Preliminary report, evaluation and results of the 1st SETAC-EC Consultation Meeting on SSbD 2 October 2023 (Online)

22 October 2023

To whom it may concern

This preliminary report presents summary information on the 1st SETAC-EC Green Deal *Safe and Sustainable by Design* Consultation, held as an online SETAC-Café format on 2 October 2023. The meeting (program, contents, aims, etc.) are summarized on the SETAC-EC 1st Consultation Meeting webpages (2 October 2023).

The summary information represents the *preliminary collation of results* of the meeting, and consists of various parts:

- Contemporary notes on the plenary part of the SETAC-Café
- Results from the eight breakout groups

The results of the breakout groups are aimed to summarize the raw results from the breakout groups after initial editing steps (solely for clarity improvement) by providing concrete sentences on proposals and ideas generated by the attendees in relation to questions under discussion in the breakout groups.

The results of the meeting will be further interpreted, edited and reported. They will also be used to prepare for a 2nd SETAC-EC Consultation Meeting, and eventually an on-site meeting in Seville in May 2024.

This report is prepared by the SETAC-Europe Sounding Board of the High-Level Round Table for the Chemical Strategy for Sustainability and Hanna Schreiber.

Report to be cited as:

Annegaaike Leopold, Michelle Bloor, Bruno Campos, Ksenia Groh, Leo Posthuma, Hanna Schreiber, Paul Thomas, and Hans Sanderson (2023) Preliminary report, evaluation and results of the 1st SETAC-EC Consultation meeting on Safe and Sustainable by Design, held on 2 October 2023. Online meeting, organized by SETAC-Sounding Board of the High-Level Round Table for the Chemical Strategy for Sustainability and representatives of the European Commission.

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1. Motives and aims of SETAC-EC Consultation Meetings on SSbD

Safe and Sustainable by Design (SSbD) is a core element of the European Green Deal's Chemical Strategy for Sustainability (CSS). SSbD is a pro-active approach that is geared towards designing novel molecules and materials that are intrinsically safe (for human health and the environment) and sustainable (which concerns impact categories beyond mere safety). Given the key importance of SSbD, it is deemed highly relevant to mobilize contemporary science, provide methodologies, data, models and tools, solve conceptual problems associated with SSbD and operationalize SSbD for practitioners. Hence, SETAC and the European Commission joined forces, to organize a SETAC-EC Consultation Meeting on SSbD.

The meeting, of which the results are summarized as preliminary results in the present document, was described on the following webpage: SETAC-EC 1st Consultation Meeting (2 October 2023). The general idea is that the scientific community of SETAC can "[…] *support the European Commission (EC) in identifying creative solutions on the Safe and Sustainable by Design (SSbD) vision and [that SETAC-members are invited to] become involved in the process!*"

The website summarized backgrounds and goals as follows:

> "*The SETAC Café, titled "*Advancing safety and sustainability of chemicals through science-based strategies: service checks, gaps, bottlenecks, and the way forward*", is organised by the Sounding Board of SETAC Europe's representation at the High-Level Roundtable for the implementation of the EU's Chemicals Strategy for Sustainability (HLRT CSS) and has been designed together with the EC's Directorate-General for Research and Innovation (DG RTD). The purpose of the consultation meeting is to provide SETAC members with the opportunity to be involved in the process and give their opinions on SSbD topics. The meeting allows the Sounding Board of the SETAC Europe HLRT CSS to tap into and gather SETAC members' scientific expertise and knowledge. Members of SETAC with expertise in environmental toxicology and chemistry, hazard and exposure assessment, life cycle assessment, and risk assessment, are welcomed and joined by representatives from the EC, EU Agencies, EU projects working on SSbD, and EU Member State Agencies. The insights gathered will feed into planned SSbD-focused events organised by the JRC and DG RTD in 2023 and to the 2024 events to be organised by SETAC together with the EC.*"

Given this background, and in view of the need to support ongoing development processes and meetings, the members of the SETAC-Europe Sounding Board of the High-Level Round Table for the Chemical Strategy for Sustainability prepared the present report. The present report represents *the preliminary summary of results of the 1st Consultation Meeting*, held online on 2 October 2023, in the format of a SETAC-Café. This means that the preliminary results can be used in the ongoing processes of developing and testing SSbD, but also that the results can be further developed. That will occur in preparing the 2nd SETAC-EC Consultation Meeting, and the final onsite meeting in Seville in May 2024. In the process towards those meetings, the results are further evaluated and reported in forms and formats to be chosen (such as a SETAC-Globe article, and/or a formal report to the attendees of the first meeting).

2. Contemporary notes on the plenary session: presentation contents, highlights and interactions

2.1. Reader's guide:

This chapter contains notes contemporarily made during the plenary session of the 1st Consultation Meeting. The aim of this chapter is that the flow of events, the subjects addressed, the general atmosphere and attendees' comments, suggestions and ideas are captured. This, for further digestion in next steps of the three-step SETAC-EC Consultation (1st and 2nd Online SETAC-Café format, and the onsite meeting in Seville, May 2024). The present chapter consists of contemporary notes, taken during the presentations, with screen shots of various slides that were shown[1] and a summary of questions and answers (Q&A), if posed directly after a presentation.

2.2. Program of the 1st SETAC-EC Consultation plenary session

The program of the plenary session is shown in Figure 1.

Start	Title	Speaker/Chair	Affilliation
13:30	Welcome on behalf of Organising Committee	Annegaaike Leopold	SETAC
13:31	Welcome on behalf of SETAC	Bart Bosveld	SETAC
13:33	Introduction, background, aims and programme	Annegaaike Leopold and Sofie Norager	SETAC and EC
13:40	Safe and Sustainable by Design: the framework and its key challenges	Serenella Sala	EC
13:55	SSbD: How can we translate scientific methods into practical substitution with SSbD?	Peter Fantke	DTU/Denmark
14:10	SSbD: Solutions for challenges, and requirements on SSbD from the perspective of large companies	Wibke Loelsberg	BASF
14:20	SSbD: Solutions for challenges, and requirements on SSbD from the perspective of SMEs	Marko Susnik	SME-United
14:30	SSbD: Stimulating the science-to-practice transfer	Leo Posthuma and Hans Sanderson	RIVM and Aarhus University
14:45	BREAK		

Figure 1. Program of the plenary session of the 1st SETAC-EC Consultation Meeting on SSbD.

The program represents a sequence of presentations that:

1. Summarize the aims of the Consultation Meetings, i.e., to mobilize science to forward SSbD in both concepts and operationality (Leopold and Nørager)
2. Introduce the framework, as developed by JRC, and its challenges (Serenella Sala)
3. Introduce aspects of bringing science to practice, by presenting experiencing gained from developing an operational tool (Peter Fantke)
4. Introduce challenges and needs seen from the perspective of a large industry (Wibke Lösberg)
5. Introduce challenges and needs seen from the perspective of small and medium enterprises (SME's, Marko Susnik)
6. Introduce both forward-looking needs (Green Swan concept) and practical requirements of science-practice transfer (Leo Posthuma and Hans Sanderson)

This sequence of presentations was aimed to inform the attendees on the framework and its challenges, seen from a variety of angles (from the designers, from industry, and from a scientist who has made operational science-based tools) and with the two key approaches that are needed to stimulate science-practice transfer for SSbD. That is, first, the Green Swan concept, as developed by John Elkington – who proposed the triple bottom line concept of *People, Planet and Profit*, for sustainability assessment – which represents a concept that highlights that SSbD may be a Green Swan if it helps to create exponential solutions, to the exponential increase of various environmental problems, and if it results in resilient and regenerative outcomes. Second, and also key, there is a need to make science practicable and evaluate

[1] The complete slide decks will be made available in a later stage.

which current research subjects would enable development of useful tools for SSbD – in the format of tools that can be utilized by large companies and SME's alike.

With the plenary program, the organizers aimed at preparing the attendees for the breakout group session (which was following the break), in which the attendees would be asked for their proposals to bring science to (SSbD) practice.

2.3. Welcome on behalf of Organizing Committee and SETAC

Annegaaike Leopold (member of the High-Level Round table on the CSS and chair of the Consultation Meeting) opens the meeting on behalf of the organizing committee, which consists of the European Commission representatives and the SETAC-Sounding Board members with Hanna Schreiber as additional member, by welcoming all people around the globe in any time zone.

Bart Bosveld, Executive Director of SETAC and SETAC-Europe says it is an honor to welcome all attendees to the meeting. SETAC's mission is "*Environmental Quality through Science*", and many people now are available to help science-to-practice on SSbD. Bart thanks the European Commission for working together with SETAC and its wide array of experts. Bart wishes all attendees good luck with this exciting meeting.

2.4. Introduction, background, aims and program

Annegaaike Leopold co-chairs the meeting with Sofie Nørager of the EC. She explains the aims and backgrounds of the meeting, which was organized as collaborative effort of EC and SETAC.

Sofie Nørager expresses her happiness about the activity that is now going to start. Sofie states that the activity of today is about the guidance on SSbD, which is not a policy matter, but a development towards early-stage enabling SSbD-evaluation of chemicals. Currently, the framework is tested (2 yrs), and EC now welcomes input during the test phase.
Sofie highlights that the utility of the framework asks for many things to be implemented. Sofie looks forward to the discussions and ideas. Sofie highlights the key issue of "early-design phase", which relates closely to introducing New Approach Methodologies and reduced animal testing. She notes that JRC, PARC and many other agencies and activities are active.
Sofie hopes and expects that the workshop yields science-based advancement ideas for SSbD. She also hopes people to be present, and willing, to evaluate SSbD in practice. If so, contact JRC, PARC or EC, and "be ambassadors" for a sound SSbD base.

Annegaaike thereupon summarizes the aims, program and approaches of the present SETAC-Café. She explains that there will be two follow-up activities, viz,

- 31 January 2024: a second online Consultation Meeting
- May 2024: an in-person SETAC Workshop, back-to-back with the SETAC Europe 34th Annual Meeting in Seville, Spain

Finally, Annegaaike explains how – as if in a complete round table – all visions and viewpoints are collated in the program.

Regarding rules of engagement, Annegaaike explains that the online chat-facility is the key "message board", whereby the plenary is recorded to capture all thoughts, only using it to complete the report of *what* was contributed, *not by whom*. Key is to speak as yourself, as it is about ideas to forward SSbD.

2.5. Safe and Sustainable by Design: the framework and its key challenges

Serenella Sala (EU-JRC) introduces her long-standing interest in linking Safety to Sustainability. Serenella illustrates that, and how, the SSbD framework in the Chemical Strategy closely relates and binds various aspects of the full Green Deal. Safe and sustainable are together, to avoid "trade-offs" for whole life cycles of chemicals.
The SSbD-framework was based on a wide-ranging review of opportunities for safety and sustainability, yielding a framework for SSbD to bring the methods to practice. A first round of testing was done, and

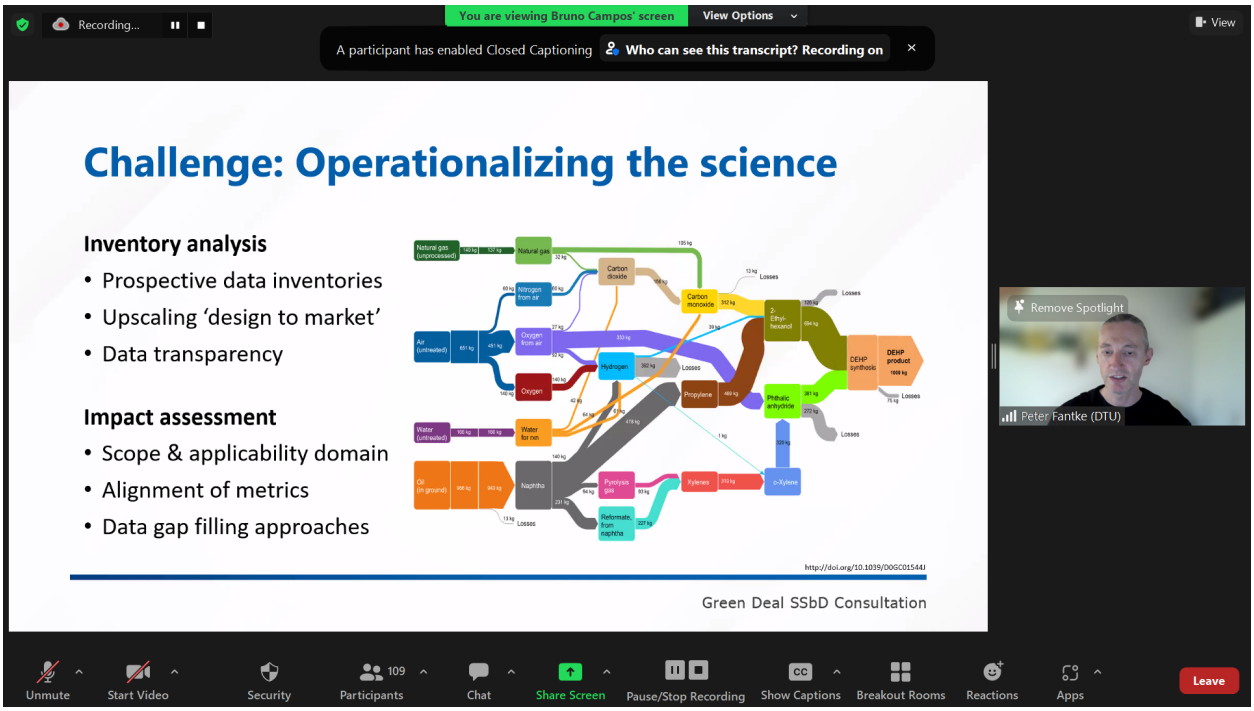
industries are working on current cases. The framework is now part of an EC-Communication, stating what/how/when SSbD will proceed to be developed and implemented.
Serenella shows that various aspects of sustainability are to be considered, so next to safety. Furthermore, the SSbD also leans on "maximum carrying capacity" of the environment, related to Absolute Sustainability and the Planetary Boundary concept. The third element relates to Green Chemistry, and similar approaches with associated criteria. Serenella stated that some issues appear missing, and that some matters need deeper verification as compared to currently available methods. This resulted in the full-life cycle view, employed with the SSbD framework.
Serenella now introduces and explains the four main steps of the framework, starting from (1) hazard evaluation, followed by (2) human health and safety aspects in the production phase, (3) human health and environmental impacts of the use phase, and eventually (4) the life-cycle evaluation of safety and sustainability aspects (for which there are currently 16 named footprint-type indicators). All this requires data, methods and practicable tools.
Three JRC-organized case studies have been done (plasticizers, surfactants, and flame retardants). The framework resulted in a set of indicators, summarized as a colored scheme. Netto, the tests also resulted in challenges:

Serenella invites attendees to head for the SSbD "bootcamp" workshop and joining in with the testing phase. She expresses the hope to help EC (us all) to connect all the dots of the complex exercise of developing and utilizing SSbDs.

➔ Q&A: One attendee asks whether the methods developed under the SSbD concept of the Chemical Strategy for Sustainability can be used for pesticide mixtures in the environment. A: The idea of the framework is yet to address one compound at a time, but the evolution may well go into the direction of further development towards unintended mixtures.

2.6. SSbD: how can we translate scientific methods into practical substitution with SSbD

Peter Fantke follows up by introducing himself as an expert who works on science-to-practice tools. SSbD goes beyond existing Safety and Sustainability (LCA) tools. This may result in paralysis. But too simple is also not good. Some key aspects need be considered to strike a balance between science-based approaches and fit-for purpose in practice.
Key question: "what do we do when science stops?" With two challenges: we have (1) relevant information needs on the true synthesis tree, with the inventory of materials used and emissions, and (2) relevant information on hazards and impacts resulting from that. All synthesis schemes are different.

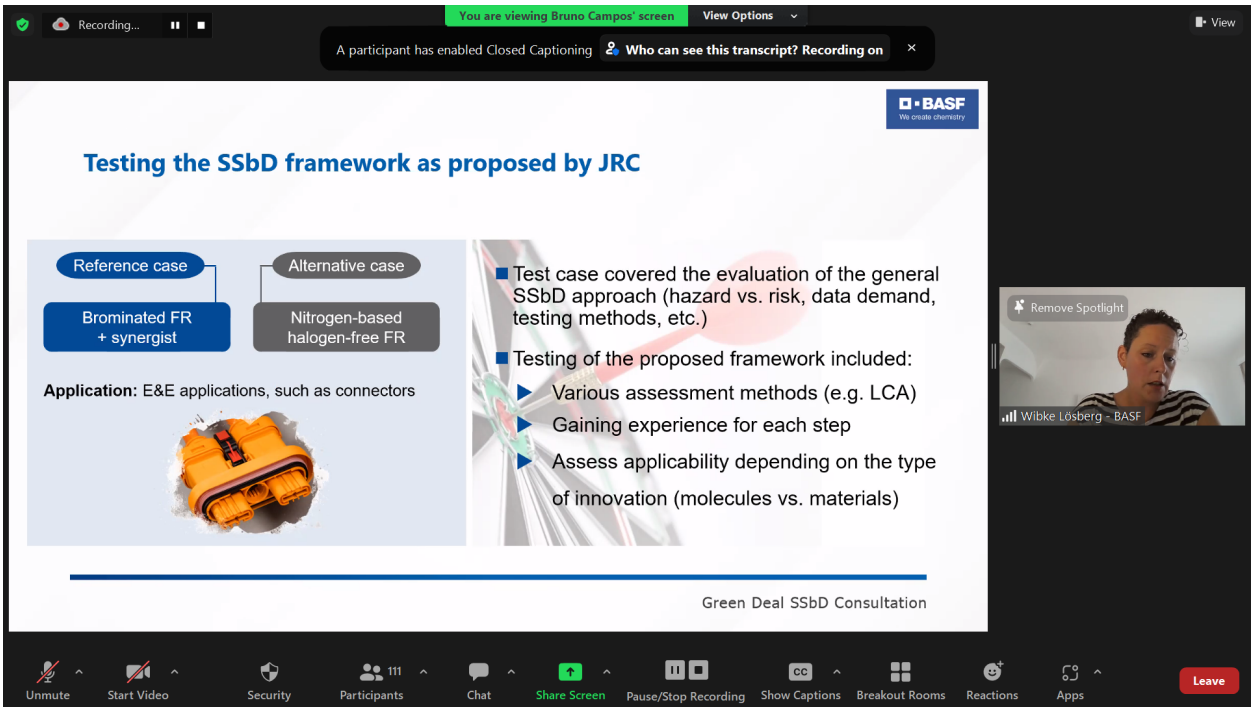


How then, can we up-scale the theoretical approach till the evaluation of the full life cycle in relation to the Absolute Sustainability? Many things are not yet aligned, and data lacks. And how can we finally make operational tools, for end-users in the SSbD-development of chemicals or materials?
When science stops, we need principles and approaches that define the decision context, which is consensus-building. We need a good tool, which should continue to be developed with increasing insights. Peter now illustrates the past (similar) process of developing USEtox, which has gone thought a similar consensus-building process. Peter shows the key design criteria for such a consensus building. Peter illustrates the first decades of developing USEtox from >5 original scholar ideas, which shared similarities but also showed differences. A new tool was created, by consensus-building. USEtox is still ongoing, training is needed and done, the tool is modular, and the interface must be fit-for-purpose. USEtox was evaluated in the context of SSbD, for the plasticizer case study of JRC. Peter highlights the key challenges for SSbD.

➔ Q&A: Can ecotoxicity impacts be broken down into specific effects on groups (e.g., pollinators etc.)
A: Peter answers that these "splits" are under development, to really make the results of SSbD "fit for all purposes".

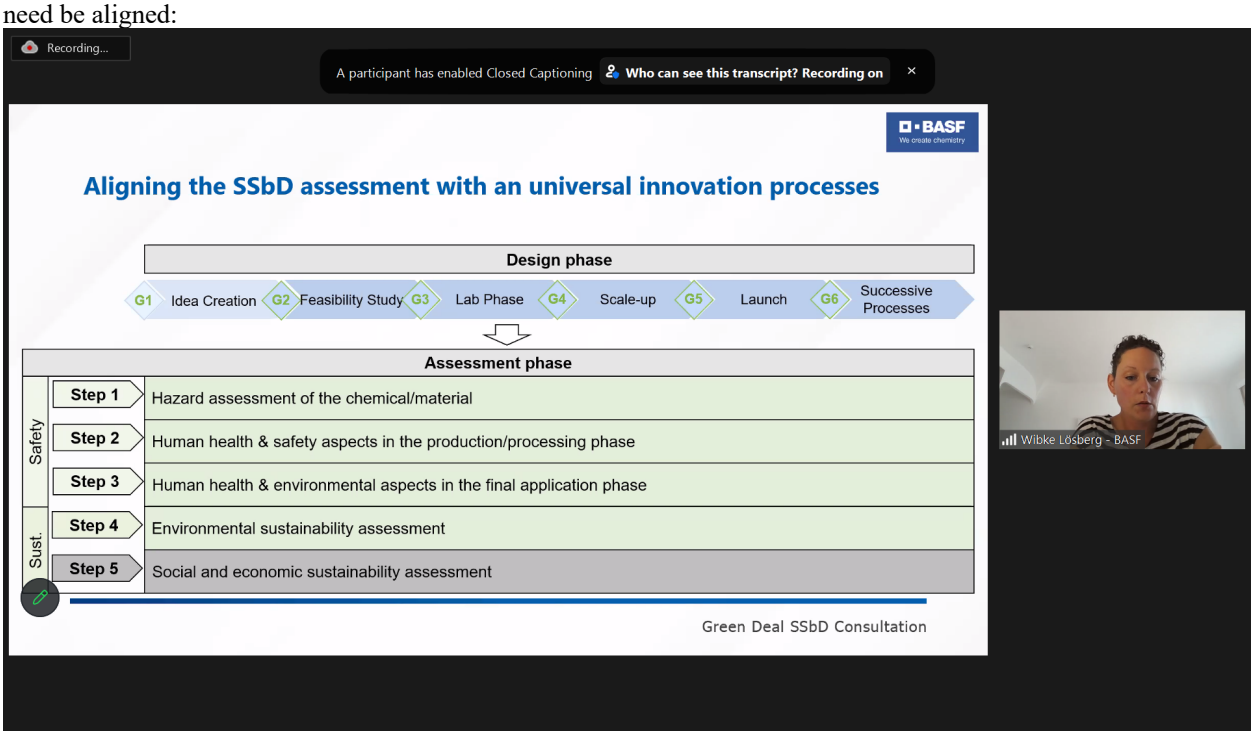
2.7. Solutions for challenges, and requirements on SSbD from the perspective of large companies

Wibke Lösberg of BASF proceeds, by continuing the "roundtable"-set of ideas, now taking the perspective of the larger industries.



Wibke explains the case with a specific example, showing a reference and an alternative case. All aspects of the SSbD Framework were tested. BASF invests extensively in R&D, for innovative products, with vastly different "maturity" levels regarding insights, models and data available for the initial molecules.

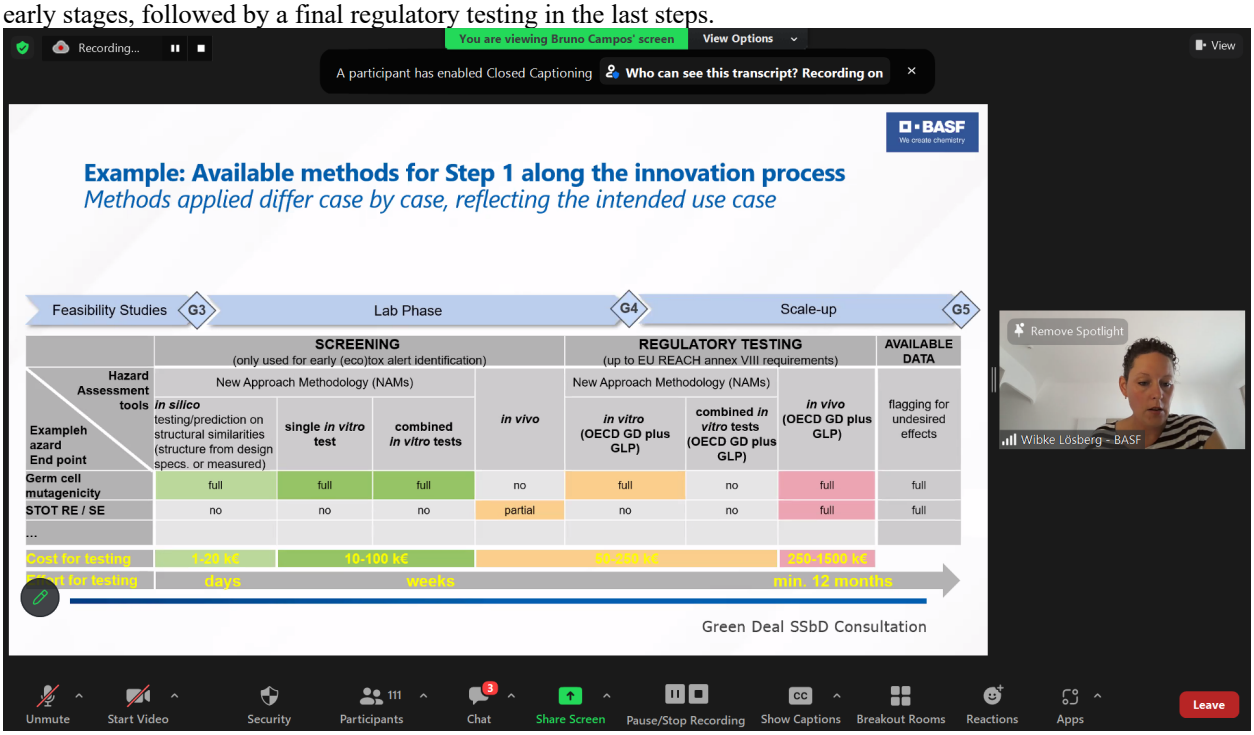
A major finding was, that the expertise of the developers of new molecules is not their core business, to that external advice is often needed. The process of the SSbD-framework, and the innovation process need be aligned:



Initially, there is a high need for testing, which narrows down over time. Methods in framework currently are applicable to High Technological Readiness Levels (TRL's), whilst they now need be applied to data-

poor situations. As a solution, the work starts with **qualitative** methods, whereby **quantitative** methods enter the assessment processes later.

A key need, learned from the framework, is that early-screenings ask for more reliable early-lower-TRL levels. That would help the innovation process. As an example, *in silico-methods* can be applied in the early stages, followed by a final regulatory testing in the last steps.

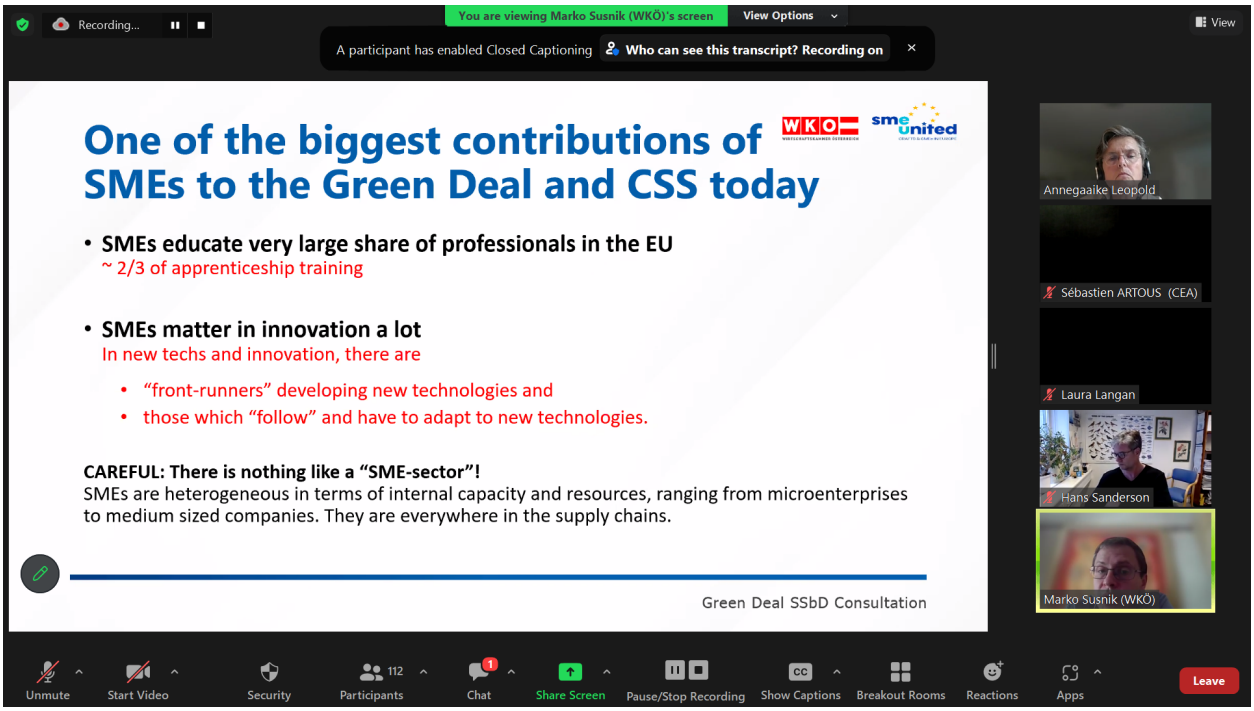


As conclusion, Wibke states that there is vast room for improvement and filling-of-gaps, especially in the early-stage evaluation of hazards. The largest wish is to have science-based methods for early-stage "informed decision-making" in the innovation process, with affordable and available tools.

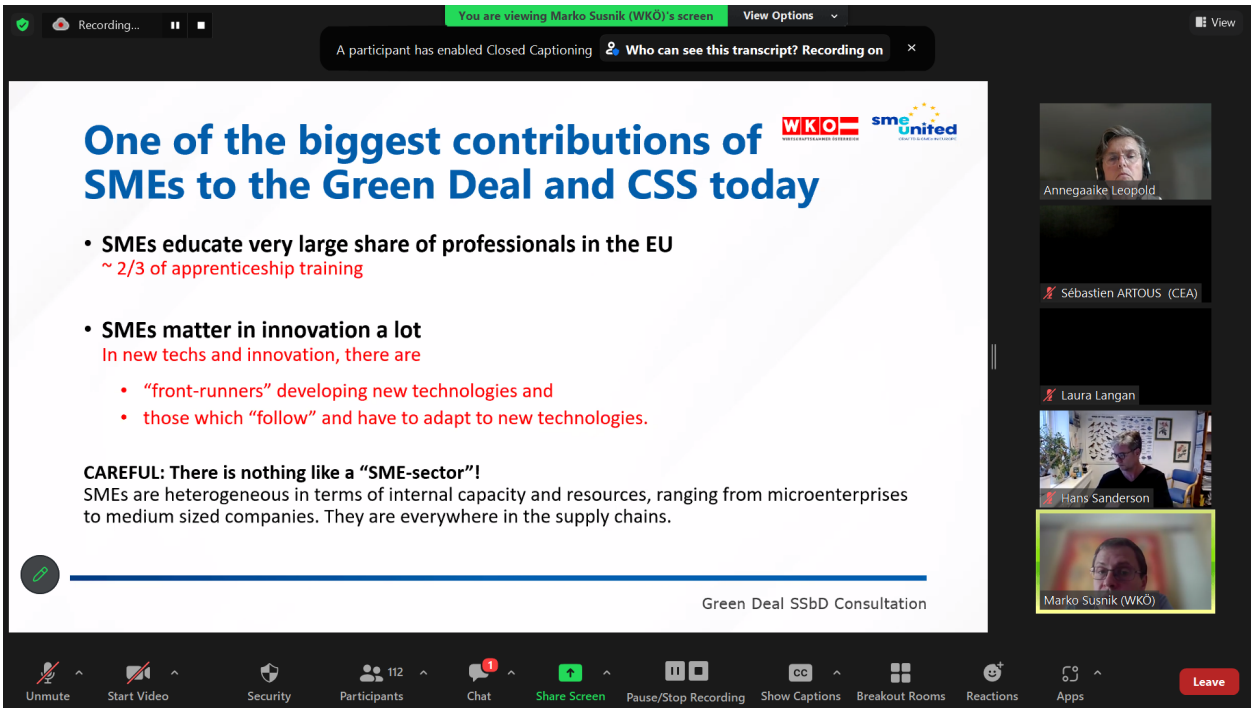
➔ Q&A: A longer question is forwarded for "post-meeting" interaction, thanks.

2.8. Solutions for challenges, and requirements on SSbD from the perspective of SMEs

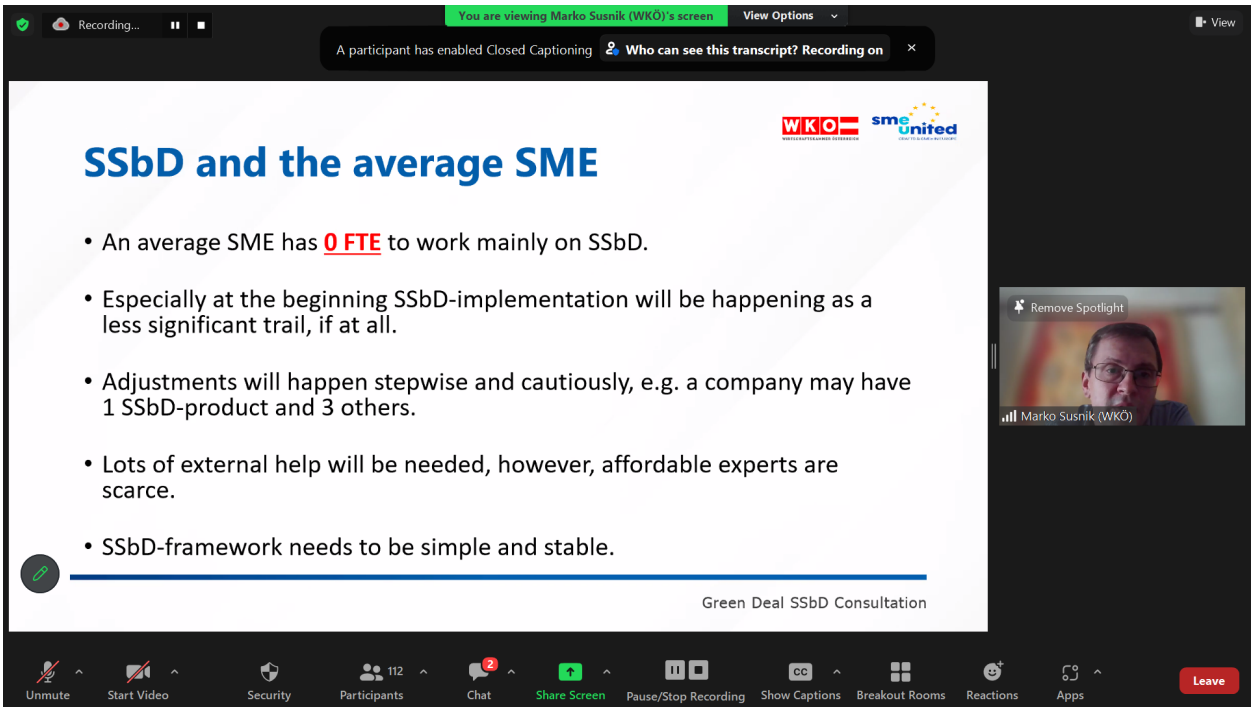
Bruno Susnik of SME-United presents that, and how, Small-and Medium-Enterprises (SMEs) play a key role in developing and implementing SSbD. He mentions that a critical point is not only that, and how SSbD could work but also that SMEs do not have the investment capacities for the testing. Whilst the presentation of Lösberg already highlighted the role of advisory firms (external hire), the same would hold for SMEs, with fewer funds for testing.
Bruno highlights some key characteristics of the SME-context, stressing that SMEs need be convinced about SSbD as well as on enabling to execute SSbD in a realistic setting.



Bruno provides a list of key items to make SSbD a success in SME-situations:



SME-united helps, amongst others, in training, schools and infrastructure, coordinates and helps in EU-projects as a partner and participates in National initiatives. SMEs run a vast number of chemical designs and need to be "on board" for CSS and SSbD to be comprehensive a success. "Costs can be breaking the necks" of many SMEs – it is a problem to work on SSbD for the sake of budget as well as multi-tasked individual scholars within SMEs. All in all, this yields specific criteria, and thus "no SME could be found in the testing phase, to test the JRC-Framework", as follows:



In short, any framework needs **be simple and stable.**

➔ Q&A: Questions will be taken up online, in view of time.

2.9. SSbD: Stimulating the science-to-practice transfer

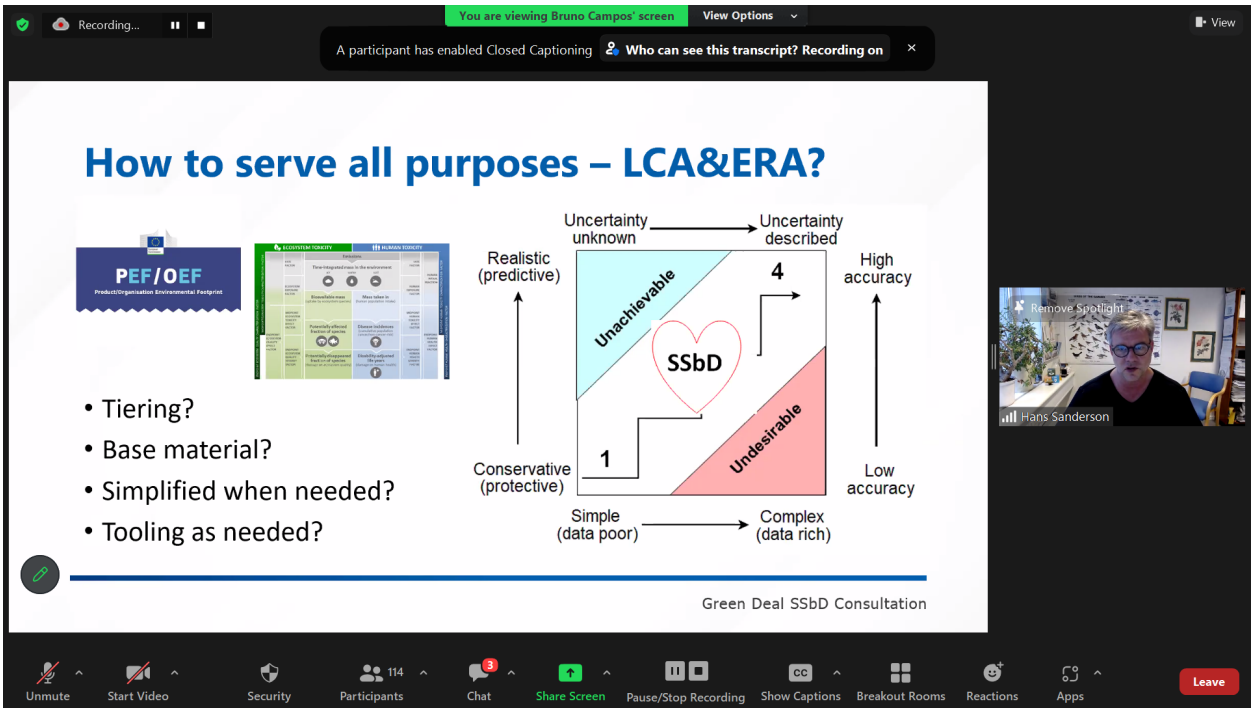
Leo Posthuma introduces the idea that there is a need to adopt a "Green Swan"-mindset. The Green Swan is a recent concept proposed John Elkington, who earlier proposed the sustainability "triple bottom line" of People, Planet, Profit. This Green Swan concept means:

1. Ideas for solutions are "exponential", as the problem of chemical pollution has exponential characteristics (the diversity as well as mass of chemicals used)
2. Ideas for solutions would best be regenerative and resilient in kind, avoiding trade-offs.
3. And we need an open mindset, to generate such ideas.

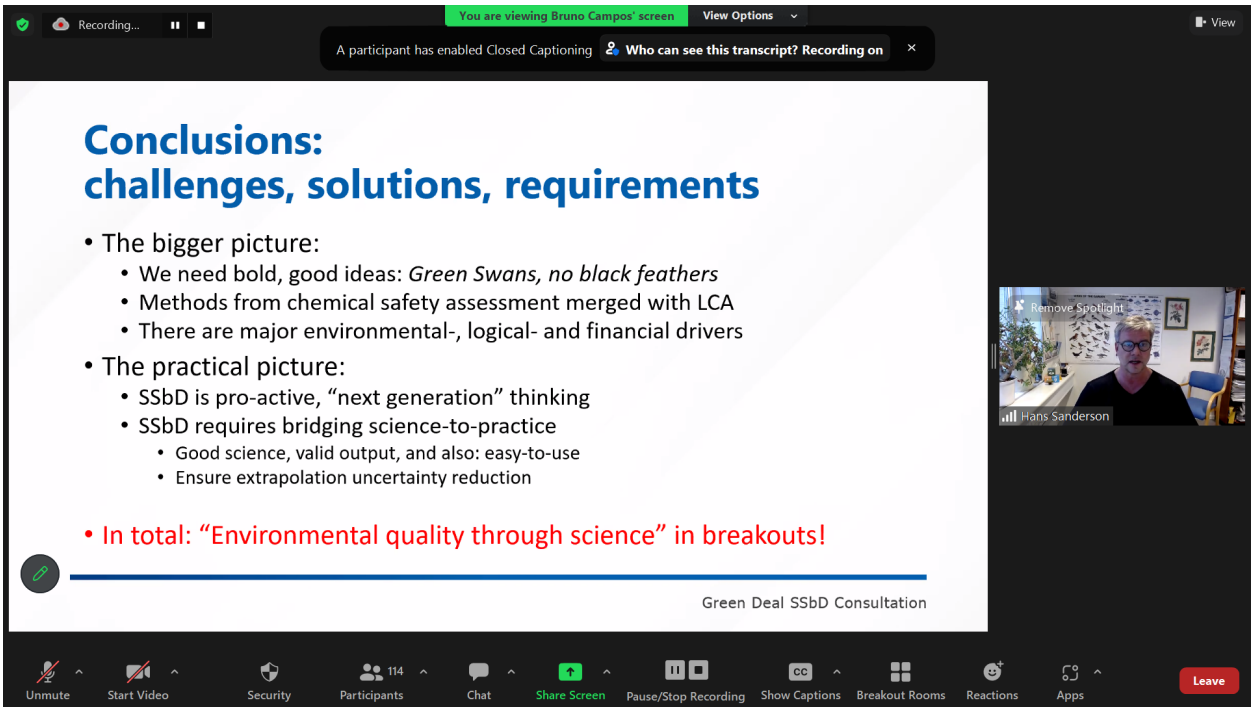
Leo introduces that - between now and the 2nd Consultation Meeting – the ideas of bringing science to practice ask for a recognition, and harvest, of the width of ideas from all scientists in the SETAC-community on the horizon on potential options to forward SSbD (concepts, models and utility), which may be relatively easy and/or 'low-hanging fruit' or more complex and time-consuming ideas. Anyway, those ideas should best be Green-Swan-ish, and any idea is welcome and should be forwarded without a filter on perceived realization problems. The next meeting can namely look into specific steppingstones which can be identified to help materializing a great idea, which seems unrealistic at first sight.

Hans Sanderson proceeds, and moves to the real-life problem faced by industries, larger and smaller, which is summarized as follows:

Key is, that indeed existing methods are simplified for early Technological Readiness Levels (TRL's), as on the next slide. Key matter on this slide is the principle of tiering. This principle aims at designing a stepwise approach, in which simpler and easy-to-use methods can be employed in earlier stages, and more refined and precise methods in later stages of SSbD-development processes of chemicals or materials. The scheme illustrates the practical 'wins' and characteristics of lower-tier methods and how assessments become more precise at increasingly high tiers.



What is practically needed, and what is the key set of matters is summarized on the last slide.



2.10. Closure of plenary introductory session

Annegaaike thanks all "roundtable"-speakers, to enjoy the break and come back in five minutes.

3. Design and detailed results of the breakout groups

3.1. Reader's guide

This part of the present report collates the results of the ideas forwarded in the breakout groups. Breakout groups were organized around three themes, with various breakout groups each. The themes were:

- Hazard Assessment
- Risk Assessment
- Life Cycle Analysis

Given the number of attendees and their recorded interests and expertise, there were 3 breakouts on Hazard questions, 3 on Risk questions and 2 on Life Cycle Analysis questions.

Below, the various sections of Risk, Hazard and LCA each present subsequently:

- The pre-defined questions posed to the attendees of the breakout groups
- The ideas generated by the attendees of the breakout groups, collated per theme, with editorial improvements made by Sounding Board members who chaired the breakouts, in order to improve clarity of the ideas that were forwarded (in staccato terms) and discussed (orally)
- The identification of one short-term highlight and one potential game-changer idea per breakout group

3.2. Breakout group work format for collecting ideas on SSbD

Building forth on the introductory presentations on the framework (Sala) and challenges for science and industry to develop good scientific concepts, models and data to operationalize SSbD, and also building forth on the dual call for making science available for SSbD (following both the big-picture idea of Green Swan solutions, that are practical at the same time), the breakout groups were organized to harvest the ideas of the attendees on making science available for SSbD.

This was done according to the following format.

- First. specific questions (prepared by EC in collaboration with the Sounding Board) were posed in the three themes to help focusing on the generation of (novel) ideas and solutions to support the employment of hazard, risk and life cycle insights into operational SSbD analyses. The SETAC scientific community experts were thus specifically asked to forward their ideas, in line with the outlook presented by Leo Posthuma and Hans Sanderson, that some bold ideas of a practicable kind, respectively, were needed.

- Second, given that these ideas may vastly differ in various key aspects, the ideas were collated in a scheme, as shown below in Figure 2, according to two criteria:

    - How *fast* is it likely that the proposed idea can serve operational SSbD analyses?
    - How *complex* is the idea to develop and/or implement?

In both cases, three categories were distinguished. Regarding the time aspect, the categories were distinguished in the context of the planned SSbD-development steps, so that short-term ideas might be available as soon as by the end of 2023, the medium-term ideas by 2025, and the longer-term ideas in the period between 2025 and 2030.

how complex→ / how swift↓	Simple	Moderate	Complex
by end of 2023 (short)			
by 2025 (medium)			
2025-2030 (long)			

Figure 2. Format used in the breakout sessions to collate ideas generated by the attendees to (potentially) solve the key problems within a theme (Hazard-, Risk- or Life Cycle Assessment). Proposals to forward the operationality of SSbD are categorized according to the axes of Complexity (simple→complex), and Speed (short-, middle- and long-term needed to implement the proposed solution).

3.3. Hazard Data Provision

3.3.1. Questions

The Hazard breakout groups were chaired by Paul Thomas, Ksenia Groh and Annegaaike Leopold.
The pre-defined questions to the breakout groups on hazard data provision were:

- **Data collection**:
  Where can data be obtained and collected? (e.g. E-Chem portal, etc)
- **Data generation and gap analysis**:
  Focus on animal alternative tools (in silico, in vitro…) needed for assessment screening, hazard identification (using new hazard categories), classification, filling specific data gaps, as well as Integrated Testing Strategies available to ensure that reliable data is generated without unnecessary animal studies.
- **Data classification**:
  Making sure that the QSAR models, or other in silico models and NAMs data are fit for purpose or combining them to provide weight-of-evidence (WoE) approaches for hazard assessment that ensure consistency when comparing results and are aligned with chemicals legislation (e.g., similar criteria).

3.3.2. Proposed ideas

The raw ideas of the three breakout groups on Hazard resulted in the following set of net results (Figure 3), derived from the raw input (staccato texts via chat, combined with the discussion on those) and **not yet edited for clarity**. Highlights are in Section 4.2.

Not yet assigned	Could take some NAM submissions as a starting point and then develop IATAs that would bring together CRED / CREED and data quality considerations, WOE, Inventory > ranking criterion for NAM'S > decision tree illustration for uncertainty level		
how complex→	**Simple**	**Moderate**	**Complex**
how swift↓			
by end of 2023 (short)	ECHA inventory DB	Generate a list of available property databases and the data they include and free vs commercial. Include methodologies.	Assessment of alternatives available; It is very complicated to know actually what alternatives exist for everything and sometimes it's a matter of hearing about it from someone else. a centralized information center would be useful.
	(Perhaps mid?) ; Assessment of the alternative methods; Make sure that when alternative methods are identified they are assessed/compared based on relevant criteria - avoid ending up with alternatives that may be so overconservative that their use becomes a disadvantage. Also avoid assessing an alternative on the wrong basis (e.g. trying to have a one to one replacement of in vivo)	CONSIDER MORE IN VITRO/QSAR COMBINATION APPROIACHES to increase confidence in results (widen defined approaches) ***(maybe should be medium/long)***	
	INVEST IN HIGHER RELIABILITY MODELLING	Data generation: Development of ontologies and application of FAIR principles ***(not short term?)***	
	It is crucial to assure that ALL available hazard data is identified and used. This was unfortunate in the plasticizer case study- it used only official hazard classification and SVHC identification as source of information and then concluded data was missing. But there were many scientific studies and also EFSA risk assessments available for those substances. Scientific databases, such as PubChem, Hazardous substance databank and even google scholar and more should be used. [Anna Lennquist (ChemSec)] [Note from discussion (comment by Christoph Schuer): practically all the Methods that were mentioned hinge on data availability and Quality and not the Methods, so Echa making their data available would be the game changer for me]	**SHORT-MEDIUM/SIMPLE**: Use the REACH registration information as part of the data collection process. Explanation: Loads of effort has been put forward into the IUCLID database which contains is a living repository for hazard information. By ultizing the tools already available we can avoid duplicative efforts and build off the knowledge we already have	
	Obligatory data-/cost-sharing of relevant data and flexible read-across [Marko Susnik (SMEunited)]		
	Data Collection through REACH data, I'm not sure how easily results are translatable between Chemicals With similar Properties but making data available is an important first step [Andreas Brekke (NORSUS)]		
	Grouping existing chemicals by certain properties in order to identify similar hazardous properties [Kelly Derom (SETAC)]		
	Don´t micromanage, Focus on what matters and gives most value added [Marko Susnik (SMEunited)] [Notes from discussion: this comment refers to gaining a better balance of gains/returns. For example, if there is some chemical for which there is some data gap and therefore some uncertainty, how much would it cost for an SME to close this data gap and whether it makes sense to do this. Further captured: "[SSbD should] not [be] an academic exercise, we cannot make this 100% but be pragmatic. Allow for data gaps and uncertainty, balance]		
	A list of benchmark chemicals that alternative Methods are evaluated against to consistently give appropriate Hazard Levels for. if everyone optimizes for different chemical spaces and there is no common benchmark, we're just working in a vacuum. [Christoph Schuer (Eawag)]		
	Benchmarking: Use well-characterised chemicals as benchmarks ("rulers") to compare new chemicals against: 10.1021/acs.est.6b03786 Note: one would need to agree on which benchmarks for what, but this seems doable if people want to use the concept. [Kathrin Fenner (Eawag), by email]		
	New full-semester course available for chemistry master students on "environmentally safe chemicals" taught at University of Zurich, Switzerland. https://studentservices.uzh.ch/uzh/anonym/vvz/?sap-language=DE&sap-ui-language=DE#/details/2023/003/SM/51117024 Note: it is marked as "short" becuse the course already exists, but in terms of how others could profit from it, for example, if we wanted to convert it into a MOOC, for instance, then it would be "medium". [Kathrin Fenner (Eawag), per email]		
	SHORT TERM/EASY: Collate endpoints from SDSs		
	Short term/simple: Use consensus of multiple independent models for an endpoint to reduce uncertainties about individual estimates		
	For each data asset provide a clear guidance and license on what is legally allowed to do with the data (often you find disclaimers like "Individual data points in this data set may be subject to additional restrictions.")		
	Use the REACH registration information as part of the data collection process. Explanation: Loads of effort has been put forward into the IUCLID database which contains is a living repository for hazard information. By ultizing the tools already available we can avoid duplicative efforts and build off the knowledge we already have		
	Collate endpoints from SDSs		
	Use consensus of multiple independent models for an endpoint to reduce uncertainties about individual estimates		
	For each data asset provide a clear guidance and license on what is legally allowed to do with the data (often you find disclaimers like "Individual data points in this data set may be subject to additional restrictions.")		

	COMPILE AREAS WHERE QSARs CANNOT FIT WITH QAF/OECD 5 PRINCIPLES (e.g., substances where toxicity > water solubility ***(cannot assign app domain)***	Single database also considering OSOA (One Substance, One Assessment); In the whole CSS context, a single database should be created to make access easier	UNCERTAINTY, DATA COLLECTION, ESTIMATION: when evaluating hazard, uncetatinty due to measurement erros and or decisions can be relevant, and limit hazard quantification and decision making
	DATA COLLECTIOM, METHODOLOGIES. The defintion of adequate data collection and/ore generation methodologies may be relevant to ensure a more objective comparison between produts or products	INTRODUCE GMoP (Good Modelling Practice): to allow global regulatory acceptance standards for QSAR accreditation => level playing field with experimental studies	ARTIFICIAL iNTELLIGENCE IN HAZARD PREDICTION: Articficial intelligence tools, such as machine learning or data mining, may help in hazard assessment, as for example in filling data gaps or even data classification
	Do a deep dive into the NAM submissions received by the regulatory authorities and directly discuss challenges / issues in their acceptance / non-acceptance	Data accessibility across multiple sources and beyond ECHA so that leveraging all available (good quality) data can be used to assess hazard via machine learning, predictive tools, validation of in vitro/in silico methodologies	UNCERTAINTY, DATA COLLECTION, ESTIMATION: when evaluating hazard, uncetatinty due to measurement erros and or decisions can be relevant, and limit hazard quantification and decision making
	Medium-term/simple: creation of communication groups to come together, outside of workshops, to get people working outside of silo's	Data collection; Integration of databases (REACH, Ambit, echemportal, subsportplus, and hazards lists (for instance ED lists https://edlists.org/ , SIN list,) and hazard specific information sources (https://easis.jrc.ec.europa.eu/) plus sources of alternatives such as ChemSec MarketPlace	Relevant conditions as a requisite in hazard assessment; avoid classification based on overconservative assumptions or completely unrealistic cases/concentrations and/or based only on worst case assumptions. In that case everything will be classified and the SSbD cannot work because nothing will be safe.
		Identify the data-gaps in property measurement and predictions, i.e. where the OECD TG are not applicable for CEC and there are few data available	Use QSAR approach for mixture Hazard prediction [Laura Mayor (EUT)]
		Databases that are transparent, searchable and traceable. Quality criteria needs to be clearly defined to increased data applicability/useability	Any 'design' SSbD tool should rely mainly on predictors (with explanatory logic to guide design) and perhaps (on hazard) some basic NAM to feed mechanistic understanding... Important ability of any tools will have to be to be able to re-run / transparency required [Andrej Kobe (EC)]
		Consider trait-matching in hazard prediction; by pairing species traits (e.g. detox mechanisms, genomic information, size, metabolic specificities, etc.) with chemical traits, combinations of new chemicals and untested species can be predicted. [Magdalena Mair (UBT)]	Suggestion for new hazard indicators for early state testing using the idea of combining in vitro bioassays with in vitro degradation assays toward cumulative toxicity evaluation (CTE) and persistent toxicity evaluation (PTE): 10.1007/s00204-023-03485-5 Note: it is by 2025 (medium) for proof-of-concept, but longer (long) for full maturation of the workflow. Regarding the complexity, it is "normal to complex (if a battery of in vitro assays is considered "complex") [Kathrin Fenner (Eawag), by email]

		Consider trait-matching in hazard prediction; by pairing species traits (e.g. detox mechanisms, genomic information, size, metabolic specificities, etc.) with chemical traits, combinations of new chemicals and untested species can be predicted. [Magdalena Mair (UBT)]	Suggestion for new hazard indicators for early state testing using the idea of combining in vitro bioassays with in vitro degradation assays toward cumulative toxicity evaluation (CTE) and persistent toxicity evaluation (PTE): 10.1007/s00204-023-03485-5 Note: it is by 2025 (medium) for proof-of-concept, but longer (long) for full maturation of the workflow. Regarding the complexity, it is "normal to complex (if a battery of in vitro assays is considered "complex") [Kathrin Fenner (Eawag), by email]
		Improve cross-species/cross-level prediction for untested/untestable species; use ML/statistical models to extrapolate hazard predictions from surrogate species to species we cannot test and from sub-organismal/in vitro tests to organismic/population endpoints. [Magdalena Mair (UBT)]	Develop IATAs for ecotox to submit via the OECD programme
		Animal-free InFinite tech: merging automated in vitro automatedly translated into in silico for long-term hazard prediction of particulate matter; Explanation: monitoring early (physical/biochemical/biological) events during exposed tissue-on-chip AND translating them in silico system that can propagate them in time to predict chronic diseases in the future (months to years) on much more cost &time efficient approach; validated with data from various NM-exposed animal experiments from last 3 decades. [Janez Strancar (nanoPass / Infinite & IJS)] [Notes from discussion: This refers specifically to microparticles/nanoparticles, but also for combinations of particles and chemicals. Also applicable for bigger systems like vaccines or viruses. Nanopass project is getting this validated]	
		To collection data: link the GIS tecnhology as a tool [Laura Mayor (EUT)]	
by 2025 (medium)		Bbuild a support-network which includes sufficient labs and experts. Objective is to offer SMEs a competative infrastructure to Keep up with larger competitors. [Marko Susnik (SMEunited)] [Notes from discussion: E.g. network within SETAC, but could be more. 23'000 SMEs involved into chemicals registration/ chemicals industry. Plus there will be more, when materials come in. Push stronger for cooperation. Enough resources, enough capacities. Synergies, more structured dialogue. Comment Vangelis: example with NAMs, an approach exists with the Netval group of laboratories acrosss. Maybe do something similar to cover everything for SSbD. Overal, what Marko showed in his talk, this is one of the reasons why things cannot go faster. Need to know which people are inovlved, which labs are doing this kind of work, and slowly build this. This is one of the goals of the SSbD framework. Right now, the SSbD framework is in a testing phase, seeing where it's gonna go. Further comment Marko: regarding quality criteria, were working on this with previous SME ambassadors, but it is not easy to do, but certainly something that is needed. Further captured notes by Anna: The output/labs/consultancies would need to be evaluated to fulfil requirements/standards. It is time and resource-consuming, but needed. Net-val is an approach for laboratories in EU that could be used. Important not to move too fast, things will take time.]	
		medium/moderate; use high throughput automatized (tracking, object detection, other AI methods) testing schemes in early environmental screening; use ML methods (object detection, classification, automatized tracking) combined with automatized experimental setups (pipetting robots etc.) and automatized data analyses to create high throughput methods for chemical screening early on. From a scientific perspective, develop tools in a modular way that can be extended and integrated into user-specific workflows [Magdalena Mair (UBT)]	
		Read-across from short duration biotransformation experiments (e.g., with suspensions of activated sludge) to predict half-lives from simulation studies: 10.1021/acs.est.9b05104 [Kathrin Fenner (Eawag), by email]	
		Facilitate effective access to (all - REACH+EFSA+...) hazard data and also basic predictive tools (QSAR...) sitting on same data from common platform (ECHA) in a way that actively supports plugin of assessment model(s) used for SSbD. [Andrej Kobe (EC)] [Notes from discussion: In order to really support SSbD for all, you need to think of some tools that should be available, e.g. platform sharing tools available for all. The whole PARC logic is exactly on this as well. In order to support SSbD for all, a platform for sharing tools would be valuable. This is also the logic behind PARC. The "by design" implies that we need to use predictive assessments. Tools facilitating this would need to be developed and validated by experimental data.]	
		Data source = USEPA EcoTox database; merge / partner with REACH-based data sources	
		For ensuring consistency between results and legislation, should/could a universal nomenclature be derived to allow for comparison between different endpoints Explanation: at various conferences/workshops etc, the consistent theme between regulators, industry and innovators, is that they cant use the new data, because it doesn't fit within the current evaluation criterion. The creation of universal nomenclature, would allow for the contextualization of the old, and combined with the new, allows for an easier transition.	
		In silico methods and models that have already been developed and validated using previously generated hazard data can be interpolated to generate hazard predictions where it is necessary to fill data gaps. Thus, avoiding further animal testing and costly analyses	
		Ensure that new data being generated from NAMs is made available to refine / improve in silico tools (or develop new in silico approaches)	
		ECHA to organize the REACH disseminated dossier database so that stakeholders like researchers can more readily look for and access the study results. The eChemportal is not practical in this respect.	

	Long term...: legal obligations to share data, open source (currently ECHA would not be able to share data that is owned by the registrants)	improve the data quality in data repositories (too many wrong and incomplete entries)	Mixture assessment approaches and databases.
		Align requirements and resources of REACH, SSbD and other EU regulations to make simpler requirements that could more achievable by SMEs	Standardisation of core data requirements and assessment procedures; This needs to be done across different pieces of EU chemicals legislation in order to make the assessment balanced - and it needs to take into account specificities of different sectors
			CONSISTENCY: Ensure consistency on data quality/uncertainty for Comparative Assessment purposes
			Re-assess the hazard categories to assess their relevance; A lot of data has been generated over the years and new cases/situations have come to light. Instead of just adding new classifications, can we re-think the framework to make it more efficient
			improved hazard assessment combined with realistic exposures can lead to more impactful risk assessments. This will require the development of models
2025-2030 (long)			integrate mechanistic/TKTD knowledge into QSAR modeling; this goes down to integrating all available knowledge on mechanisms of toxicity pathways to QSAR(QSAR-like) models. this involves alignment and integration of data from different databases that were set up for different purposes and likely more data generation. Could also be used to identify species traits connected to toxic outcomes when paired with specific chemicals. [Magdalena Mair (UBT)] [Notes from discussion: feedback by Andrej Kobe: Should importantly rely on some kind of predictors. cannot rely on the endpoint testing completely, but need to conceptualize into tools that really facilitate. Also need to build up the knowledge about chemical, re-run the tools as needed.]
			From one substance to mixture assessment: test mixtures of chemicals released by materials or products, using (in vitro) bioassays relevant for HH or ENV [Ksenia Groh (Eawag)]
			Integrity of data endpoints from multiple sources on same compound. Who does the assessment?
			Data generation/Persistence assessment: develop experimental screening with cut-off criteria beyond OECD TG 301. OECD 301 is a cheap test, which needs a few months to be completed. If the test is negative, then there is no other real screening possible. Simulation tests are required, and these are not workable in a R&I context. Therefore, we need other reliable screening tools, less stringent than the OECD 301. QSARs are not reliable for RB screening. Too many false positives and négatives.
			Define an ultimate workable and comprehensive screening strategy for "no go" hazards as defined in the SSbD Framework recommendations by COM (ED HH&ENV cat.1, PBT/PMT/vPvM/vPvB, STOT RE 1, CMR cat. 1)
			Define an ultimate workable and comprehensive screening strategy for "no go" hazards as defined in the SSbD Framework recommendations by COM (ED HH&ENV cat.1, PBT/PMT/vPvM/vPvB, STOT RE 1, CMR cat. 1)

Figure 3. Screenshot of the combined suggestions on the results from the two breakout groups on Hazard. Note: text in [ ] indicates the submitter of a particular point, plus eventually additional notes taken by Ksenia and/or Anna during the discussion. Note that various ideas (top rows) were not yet specified to any of the 9 pre-defined categories during the breakout period.

NOTE FROM KSENIA's Excel

Short-term highlight:

Data - use all available data, use more data sharing (possibly this is not so "short/simple" though)
This could also be done through a network giving access to expertise and tools.

Game changer highlight:

Getting access to data would also be a gamechanger.
A tool for mixture/material assessments would be a gamechanger.

3.4. Risk Assessment topics in the context of SSbD

3.4.1. Questions

The Risk breakout groups were chaired by Hans Sanderson, Michelle Bloor and Bruno Campos.
The pre-defined questions to the breakout groups on Risk were:

- **Risk assessment**:
  Identify test strategies that better fit the different needs: better addressing uncertainties.
- **Novel methods:**
  Creating methods and suggestions for High Throughput methods for risk assessment at low Technology Readiness Levels (TRLs), addressing human health and environmental impacts (e.g., ECO TTC, tiered approaches).

3.4.2. Proposed ideas

The raw ideas of the three breakout groups on Risk resulted in the following set of net results (Figure 4), derived from the raw input (staccato texts via chat, combined with the discussion on those) and **not yet edited for clarity**. Highlights are in Section 4.2.

how complex→	Simple	Moderate	Complex
how swift↓			
by end of 2023 (short)	Offer surgeries (sit-down, thorough discussion with skilled people) to SMEs (because their views are VERY important at this stage)	Identify & highlight overlaps between SSbD and existing regulatory frameworks	
	Data sharing and accessibility	SSbD requires quantitative tools that : LCA & RA (https://pubmed.ncbi.nlm.nih.gov/28775351/) and learn from the nanotechnology methods.	
		It needs to be applied not only to current technology but also to those that are not developed (TRL 0 - 4)... that requires LCA and prospective RA	
	Tackle gaps beyond your comfort zone, move away from well known chemicals/endpoints	Common databases with relevant data to ensure comparison	
	Incentive better data-sharing (to help with quantitative/data/modelling comments above)	Increase compositional data in that and extend especially to complex substances	
	(A)CLARIFY THE NEED TO ASSESS PROCESS INTERMEDIATES. Clarification need from the EU commission Need for a tiered approach Explaination: We are facing an issue with **chemical intermediates** used during polymer synthesis: should we apply the SSbD Framework on chemicals that are no longer present in their original form in the final product (e.g. Isocyanates that transform into Polyurethane) ?		
	Increase general awareness that risk is relative, nothing is completely safe, their is no zero risk.		
	QSAR	indicative screening testing (biometer for deg, daphnia for eco, etc) as tier 2	Followed by OECD-style testing as highest tier (decreasing uncertainty across the tiers but increasing time and cost)
	Prioritization/deprioritization using a table/diagram (e.g., Risk21) to put hazard (semi)quantitatively on one axis and exposure (semi)quantitatively on the other axis. Green is when exposure/safe level <0.1, red is when that ratio >10 and in between it's orange.	Inlclusion of climate change scenario in risk assessment methods	
		Phys-chem data to predict broad exposure - air, sediment, water > build conceptual model considering use (e.g. down the drain versus CP use)	

	Collation and re-evaluation of QSARs or other models which could be used for first tier hazard ssessment for the most important endpoints during the early stage of the innovation pipeline.	common databases with relevant data to ensure comparison	
		it needs to be applied not only to current technology but also to those that are not developed (TRL 0 - 4)... that requires ex ante LCA and prospective RA	
	SET-UP SIMPLE STRATEGY TO IDENTIFY HOTSPOTS AT LOW TRL. Explanation: Along the product development a particular attention should be given to low TRL since more freedom are allowed at the design stage. In particular at low TRL, many design routes make the full assesment complex and time consuming. A screening tool could allow the identification of **hotspots** with a limited effort.	Simplified non-quatitative methods: test strategies will depend on physical state of substance (liquid/soild/gas). Develop strategy per state for risk in lower TRL	Balance between database informing methodologies or models vs maintaining Intellectual Property.
	Implementation of (A), by identifcation of trade-offs (balance of risks)		
		Expert database (with machine learning) developed by i.e SETAC community to support a harmonized tiered approach to **support risk assessment and LCA** in the context of SSBD	
	Bioassays for environmental assessment of mixtures (e.g. manufacturing discharge?)	Data mining including ML, filling data gaps and uncertainty with Baysian statistics, in vitro tests with cell cultures to follow 3Rs or tests with invertebrates to avoid higher animal experiments Read-across between human and environmental Health where data are available.	
		Development of Exposure Scenarios. Work with chemical sectors to develop greater scope and refinement of human and environmental exposure scenarios that can be codified into tools for all companies (incl. SMEs) to use and further refine if necessary.	
by 2025 (medium)		Exposure (worker and environmental fate) modelling tools based on (modelled) physchem properties are a first but pivotal need. Physchem properties indicating persistency and or mobility with medium to high certainty can/need to be uses as 'not-sustainable' flags.	
		Impact vs Risk assessment for HH & Envt safety. Assess the value of Human & Environmental safety impact categories in step 4 vs safety assessments of uses conducted in step 3. Are some uses better described by risk assessment vs impact assessment?	
		High-throughput in vitro tools to actually measure half-life in various media (for Persisteny/Very Persistency). And harmonized in vitro tools to measure for the criterion Mobile/Very Mobile (water/soil partitioning for various soil types).	
		Approaches for dealing with Trade-offs. Development of frameworks that companies can apply to help make decisions on trade-offs that will inevitably occur across the SSbD framework - e.g. demonstrated to be safe by risk assessment but not "better" vs all sustainability impact categories.	
		Integration of comprehensive tools that could address global toxicity impact and pollution "limits" that the receiving compartments could support	
		Main principle could be to integrate LCA analysis into env risk assessment but then conduct to "local env risk assessment" that would conisder local sensitivity (e.g. specific drought situation)LCA would need to better address uncertainty or on the contrary to display more clearly hypothesis and limitations of the method	

2025-2030 (long)		not having mixture toxicity included in the SSbD. Why? interactions and persistence of these chemicals can interfere with the life cycle of them and therefore impact the environment.	quantitative in vitro to in vivo extrapolation via mechanistic effect models
		review existing RA processes and streamline redundant elements with novel/better SSbD elements	Improving the exposure assessment process to reduce necessary redundancies, increasing the relevance (e.g., decreasing generic nature of exposure assessments) and increase environmental realism
			Risk assessment framework for the circular economy. Changing from the linear model in regulatory risk assessment to support the EUCOM's objective for a circular economy.
		Identification of structural moieties / chemical class that promote adverse human health or environment (e.g. halogen, CF3) and "design out"	Complex - long term - Develop LCA-based tool(s) that predict the environmental impacts of novel chemicals based on limited data (based on digital tools, such as AI), that would be user friendly and require minimal knowledge of LCA, but only on the chemical production
			Integrate Wildlife / non target organisms into env risk assessment either by including env surveys in risk assessment or by adapting emission limits to the receiving compartment
			Connect env risk assessment methodologies with an adaptation of Nature-based Solution as developped by the IUCN

Figure 4. Screenshot of the combined suggestions on the results from the three breakout groups on Risk.

The chairs and rapporteurs of the three groups on Risk further made the following comments:

1. Has to include low cost solutions (even playing field) - have to take SMEs with us
2. These ideas are focused on ecotoxicity and toxicity and not on all the many other sustainability indicators such as eutrophication, acidification, photochemical formation, ozone depletion, land use, water use, particulate matter formation, …
3. It has to be recognized that all is relative, nothing is completely safe, their is no zero risk.
4. The typical test strategy would be tiered approach. This should be combined with expert knowledge, respectively expert knowledge data bases. The later one should be developed as a larger EU wide usable and also fed by a large community
5. High throughput methods are available, however are only efficient if very large number of substances should be screened.

3.5. Life Cycle Analysis Challenges

3.5.1. Questions

The LCA groups were chaired by Hanna Schreiber and Leo Posthuma.
The pre-defined questions to the breakout groups on LCA were:

- **Integrate safety and sustainability within life-cycle thinking:**:
  Identifying methods that can serve to integrate safety and sustainability dimensions within life-cycle thinking?
- **Absolute sustainability assessment:**
  Challenges in creating absolute Environmental Sustainability Assessment?
- **Uncertainty assessment and presentation:**
  How can data quality and uncertainty assessment be integrated into the SSbD framework - to the process of Life Cycle analysis?
- **Missing data:**

User's perspective of missing data: approaches for dealing with missing data in LCA from upstream and downstream processes.

- **Prospective LCA:**
  Prospective LCA, from laboratory to industrial scale and how to establish this.

3.5.2. Proposed ideas

The raw ideas of the two breakout groups on LCA resulted in the following set of net results (Figure 5), derived from the raw input (staccato texts via chat, combined with the discussion on those) and **not yet edited for clarity**. Highlights are in Section 4.2.

how complex→ / how swift↓	Simple	Moderate	Complex
by end of 2023 (short)	#4 BUILD ON EXISTING DATA GAP FILLING METHODS USED IN REGULATION AND ELSEWHERE. Several data gap filling methods are already applied under different regulations, but not in a consistent/harmonized way. This could be a starting point for dealing with missing data in the short term.	#2 DEFINITION OF SYSTEM BOUNDARIES: LCA requires a definition of system bounderies. These system bounderies will determine what is in/out of the sustainability definition. How to set the appropriate boudaries so that also data collection/ missing data is manageble?	
	General suggestion: Simplify existing techniques for early stage explorative assessments	#3 RELIABILITY SCORE: Giving a reliability score to data to rate quality or uncertainty	
	Jutta : Provide different levels of "rich" LCI datasets to test the implications of missing data on pilot level	Javier: short /medium term: DATA EXCHANGE PLATFORM FOR LCA. faciliate data excanges to model the whole life cycle in LCA	
	Sébastien: iDENTIFY THE TOOLS AND REFERENCE CRITERIA USED IN SAFETY AND SUSTAINABILITY assessments to see where we can work towards convergence	Javier: AI TECHNIQUES FOR MISSING DATA: use AI for data search and missing data in LCA, including statistical analysis (sensitivity and uncertainty)	
	Abbate: (1) Short/-: alignment and clarification on terminology/parameters used between safety and environmental aspects		
	Leo: Short term/simple: DESIGN TRAINING, CURRICULUM STUDENTS CHEMISTRY ETC. Motive: it is key to train new generations of scholars with SSbD as principle.		
by 2025 (medium)	Léo: Short term/Medium complex: SIMPLIFY EXISTING METHODS (TOOLS). This was asked by large industry and SME and is key for SSbD success. leo Posthuma	#3 SECTOR-BASED INITIATIAVES: Support sector-based initiatives to generate and share data, methodologies and approaches relevant for SSbD assessments	David : Medium term/ complex: INDUSTRIAL CHEMISTRY DB: Build an open database of updated industrial processes in order to allow LCA modelisation of complex supply chains
	Abbate: (Q4) Medium/simple: investment in data collection and management within an industry (softwares for data management – for LCA data	#4 DEFAULT DATA: Using default values for missing data based on chemical class or QSAR	
		#4 BUILD ON CHEMICAL SPACE ANALYSIS TO FILL MISSING DATA. Chemical space analysis starts from the entire space of ALL marketed chemicals as benchmark/frame to derive "similarity" scores for new chemicals and related properties to fill related missing data.	Lucia: Q2. how to calculate how much impact can be given to this specific sector
		Leo: Medium term/Moderately complex: DEVELOP ToxGPT-type approach. Motive: this helps SAFETY assessment in early stage. leo Posthuma	
		Abate: (Q1) Medium/Medium: Possibility to regionalize the emission/impact with background information	
		Markus: Q1) As for safety, define sustainability criteria // Explanation: E.g.; analogously to risk quotients in toxicity testing (Hazard/Exposure) develop sustainability metrics (e.g. frequency/intensity of application/European tonnage) or something else Q2) No common definition of Sustainable? What is sustainable? Does it mean „no waste at all"?	
2025-2030 (long)		Better use of existing data. Collect alll insights from what we already know. Use machin learning to simplify	#2 #5 DEFINE SPATIALIZED ECOLOGICAL BOUNDARIES FOR CHEMICAL POLLUTION. Benchmarking the ecological impact of a new chemical or material against ecological targets requires to consider (a) chemical pollution as a whole as background, (b) regional differences in ecological capacities to dilute chemical pollution, and (c) be applied to market-level impacts (i.e. based on scaling up impacts). Such boundaries will have to be consistent with the Planetary Boundaries framework as well as with LCA boundary conditions (i.e. quantitative, comparative).
			#2 AGREEMENT ON ALLOCATION MECHANISM: discussing and agreeing on an allocation mechanism of the absolute amount of chemicals that are allowed to be still produced worldwide not to exceed the novel entitizes boundary even more. I find the applied allocation mechanism (via which "fair quotas" are supposed to be achieved) of the EPC (equal per capital) problematic, as it results in the action premise "expensive=ecologically good"

Figure 5. Screenshot of the combined suggestions on the results from the two breakout groups on LCA. Colored cells indicate the short-term and potential game-changer highlights identified by groups 7 and 8.

4. Plenary wrap-up session with highlighted ideas for SSbD

4.1. Introducing the plenary wrap-up

After a short break (after the breakout sessions), Annegaaike re-opens the plenary session, in order to concisely recapitulate some main results of the breakout sessions, and look forward to the next two steps: the 2nd online SETAC-Café style Consultation Meeting, and the on-site meeting that will be organized back-to-back with the SETAC Europe Annual Meeting in Seville, May 2024. She introduces that the plenary wrap-up session will consist of the presentation of some highlighted results from the breakout groups, followed by a reflection of the SETAC and EC organizers, and a final outlook to the further steps in the SETAC-EC Consultation process.

4.2. Presenting the highlights of the breakout sessions

Annegaaike asks the chairs of the 8 breakout groups to present the highlights that were identified in each of the groups. She explains that the organizers had to choose for this relatively compact feedback, in view of time limits for the whole Consultation Meeting of today, but that this means that we now have indeed potentially thrilling highlights. Annegaaike explains that detailed results will be presented in a Consultation Meeting report.

4.2.1. Highlights of the breakouts on Hazard

The highlights identified in reply to the questions on hazards are:

1. There is a massive influx of data arriving from all sides as well as new methods which are being used to produce them. Even experiences scientists are struggling to keep up with the novelties and the ever changing degree of acceptance of methods and there is a need for two types of centralized databases/repositories which will provide a quick and easily available resource allowing scientists to keep up to date.

2. Alternative methods and their associated degree of uncertainty need to be assessed using relevant criteria to avoid over conservatism when they are used and to highlight where other data can be combined with them in a weight of evidence approach (e.g., combinations of in vitro and QSAR approaches may provide more relevant information than when used alone and certainly more than an empirical in vivo study used alone). A better definition of adequacy of data should be compiled (and recognized by the authorities).

3. For the future, NAMs will start to outpace the so called “gold standard” methods which are slower and more costly. Thus, In the light of QAF and AI NAMs, there should be more investment (e.g. in datagap analysis including mixture effect analysis) and attention paid to higher reliability modelling. QAF should be reviewed in terms of its relevance to all QSAR approaches (e.g., when toxicity is > solubility limit this cannot be an unambiguous algorithm). Introduction of Good Modelling Practice (in the same way as Good Laboratory Practice) may help to build confidence in in silico NAMs and will avoid confidentiality issues.

4. In the long term the classification process could be rethought out to make it more efficient and appropriate to real hazards and more impactful risk assessments.

4.2.2. Highlights of the breakouts on Risk

The highlights identified in reply to the questions on risk are:

1. Data availability and access is critically important.
   Sound and robust data is the basis to develop next generation risk assessment support tools and models. Where tonnage bands, grouping, read-across and the use of QSARs were important for REACH, the next generation models and tools will take place in an era of Big Data, Machine Learning and Artificial Intelligence.

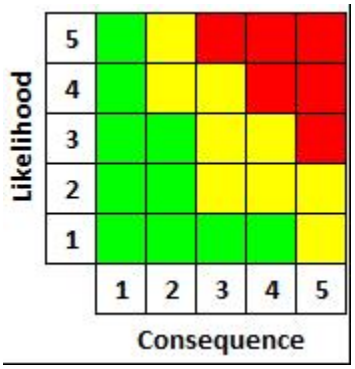
These technologies will be important in the years to come in delivering SSbD and the CSS – tools and methods designed incorporating different levels of innovation will be needed to ensure a common understanding and level playing field.

2. Due to the different actors and needs in the sector, tiered and differentiated approaches will be required to meet these.
   The suggested Framework for SSbD step 4 (environmental sustainability assessment) from the EU Commission will require further development of a tiered approach, which integrates Risk Assessment approaches with Life Cycle Assessments.
   There are good tools already available e.g. on aquatic toxicity with the USEtox method – but this needs to supplemented with additional tools relevant for different levels of innovation with the chemical sector to also facilitate SME's capabilities and needs as well as larger companies higher tier methods.
   This is needed to be able to inform innovation in the selection of candidate molecules moving forward in the innovation process leading to more sustainable choices with increasingly data richness and robustness as the innovation process advances until market release.

Further highlights were identified in the three breakout groups on Risk, as follows.

The short-term highlights identified in reply to the questions on hazard data provision were:

1. It is suggested to use the risk assessment thinking in the LCA process as known from e.g. the HESI Risk 21 methods (https://risk21.org/). See figure. Both in terms of assessing significance but also in terms of tool complexity – in hazard characterization moving from simple to more complex in line with decreasing assessment factor assignment to balance and improve conservatism and realism as well as accuracy and precision – e.g.: eco TTC > read-across > SAR > QSAR (in silico) > in vitro > in vivo > SSD > communities > cosms > field > EQS (?). Similar in exposure assessment moving from simple box-based exposure modelling laden with conservative assumptions – towards more realistic, empirical, and compound and environment (site) specific assessments. This methodological approach is also applicable in regard to the different tiers of innovation within the companies moving from simple conservative methods for the early tiers of innovation to more complex methods at higher levels. Same principle between companies – simpler/lower tier methods for low volume chemicals and SMEs – but also ensuring availability of complex/higher tier models for larger companies and higher volume chemicals.



The potential game-changer highlights identified in reply to the questions on hazard data provision were:

2. We did not realistically identify one or more game changer innovations beyond deepening the points under the near term described above. This is maybe most obvious in terms of optimizing the usability of the plethora of big data across multiple areas of science that are accessible but require additional Artificial Intelligence (AI) to become activated and relevant for supporting analysis – e.g. further deepening of AOPs - an example in human toxicology of this is the Comparative Toxicogenomic Database (https://ctdbase.org/) where users are guided through the toxicological analysis.

4.2.3. Highlights of the breakouts on Life Cycle Assessment

The short-term highlights identified in reply to the questions on LCA were:

1. Regarding question #4, the short-term highlighted issues was defined as: "BUILD ON EXISTING DATA GAP FILLING METHODS USED IN REGULATION AND ELSEWHERE. Several data gap filling methods are already applied under different regulations, but not in a consistent/harmonized way. This could be a starting point for dealing with missing data in the short term."
2. Regarding all data and tools that are needed, the short-term highlighted issues was defined as: "Simplify existing techniques for early-stage explorative assessments"

The potential game-changer highlights identified in reply to the questions on LCA were:

3. Regarding questions 2 and 5 the potential game-changer highlight was defined as: "DEFINE SPATIALIZED ECOLOGICAL BOUNDARIES FOR CHEMICAL POLLUTION. Benchmarking the ecological impact of a new chemical or material against ecological targets requires to consider (a) chemical pollution as a whole as background, (b) regional differences in ecological capacities to dilute chemical pollution, and (c) be applied to market-level impacts (i.e. based on scaling up impacts). Such boundaries will have to be consistent with the Planetary Boundaries framework as well as with LCA boundary conditions (i.e. quantitative, comparative).
4. Regarding LCA-issues in general, the potential game-changer highlight was defined as: "Better use of existing data. Collect all insights from what we already know. Use Machine Learning to simplify and bridge data gaps/insights"

5. Closing the Consultation meeting

5.1. Reflections by Sofie Nørager (EC)

Annegaaike first gives the floor to Sofie Nørager (EC).

Sofie highlights that SSbD is a concept to which we are not easily used to, it is not an "animal, that we can easily tame". Sofie stresses the apparent need to make good science available for use in the context of the CSS and especially its core element of SSbD. She expects that the SETAC-scholar community has a wealth of good ideas, for which it is a challenge to move them forward to utility – which asks for a highly 'forward-looking' mindset: what will be done with the science? What can science bring to the table, and indeed – as she cites – 'get Green Swans to fly'? Sofie invites the SETAC scholar community to be not shy and make the necessary change.

5.2. Closing remarks and thanks expressed by the chair

Annegaaike thanks the chairs and rapporteurs of the breakout groups, emphasizing that especially the rapporteurs have done and excellent job. They were asked to copy proposed ideas in the chat, position those in the Excel-format on the right spot, and key track of a swiftly developing brainstorm-by-chat. Rapporteurs were Tamar Schlekat, Nathalie Vallotton, Alan Samel, Barry Hardy, Anna Lennquist, Monika Nendza, Eva Hatzl and Erwan Saouter.

Annegaaike finally thanks all attendees for their attention, the speakers for their valuable and to-the-point contributions, the SETAC-office for their support, and the organizing committee (SB and EC) for their efforts to organize the present, and subsequent, meetings. She announces that the 2nd Consultation Meeting is pre-planned for 31 January 2024.

Then Annegaaike closed the meeting.