level and practical implementation obstacles.

- **Accessibility for SMEs**: SMEs, central to many economies, face difficulties adopting complex sustainability frameworks. Simplified tools or digital checklists were recommended to make sustainability principles more accessible to these smaller organisations, which often lack specialized expertise or resources in sustainability and toxicology.
- **Standardization Issues**: Consistent methodologies and shared terminology across sustainability frameworks emerged as essential, as varied definitions and measures make cross-industry alignment challenging. Standardized indicators (e.g. for biodegradability) and methodologies (e.g. lifecycle assessments (LCAs)), were frequently cited as necessary for consistent and comparable sustainability metrics.
- **Measurement for different purposes**: Related to standardization, there is also a challenge with measurement for different purposes. This could be to prove the sustainability of the product/chemical, to disclose information in an official report (such as corporate sustainability reporting), to disclose information for the supply chain or customer, to collect data etc. Currently the purposes are being entangled with in sustainability attribute discussions.
- **Data Availability and Quality**: Reliable data sharing across value chains remains a hurdle, with issues surrounding data accuracy, transparency, and accessibility. This problem is amplified for SMEs, which may lack the resources to develop or access high-quality lifecycle data. However, many agreed that data availability would likely improve as methodologies evolve and the "fast-moving train" of data collection gains momentum.
- **Lifecycle Considerations and Resource Constraints**: Implementing LCAs is resource-intensive, with many organisations noting the difficulties of performing such assessments for each product due to the substantial workload and cost. There is also complexity in applying the same standards across different products and materials, as sustainability impacts are often context- and industry-specific, requiring tailored lifecycle assessments for fair comparisons.
- **Global Alignment and Coordination**: Participants underscored the need for global collaboration, particularly given the international nature of supply chains. The alignment of EU-centric regulations, like the EU's digital product passport, with global practices is essential for effective sustainability integration. Without this, companies risk creating isolated compliance efforts that may not align with global market requirements.

- **Balancing Transparency with Complexity**: The reluctance to publicly share complex lifecycle data, like Product Carbon Footprints, due to issues of interpretation and evolving data, points to a need for transparency balanced with practicality. A tiered and iterative approach was often recommended, allowing organisations to refine data accuracy and clarity over time without overwhelming resources.
- **Incentivizing Innovation**: An ongoing challenge is how to incentivize companies to adopt safe and sustainable design methods voluntarily. By having **dialogues with regulators** and ensuring that new methods are recognized, industries can better align their sustainability efforts with compliance expectations.
- **Industry-Specific Attributes and Impact**: Finally, the discussions highlighted that sustainability attributes are highly specific to industries, making a one-size-fits-all approach difficult. For example, recycled content is particularly relevant to metals industries, while biodegradability might be crucial in cosmetic products. Such specificity means that sustainability metrics must be adaptable to different contexts, uses, and regulatory environments.

26. These insights underscore the need for more adaptable, harmonized approaches and frameworks that recognize the unique sustainability challenges and metrics across industries while fostering global cooperation and data accessibility for more informed decision-making.

5 Convergence and follow up on attributes

27. During this workshop session, participants engaged in a structured discussion to gauge opinions on the convergence of impactful and measurable sustainability attributes, building on insights from earlier sessions. The session's aim was to assess if there was consensus on key attributes that might support the OECD in developing complementary guidance on selecting safer chemical alternatives. By polling the room on a series of questions related to environmental impacts, attribute standardization, and the role of benchmarks and cutoffs, the OECD gathered a "pulse" on participant views and priorities for sustainable chemical management.

Possible paths of convergence on sustainability attributes

28. In discussing these paths for convergence on sustainability attributes, workshop participants expressed strong consensus on some issues while views remained more divided on others. Most participants agreed that considering additional environmental sustainability impacts beyond just chemical safety is essential for meaningful chemical selection. Similarly, there was broad support for establishing a core minimum set of sustainability attributes, with most participants indicating it would offer useful guidance for consistent evaluation across applications.

29. The idea of promoting standardized metrics for sustainability attributes also gathered strong agreement among participants. When discussing the assessment of attributes, opinions were split, with about half of the participants indicating that a comparative benchmark would be important, while the other half were either undecided or felt benchmarks may not always be necessary.

30. Assessing sustainability attributes qualitatively saw mixed opinions as well, with around a quarter strongly supporting qualitative assessments, half taking a middle-ground stance, and the remainder showing limited enthusiasm. Finally, while specific cutoff criteria for certain attributes were considered important by some participants, the majority were neutral, with only a few expressing strong agreement or disagreement on this point. This reflects ongoing dialogue on how best to incorporate both quantitative and qualitative approaches for evaluating sustainability.

Reactions to the top three most impactful attributes

31. In the workshop, participants were invited to identify the top three sustainability attributes they believed should be prioritized in a core set for chemical selection. The attribute receiving the most support was carbon footprint, which a majority of the room considered critical for assessing sustainability impact. Raw material sourcing also received significant agreement, with about three-quarters of participants highlighting its importance. Water use saw interest from a moderate number of participants, notably more than energy use, which only a couple of people mentioned. Waste generation was also noted by around

one-fifth of attendees as a key attribute to monitor. Additionally, a few participants raised other considerations—such as downstream toxicity, economic impacts, and the treatability of chemicals—as crucial to sustainability evaluation.

32. In addition to selecting impactful attributes, participants suggested grouping certain attributes together under a broader environmental category, such as "nature," which would include aspects like land use, water use, and other environmental impacts. This holistic perspective would help streamline assessments, making it easier to identify overlaps and intersections in environmental considerations. Participants also recommended reframing some attributes in terms of their environmental impact rather than simple usage metrics. For example, instead of assessing water use alone, a more nuanced approach would consider the water impact, taking into account whether usage occurs in water-scarce regions, thereby adding context to each attribute's significance. Additionally, many agreed that which attributes are most impactful will often be conditional and context-dependent, meaning that the specific circumstances, such as geography or production methods, should guide decisions on prioritizing certain attributes. This flexible approach could ensure that sustainability assessments remain relevant across diverse settings and applications.

Reactions on measurement progress

33. During the workshop, participants were asked to identify three sustainability attributes where they felt substantial progress had already been made in measurement practices. Carbon footprint was noted by approximately a quarter of participants as an area where measurement approaches are relatively advanced. Around 70% of participants saw energy use as having considerable progress in measurement techniques, while water use was acknowledged by about half of the attendees as well-developed. Waste generation was recognized by roughly one-fifth of participants as having effective measurement methods. Land use, however, did not receive strong agreement, as no one cited it as an area with robust measurement progress, reflecting potential challenges in establishing standardized approaches for this attribute.

Reactions on feasibility to identify a core set of attributes

34. In response to the question on the feasibility of establishing a core set of impactful sustainability attributes for chemical selection, opinions among participants showed varied levels of optimism and concern. The majority viewed this goal as increasingly achievable, with many expressing a sense of progress and momentum following the workshop's discussions. A significant portion of participants, however, remained neutral, acknowledging both the potential and the challenges ahead without a definitive leaning toward feasibility. Meanwhile, a notable group felt that the complexities of the sustainability landscape had, if anything, become more apparent, suggesting that the task of harmonizing and simplifying core sustainability attributes might be more challenging than initially anticipated. These varied perspectives highlight both a shared ambition for alignment and the recognition of substantial hurdles in achieving it.

What could the OECD do as a useful follow up?

- **Facilitating Framework Comparisons and Long-Term Impact Studies**: Several participants highlighted the importance of comparing existing frameworks and conducting follow-up evaluations to assess their effectiveness. A useful next step for the OECD could be to initiate a review of how companies are implementing these sustainability frameworks after a few years, identifying significant decisions or exceptions made, especially in cases

where businesses avoided unsustainable practices. This follow-up would help track real-world impact (early wins) and lessons learned across industries.

- **Providing a Platform for Continued Dialogue**: Many participants called for the OECD to continue offering a platform for dialogue among various stakeholders. This would allow for deeper conversations on complex issues like carbon footprint and scope 3 emissions. There's also a need to bring together different actors from across the value chain and product sectors, ensuring the complexities of sustainability across industries are thoroughly explored.
- **Standardization and Metric Refinement**: There was a strong call for the OECD to focus on standardizing sustainability metrics and methodologies. Mapping out how different systems (chemicals risk management, sustainability reporting, innovation, etc.) interrelate would clarify which metrics apply to specific areas. This effort could also lead to more coherent standards across the board, aiding industries and regulators alike.
- **Monitoring and Policy Integration**: Participants emphasized the need for the OECD to track how these sustainability concepts are embedded in both corporate and regulatory policies. The OECD could play a role in monitoring how these frameworks influence decision-making processes and market-oriented instruments, contributing to the development of better policies aligned with sustainability goals.
- **Incorporating External Context into Sustainability Prioritization**: It was noted that external factors—such as policy trends, societal demands, and media attention—strongly influence which sustainability attributes are prioritized. The OECD could benefit from integrating these external drivers into its guidance on which attributes should be the focus of industry efforts, ensuring that the guidance remains relevant and forward-looking.

6 Accounting for downstream sustainability benefits

35. The discussion around downstream sustainability benefits at the workshop focused on how companies can elevate the sustainability conversation beyond immediate business-to-business (B2B) benefits and demonstrate value to society as a whole. Key points included:

1. **Sustainability for Society vs. Clients**: One of the main questions raised was how companies can move from showing sustainability benefits for customers to demonstrating those benefits at a societal level. The response highlighted the need to identify incumbent systems or products and work toward replacing them with more sustainable alternatives, ensuring that improvements are measured and clearly defined.
2. **Challenges in Quantifying Avoided Emissions**: There was discussion about the difficulty in quantifying avoided emissions, especially in cases like consumer behavior (e.g., laundry practices). While some avoided emissions can be extrapolated, it's hard to provide third-party assurance for claims involving millions of consumers. Advances in data from smart machines may help quantify such impacts in the future, but current models struggle to incorporate them fully.
3. **Performance-Based Business Models**: An example of sustainability in action was discussed in the context of water treatment services. In these models, the functional unit is cubic meters of clean water, with chemical service providers incentivized to minimize chemical use while achieving clean water. This performance-based approach ties profitability to sustainability by rewarding efficiency.
4. **Balancing Regulatory Constraints and Efficiency**: A challenge highlighted was balancing regulatory requirements with sustainability goals. For example, chlorine use in water treatment must comply with strict public health standards, even as companies aim to minimize chemical usage. The upstream quality of water impacts the downstream treatment required, underscoring the importance of knowing the source and composition of the water to optimize chemical use.

7 Decision making, deciding about trade-offs

36. The discussion on decision-making about trade-offs in sustainability and regulation involves the balancing of multiple complex factors when evaluating products, processes, or substances. Key points of the discussion included:

1. **Tools for Decision-Making**: Various tools have been developed to support decision-making in sustainability and environmental assessments, such as the Product Environmental Product Category Rules and software like Socrates (by JRC), which help in assessing alternatives, including economic impacts. These tools aim to provide a structured framework to help businesses and policymakers make informed choices.
2. **Challenges and Limitations**: While decision-analytic tools offer benefits, there are limitations. These tools can be resource-intensive and may not always align perfectly with the decision goals. Moreover, concerns arise when tools overtake decision-making, leading to reliance on models rather than deliberation.
3. **Internal Governance and Sustainability Committees**: Companies have established internal sustainability boards or transitional panels. These committees evaluate products using established criteria (e.g., sustainability assessments) and involve various corporate functions to ensure a balanced approach to decision-making. When conflicts arise, the decision can be escalated to higher management, including the CEO.
4. **Regulatory and Reputational Risks**: Decision-making must also account for regulatory risks, such as changes in the classification of substances over time. Companies build dynamic reassessments into their product evaluations, considering the potential for future regulatory changes and the impacts of these changes on product classification.
5. **Carrots vs. Sticks**: A key topic of discussion is whether governments should use incentives (carrots) or penalties (sticks) to drive sustainable practices. Some argue for a more systematic decision-making approach within regulatory bodies, while acknowledging that current processes may lack this structured thinking.
6. **Sustainability Criteria and Benchmarks**: There is an ongoing conversation about establishing clear decision rules for declaring products as sustainable. While some sustainability metrics are already being used, like carbon footprinting, others still require development and alignment across industries.
7. **Uncertainty and Long-Term Impacts**: Another major point in decision-making is accounting for long-term impacts and uncertainty. Companies and regulators must anticipate future changes in product profiles, regulatory landscapes, and societal norms. They must also address the potential for past actions (e.g., chemicals used historically) to create lasting environmental impacts.

37. This discussion reflects the complexity of integrating sustainability into decision-making, requiring collaboration, constant reassessment, and alignment between businesses and regulators.

8 Ideas for future work

38. Given the workshop discussions, several key areas of consideration for possible future work for the OECD were raised for advancing sustainable chemical selection and aligning industry practices more closely with sustainability goals. Future work should also take into account and identify collaborative opporutnities with other parts of OECD where similar topics may be addressed (e.g. the Safe(r) and Sustainable Innovation Approach (SSIA): Nano-Enabled and other Emerging Materials; work on carbon footprint, water and resource productivity).

1. **Create a Platform for Regular Dialogue and Knowledge Exchange**: The workshop highlighted the need for ongoing dialogue among regulators, industry stakeholders, and SMEs to adapt to evolving sustainability challenges and to share real-life case studies. The OECD could institutionalize such knowledge-sharing opportunities, enabling stakeholders to share best practices and discuss effective sustainability attributes and methodologies as the field progresses.
2. **Facilitate Global Coordination in Sustainability Metrics and Standards**: To account for global customers and suppliers, a coordinated approach is essential. The OECD could establish an international platform for alignment on metrics, such as a common approach to calculating sustainability metrics, that incorporates geographic factors like regional regulatory differences and environmental conditions.
3. **Promote Standardization Across Sustainability Frameworks**: Participants frequently emphasized the need for consistent sustainability metrics, particularly around key attributes like lifecycle assessments (LCA), biodegradability, recycled content, and carbon footprint. The OECD can play a critical role in harmonizing definitions and metrics across frameworks to reduce variation, enabling companies to adopt a standardized approach that fosters comparability, especially across diverse sectors.
4. **Develop Accessible Tools for SMEs**: Since SMEs are vital to the chemical industry's supply chain yet often lack the resources and expertise to apply sustainability principles effectively, the OECD could focus on simplified tools that make sustainability frameworks more accessible. This would encourage wider adoption of Sustainability by Design (SbD) principles across different industry levels and facilitate a stronger integration of sustainability into product specifications.
5. **Encourage Lifecycle Thinking and Data Sharing**: Workshop participants expressed the need for broader lifecycle considerations that extend to the full spectrum of a product’s use, including its end-of-life phase. In addition, improved data-sharing practices along the supply chain are vital for reliable decision-making. The OECD could support initiatives that establish data-sharing protocols and provide guidance on practical methods for lifecycle assessments, aiming for greater transparency and accuracy across the board.
6. **Provide Guidance on Balancing Complexity and Usability in Metrics**: Given the challenges of complex frameworks like LCA, especially for SMEs, the OECD could work to develop tiered approaches that balance robust analysis with practical application. Offering guidelines on when qualitative vs. quantitative assessments are appropriate and providing examples of effective benchmarking and cut-off

criteria could help industries approach sustainability assessments more consistently and effectively.

39. These steps can help the OECD drive a globally coherent approach that prioritizes sustainability while remaining practical and achievable across diverse industrial contexts.

Annex A. Agenda for the Workshop on Additional Attributes beyond Safer for Chemical Selection and Substitution, 23-24 September 2024

Monday 23 September 2024	
9:30	**Welcoming remarks** - ***Bob Diderich, Head of Division, Environment, Health and Safety, Environment Directorate, OECD***
	Setting the scene
9:40–10:00	Recap of OECD guidance on "Key Considerations for the Identification and Selection of Safer Chemical Alternatives" leading to objectives of this workshop & Revisiting Sustainable Chemistry Concepts and Frameworks – ***Eeva Leinala, Principal Administrator Risk Management Programme, OECD***
10:00–10:30	Presentation of the OECD "Landscape Study of Sustainability Attributes Considered by Companies During Chemical and Material Selection" – ***Molly Jacobs, Director of Applied Research at Sustainable Chemistry Catalyst, Lowell Center for Sustainable Production, UMass Lowell***
10:30-11:00	***Coffee Break***
11:00	**Session I: Sustainability Frameworks** Moderator: Andrew Beck, Director of Risk Management, Safe Environments Directorate, Health Canada
	Overview of sustainability frameworks related to chemicals This session will include a series of presentations of a sampling of some existing/in-development frameworks related to sustainability aspects and chemicals. The presentations will be interspersed with country delegate dialogue and specific discussion points including: If frameworks have different goals – are/should the key attributes be the same? Are/should the metrics be consistent when the frameworks are applied? How do they differ?
11:00-11:10	**Objectives of the session**
11:10-11:30	**Innovation-based frameworks** • **EU Commission Safe and Sustainable by Design Framework**

	○ *Irantzu Garmendia Aguirre and Giulio Bracalente, Joint Research Centre, European Commission*
11:30-11:50	• **European Chemical Industry Council (CEFIC) Safe and Sustainable by Design Guidance and related experience** ○ *Dr. Eva-Kathrin Schillinger, Senior Innovation Manager CEFIC*
11:50-12:10	Questions and Discussion
12:10-12:30	**Other frameworks** • **Eurometaux Risk Management Options Framework** ○ *Hugo Waeterschoot, Chemicals Management Advisor, Eurometaux*
12:30-12:50	• **World Business Council for Sustainable Development (WBCSD) Chemical Industry Methodology for Portfolio Sustainability Assessment (PSA)** ○ *Anne-Laure Brison, Senior Manager, Chemicals Group, WBCSD*
12:50-13:10	Questions and Discussion
13:10-14:30	***Lunch Break***
14:30-14:50	**Sustainable chemicals** • ***ChemSelect* & Guide on sustainable chemicals - A decision tool for formulators and end users of chemicals** ○ *Antonia Reihlen (Oekopol), consortium lead for development of ChemSelect on behalf of German Environment Agency (UBA)*
14:50-15:10	Questions & Session Wrap Up *Participants are asked to input on if they identify convergence on potential impactful, measurable attributes from the discussions thus far.*
15:10	**Session II: Examples from industry actors incorporating sustainability attributes during chemical selection decision-making** Moderator: Molly Jacobs, Director of Applied Research at Sustainable Chemistry Catalyst, Lowell Center for Sustainable Production, UMass Lowell
	Series of company examples of consideration of sustainability attributes during chemical selection/substitution This session will include a series of presentations of how chemical companies are considering other attributes beyond safety in the context of chemical selection (new chemical innovation, chemical substitution etc.). Companies will be asked to identify the top 2-4 attributes that they consider to be most easily measured consistently and that are the most impactful regarding sustainability outcomes. Also, if this measure is comparative between chemicals or absolute, and if it dependent on the downstream context of use of the chemical/chemical product.

15:10-15:20	**Objectives of the session** (moderator)
15:20-15:40	**Croda Europe Ltd** • *Sarah Davidson, Technology Development Lead, Croda Europe Ltd*
15:40-16:00	**Clariant** • *Fabio Amorim, Global Sustainability Specialist, Clariant*
16:00-16:20	Questions and Discussion
16:20-16:50	***Coffee Break***
16:50-17:10	**International Flavors & Fragrances Inc.** • *Michael Hershkowitz, Director, Global Sustainability & Sustainable Innovation, IFF*
17:10-17:30	**International Wrought Copper Council (IWCC)** • *Mike Smith, Vice President, IWCC*
17:30-18:00	Questions & Day Wrap Up *Participants are asked to input on if they identify convergence on potential impactful, measurable attributes from the discussions thus far.*
Tuesday 24 September 2024	
9:30	**Session II continued: Examples from industry actors incorporating sustainability attributes during chemical selection decision-making**
9:30-9:40	Day 1 Recap
9:40-10:00	**Advancion Sciences** • *Pam Spencer, Senior Vice President Regulatory, Product Stewardship, Quality, and Sustainability, Advancion Sciences*
10:00-10:20	**BASF** • *Wibke Lölsberg, Corporate Sustainability Strategy, BASF*
10:20-10:40	Questions and Discussion
10:40-11:10	***Coffee Break***
	Session III: Is there Convergence on a Potential Subset of Impactful, Measurable Attributes Moderator: Eeva Leinala, Principal Administrator Risk Management Programme, OECD
11:10-11:45	This session will consider the outputs of Session I and II to discuss with participants if they identify convergence towards a potential subset of impactful, measurable attributes that could inform the development of OECD guidance to complement the guidance on selection

	of safer chemical alternatives.
11:45-12:15	Session III, Part B: How can the frameworks and approaches described in Session I and II also inform **OECD Nanomaterial and Advanced Material Safe(r) and Sustainable Innovation Approach** – *Lya Hernandez, RIVM, the Netherlands.*
12:15-13:30	***Lunch Break***
13:30	**Session IV: Accounting for downstream sustainability benefits** Moderator: Laia Perez-Simbor, Policy Officer, European Commission DG for Internal Market, Industry, Entrepreneurship and SMEs
13:30-14:20 (15 min each) followed by discussion	This session will consider how downstream sustainability benefits are factored in. As an illustrative example, if a chemical itself has a 'moderate' resource-use profile during its production (e.g. energy, water, raw material consumption) but it is a catalyst that vastly improves a downstream reaction, and in that reaction reduces resource-use significantly, how is this accounted for? ***Michael Hershkowitz, Director, Global Sustainability & Sustainable Innovation, IFF*** and ***Marie-Thérèse Laguerre, Africa, Near & Middle East Strategy and Marketing Director at Veolia*** followed by interactive discussion with all.
14:20	**Session V: Decision-Making** Moderator: Laia Perez-Simbor, Policy Officer, European Commission DG for Internal Market, Industry, Entrepreneurship and SMEs
	As the number of attributes to be weighed increases, the number of potential trade-offs between safety and sustainability attributes increases. This likely leads to case-by-case decision-making. But are there mechanisms to helping structure decision-making? Different constructs will be explored in this session.
14:20-14:50	*Timothy Malloy, Professor of Law, University of California Los Angeles School of Law*
14:50-15:10 (10 min each)	*Discussants* ***Fabio Amorim, Global Sustainability Specialist, Clariant*** and ***Wibke Lölsberg, Corporate Sustainability Strategy, BASF***
15:10-15:30	*Questions, Followed by interactive discussion with all.*
15:30	**Session VI: Wrap and Next Steps** Moderator: Eeva Leinala, Principal Administrator Risk Management Programme, OECD
15:30-16:00	