2022 SCOPING MEETING

ACTIVITY PROPOSALS POSTERS

In this document you will find the posters of the activity proposals pitched at the 2022 Scoping Meeting.

Each poster highlights gaps in knowledge or methodology associated with the proposal, its objectives, its expected impact and, where available, additional or supporting information for further reading.

ECETOC 2022
SCOPING MEETING

13-14 September,
Brussels

LIST OF ACTIVITY PROPOSALS

1. Use of big data and AI technology to prevent occupational diseases
2. Framework to facilitate the development of Safe and Sustainable by Design chemicals
3. Assessing risks to biodiversity: Improving our understanding and prediction through modelling
4. Understanding the environmental hazards of bio-based and circular-waste chemicals
5. Development of grouping approaches for persistence assessments
6. Leveraging available experimental data to investigate the suitability of a default activation energy for temperature correction of biodegradation rates
7. Exposure-led programme for a step-change in human and environmental safety and sustainability assessment of chemicals – Recommendations to stakeholders
8. Novel statistical approaches for improving exposure assessment models
9. Cross-species extrapolation in regulatory hazard assessment of chemicals
10. Capacity development in industry and agencies on NAMs
11. Omics data handling and analysis training program
12. Enabling regulatory use of omics by forming an expert group to develop an Omics Data Interpretation Framework for Regulatory Application (ODIFRA)
13. Quantitative validation of NAMs across interdisciplinary data domains
14. Rethinking validation of NAMs
15. In silico/QSAR tools – Comprehensive review of applicability and applicability domains of the different tools
16. Towards a formal incorporation of predictive models in chemical hazard evaluation

Use of big data and AI technology to prevent occupational diseases

The global burden of occupational diseases vary between 5-7% of the total mortality. Associated economic costs vary between 2-6% of EU countries GDP.

More data-driven prevention is needed and becomes reality with AI technology.

WORKSHOP

Eelco Kuijpers
TNO

ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- High-quality data is fragmentedly available and often not public (due to e.g. GDPR and IP).
- Privacy enhanced technologies (PET) are capable of overcoming these issues, but application is still in its infancy.
- Machine learning models efficiently use data, reducing the need for data, but are largely missing for the prevention of occupational diseases.

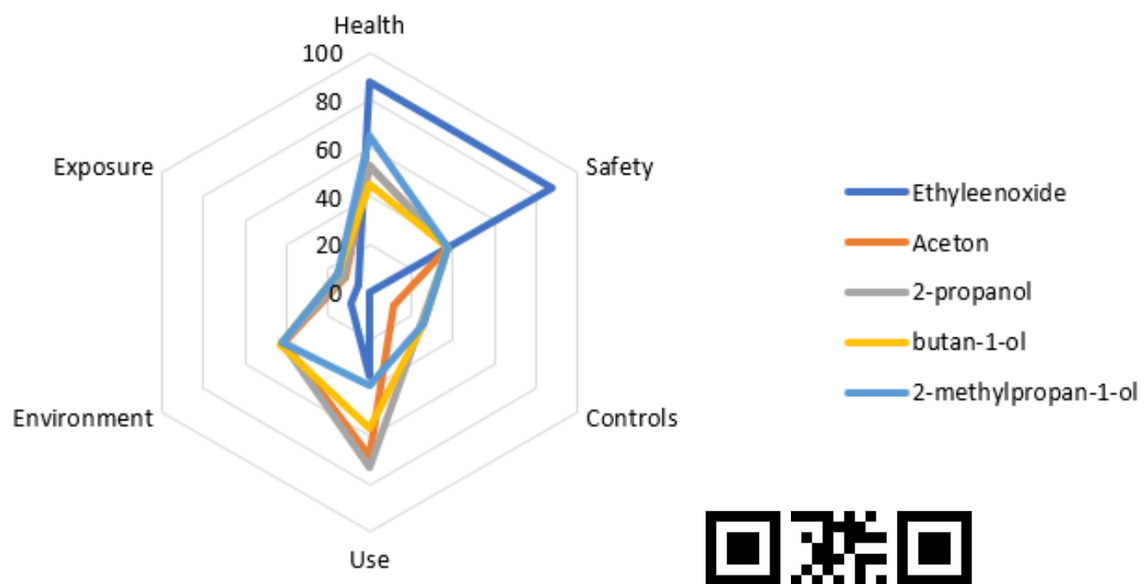
OBJECTIVES

- We propose a workshop which includes the following aspects:
  - Introduction on PET technology and machine learning;
  - Some examples with the Substance Information System (SIS);
  - Discussion on industries' data (sharing) needs, challenges and the added value of the aforementioned technologies;
  - Defining a priority use case as a possible next step.

EXPECTED IMPACT

- The target audience will be trained on the possibilities of PET and machine learning technologies.
- The main expected outcome is a workshop summery with industries' identified needs, challenges and possible next steps.
- **Ultimately:**
  - More data-driven prevention becomes reality.
  - Improving worker health

ADDITIONAL INFORMATION



More info see:

https://diamonds.tno.nl/sis

Framework to facilitate the development of Safe and sustainable by design chemicals

Safe and sustainable chemical innovations need to be supported by a "structurally organized system or framework" of different predictive in-vitro and in-silico methods which enables efficient assessment of potential environmental and human impacts early in the design phase.

TASK FORCE

Neeraj Shandilya,
TNO, Netherlands

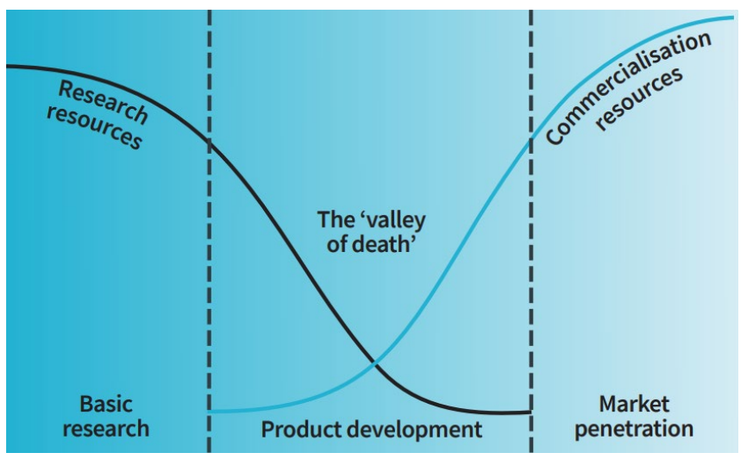
ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- Several NAMs: which one to use and when?
- Coupling performance or functionality driving properties with risk relevant data from NAMs
- An evidence-based decision making process instead of precautionary or conservative approach
- Effective data use through machine learning approaches

OBJECTIVES

A conceptual framework to structure the NAMs retrieved information and facilitate the decision making process through:

- mapping performance/functionality driving properties with safety in a Substance Information System (SIS);
- identification of potential substitutes;
- sustainability and safety screening: raising early red flags



EXPECTED IMPACT

- Coherent fit of the innovative product development with the EU plans for a greener future
- Useful tool to accelerate market uptake of new and alternative chemical products and technologies
- High economical and societal relevance to the industry

ADDITIONAL INFORMATION

EC (2020) Chemicals Strategy for Sustainability – Towards a Toxic-Free Environment, COM(2020) 667 Final.

Safe and sustainable-by-design cefic.org

Safe and sustainable by design chemicals and materials - Publications Office of the EU

ECHA, New Approach Methodologies in Regulatory Science Helsinki, 2016

Economic Analysis of the Impacts of the Chemicals Strategy for Sustainability, Final Report for Cefic, April 2022

eceftoc

Assessing risks to biodiversity: improving our understanding and prediction through modelling

Biodiversity loss is one of the biggest environmental challenges today and resulted in much strategizing and consideration from governments as well as industry to prevent its further decline.

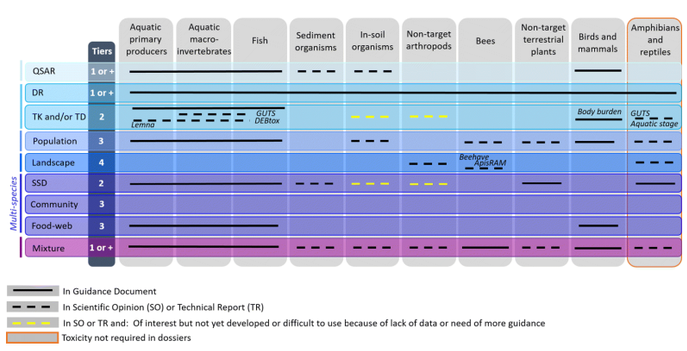
Mechanistic effect models used as predictive tools in ecological risk assessments – can they be used to address the objectives of biodiversity risk assessments?

WORKSHOP

NIKA GALIC, SYNGENTA AG

ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

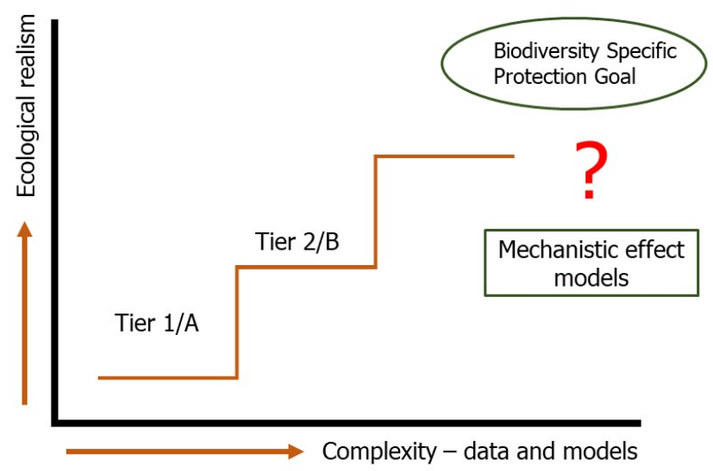
- Biodiversity risk assessment – currently **protection goals** and assessment approaches are **undefined**
- Mechanistic effect models (MEMs) used as **predictive and explanatory tools** in ecological risk assessments
  - Represent individuals, populations, ecosystems
  - Developed for specific objectives and domains of applicability



Larras et al. 2022

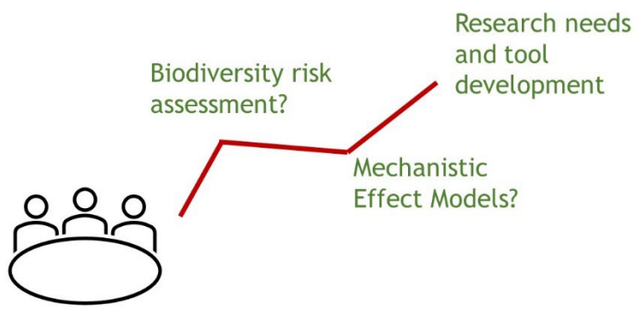
OBJECTIVES

- **Define protection goals and endpoints** for biodiversity risk assessments – spatial and temporal component, metrics for assessment
- Understand when **MEMs** should be applied
- Identify **needs for future research** and tool development



EXPECTED IMPACT

- **Multi-stakeholder agreement** on the objectives of biodiversity risk assessment
- Identify relevant modelling approaches
- Carve out **a research path** for appropriate tool development



ADDITIONAL INFORMATION

This topic is **relevant to** multiple stakeholders and experts, including **different sectors of chemical industry** given the broad concerns about impacts of chemicals more generally.

The proposed workshop will also **deliver a publication** describing the current challenges for biodiversity risk assessments and possible solutions, as well as the potential for MEMs to be used as explanatory and predictive tools.

eceTOC

Understanding the Environmental Hazards of Bio-based and Circular-waste Chemicals

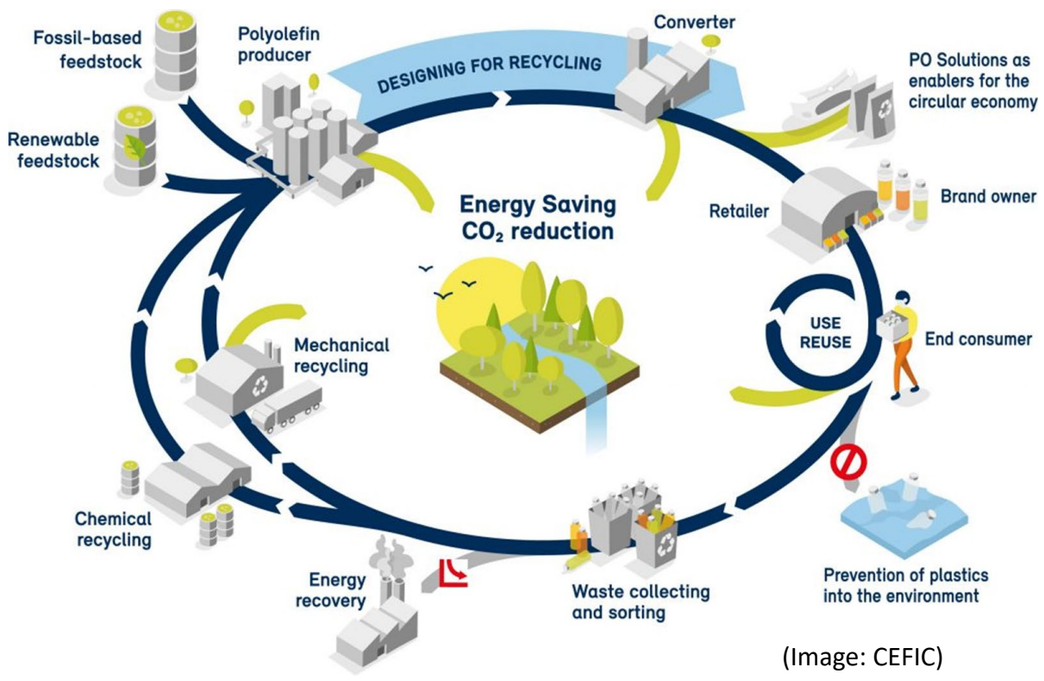
In order to become carbon neutral by 2050 we need a rapid transition to circular economy. Bio- and circular-based feedstocks are increasingly being used as "drop-in" or novel chemical feedstocks in products. There is an urgent need to quickly evaluate the environmental risk of novel feedstocks from manufacturing through to end use in products.

TASK FORCE

Sarah Hughes, Shell

ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- Evaluate the landscape of waste and circular chemical products
- Uncertainty on environmental hazard of these chemicals compared to conventional petrochemicals
- Differences in circular chemical processes "drop-in" vs novel bio-chemicals
- Need to understanding ecotoxicity risk throughout the product life cycle



(Image: CEFIC)

EXPECTED IMPACT

- Safe adoption of bio- and circular-wastes
- Faster & safer transition to circular economy
- Safer transition to circular economy
- Reduce product testing through stronger read-across
- Identify future science needs of tomorrows chemical feedstocks

OBJECTIVES

- Review the state of alternative bio-and circular-based chemicals
- Evaluate environmental risks of all bio-circular feedstocks
- Identify gaps in science
- Identify where data could be read-across from conventional chemicals
- Forecast if bio and circular waste processing could alter risks conventional manufacturing processes (e.g., effluent discharges)

ADDITIONAL INFORMATION

Bio- and circular-based feedstocks are being proposed for incorporation into many different chemical processes and products. This Task Force will help companies and regulators understand the landscape of different chemicals produced by wastes where there are data gaps for their risk assessment throughout their manufacture and use.

ecetoc

Development of grouping approaches for persistence assessments

Persistence is an increasingly important property for sustainability and regulation of chemicals.
Persistence data are very scarce, but demand is increasing rapidly.
Testing is challenging and costly – assessment outcomes trigger risk management and animal testing.
Grouping approaches are not well developed but are sorely needed.

TASK FORCE/EXPERT GROUP

CHRIS HUGHES

RICARDO ENERGY & ENVIRONMENT

ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- Substance characteristics (structure and properties) that influence relevant degradation endpoints.
- Degradation at low, environmentally relevant concentrations.
- Category/read-across justifications and in silico methods.

OBJECTIVES

- Identify opportunities to implement grouping approaches for persistence.
- Address all key endpoints: degradation kinetics, transformation products and non-extractable residues (NER).
- Address aspects of (and barriers to) regulatory acceptance vs experimental testing.

EXPECTED IMPACT

- Improved understanding of factors influencing persistence.
- More appropriate grouping and P assessments.
- Improved compliance with regulatory requirements and reduced testing costs.
- Fewer false positive P outcomes.
- Urgent solutions for complex UVCB substances.

ADDITIONAL INFORMATION

Persistence is moving toward the centre of EU regulatory strategy, and the chemicals industry needs to wake up to this new reality.

For more information, see outputs from the Cefic-LRI ECO52 project.

Leveraging available experimental data to investigate the suitability of a default activation energy for temperature correction of biodegradation rates.

ECHA has been using the Arrhenius equation to any DT50 generated at a temperature other than 12 °C. The correction is done using a default average value for the activation energy (Ea) on a DT50 which includes the lag phase and the formation of non-extractable residues.

This practice is considered overly conservative and uncertain as it results in substances being inadequately labeled as persistent and/or very persistent .

TASK FORCE

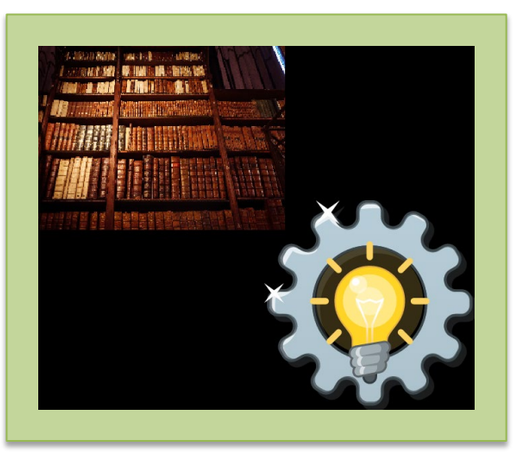
Marie Collard, Firmenich

ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- **Relevance of the use of a single default Ea value derived from soil data**
- **Impact of temperature of collection of the inoculum**
- **Origin of EFSA's value**
- **Lack of alternative methods/values**

OBJECTIVES

- **Review available literature and data to assess:**
  - **relevance and accuracy of the practice**
  - **impact of the temperature inoculum is collected at**
- **If possible, propose an alternative method.**



EXPECTED IMPACT

- **Provide support for an alternative strategy**
- **Avoid mislabeling of substances as SVHCs**
- **Proactively provide scientific support for the update of the guidance (PMT implementation)**

ADDITIONAL INFORMATION

Data may be available from

- **The ECHA database**
- **EFSA reports**
- **Publications**
- **Horizon 2020 project "ReArrhenius (Re-evaluation of temperature correction in microbial biodegradation kinetics)"**
- **The industry**

Exposure-led programme for a step-change in human and environmental safety and sustainability assessment of chemicals – Recommendations to stakeholders

Current regulatory programmes on chemical safety are stalling due to focus on hazard alone, whilst chemical safety and sustainability assessment need to be informed equally if not more by exposure considerations.

With the prospect of revision of European chemicals control legislation 2022-2023, are important years to advance this field of applied science.

WORKSHOP

JAN URBANUS, SHELL

ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- Wide misconception among non-experts that 'hazard = risk'
- Insufficient expertise in stakeholder organisations – development stalling
- Industry exposure data not disclosed
- Selective data, untransparent methods in academic publications

OBJECTIVES

Convene a group of leading scientists in a workshop to develop recommendations to all stakeholders (companies, trade associations, REACH consortia, regulators, institutes, academia)

Prepare a report with recommendations

Invite stakeholders incl ECETOC members to act on the recommendations

EXPECTED IMPACT

The workshop and report will contribute to:

- Stakeholders implementation of ECETOC recommendations
- Increased trust between stakeholders (high on C, R and I, low on S)
- Better decisions on safety and sustainability of chemicals

ADDITIONAL INFORMATION

Build the recommendations with the Trust Equation in mind:

$$T = \frac{C + R + I}{S}$$

Trust is a function of credibility, reliability, intimacy between partners and which is negatively affected by self-orientation

ecetoc

Novel statistical approaches for improving exposure assessment models

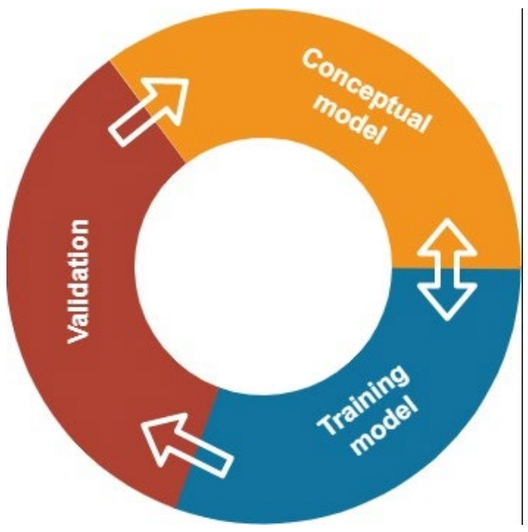
The goal of this project is to look for novel / new approaches for exposure modelling, improving on the conceptual design- , training of the model- as well as the external validation phase

TASK FORCE

Eelco Kuijpers,
Remy Franken,
TNO

ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- Focus currently mainly on improving user friendliness of tools (which is not wrong)
- Validation results show a need to improve accuracy / conservativeness of models
- Unclear how validation results can be translated to conceptual model changes / improvements

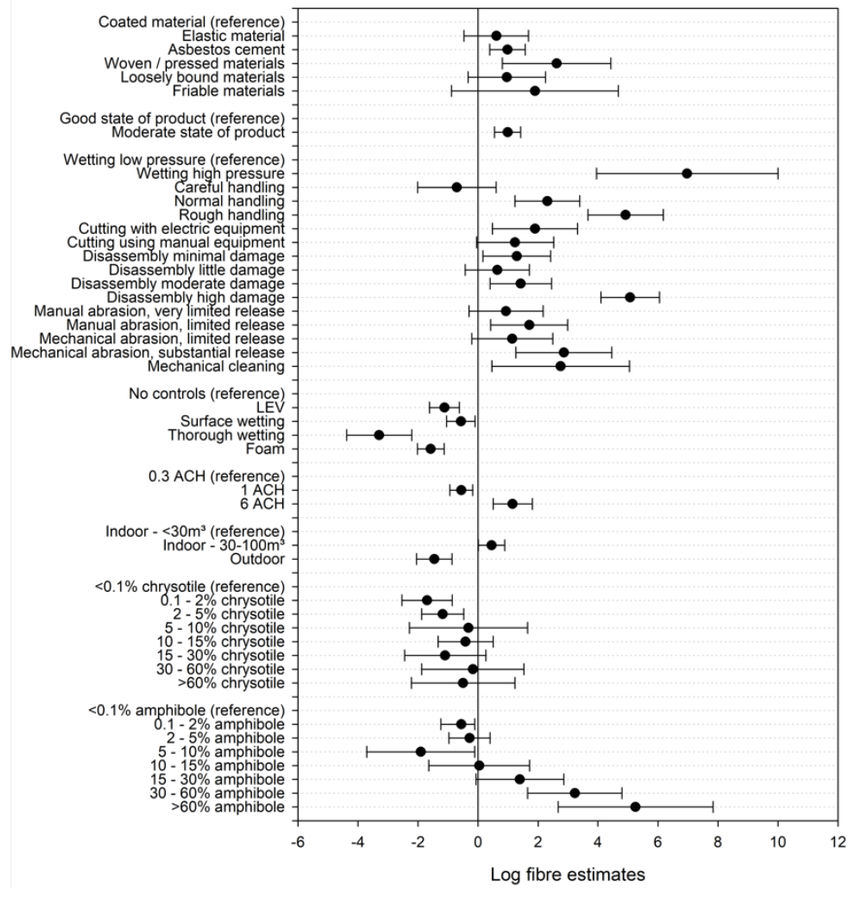


EXPECTED IMPACT

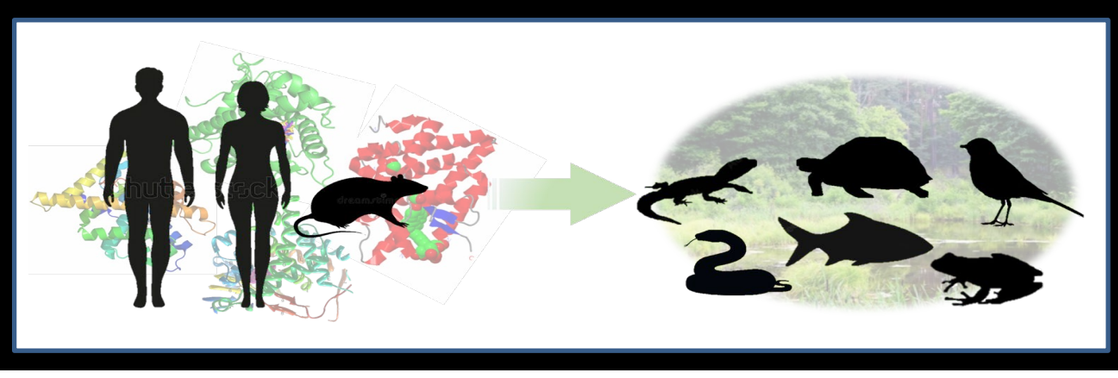
- Novel statistical approaches tested and compared for suitability exposure modelling in general
- New ways to translate validation results into model improvements
- Improvements made to ECETOC TRA V3.1
- Ultimately, improved worker health

OBJECTIVES

- Translate validation results into model improvements with use of different novel statistical approaches
- Compare impact on improvements between different approaches:
  - Linear regression (see example local controls Foam appeared less effective than original assumed);
  - Bayesian;
  - Machine learning;
- Make use of available exposure data from previous conducted validation studies
- ECETOC TRA v3.1 as case study:
  - Conservativeness, model trends, accuracy of model parameters, PROC baseline estimates, etc.



Cross-species extrapolation in regulatory hazard assessment of chemicals



Growing interest for cross-species extrapolation in regulatory science (e.g., new approach methodologies - NAMs, endocrine disruption assessment)

Appropriately apply hazard information across species to protect ecological entities

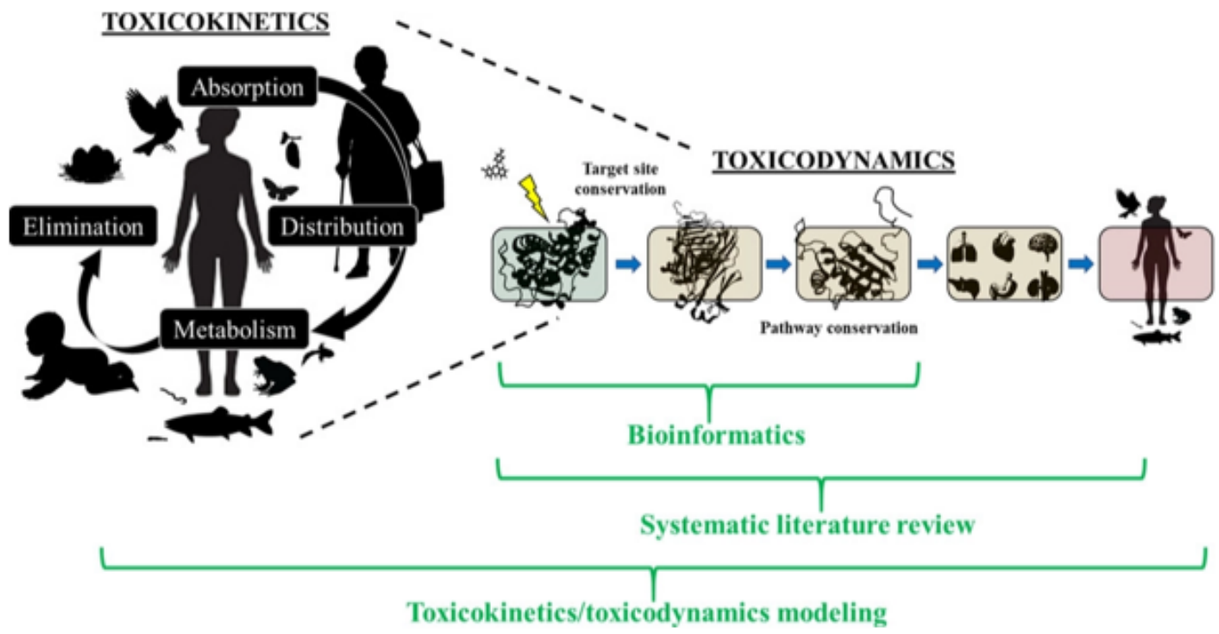
Understand state of the science for cross-species extrapolations

TASK FORCE

Katie Coady and Laurent Lagadic
BAYER CROPSCIENCE

ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- The following are important factors for cross-species extrapolation: physiology, life history, toxicokinetics, toxicodynamics.
- There are multiple approaches for cross-species extrapolation – which is the best for regulatory decisions?
- Data gaps exist for many environmental species – where should efforts focus to fill these data gaps?



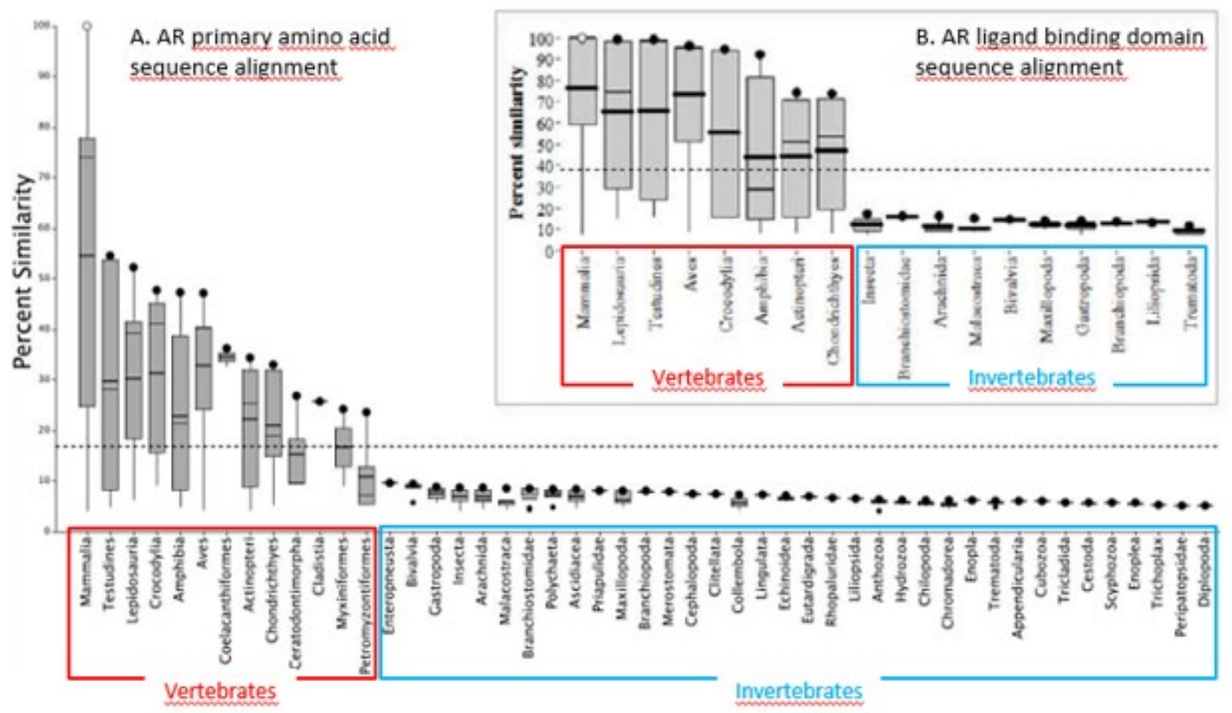
From LaLone *et al.* (2021), International Consortium to Advance Cross-Species Extrapolation of the Effects of Chemicals in Regulatory Toxicology. *Environmental Toxicology & Chemistry* 40, 3226-3233.

OBJECTIVES

- Survey methods and provide recommendation on approaches for cross-species extrapolation in regulatory scenarios
- Identify high research priorities to enhance cross-species extrapolations
- Integrate perspectives with other groups evaluating cross-species extrapolation (*e.g.,* ICACSER group at SETAC)

EXPECTED IMPACT

- Deliverable: Guidance document / recommendations on the use of a "cross-species extrapolation toolbox" in regulatory scenarios
- Enhance coordination on cross-species extrapolation methods and data gaps with other interested parties.
- Increase use and acceptance of cross-species hazard assessments; minimize animal use in hazard testing



From LaLone *et al.* 2018. *Environmental Science & Technology* 52:13960-13971. www.seqapass.epa.gov/seqapass

ecetoc
WE ARE THE CENTRE FOR CHEMICAL SAFETY ASSESSMENT

Capacity Development in Industry and Agencies on NAMs

The transition to less animal testing requires change management:

- To develop and validate experimental methods
- To drive change in legislation
- **To educate the community on how to use and interpret NAM data in a relevant manner**

EXPERT GROUP

Heli Hollnagel, Dow

ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- Regulatory (eco)toxicologists are largely trained to interpret animal studies, both in Industry & Agencies
- Lack of opportunities for continuing education of professionals on
  - novel approaches as such and
  - within assessment frameworks
- This creates reluctance to accept NAM data

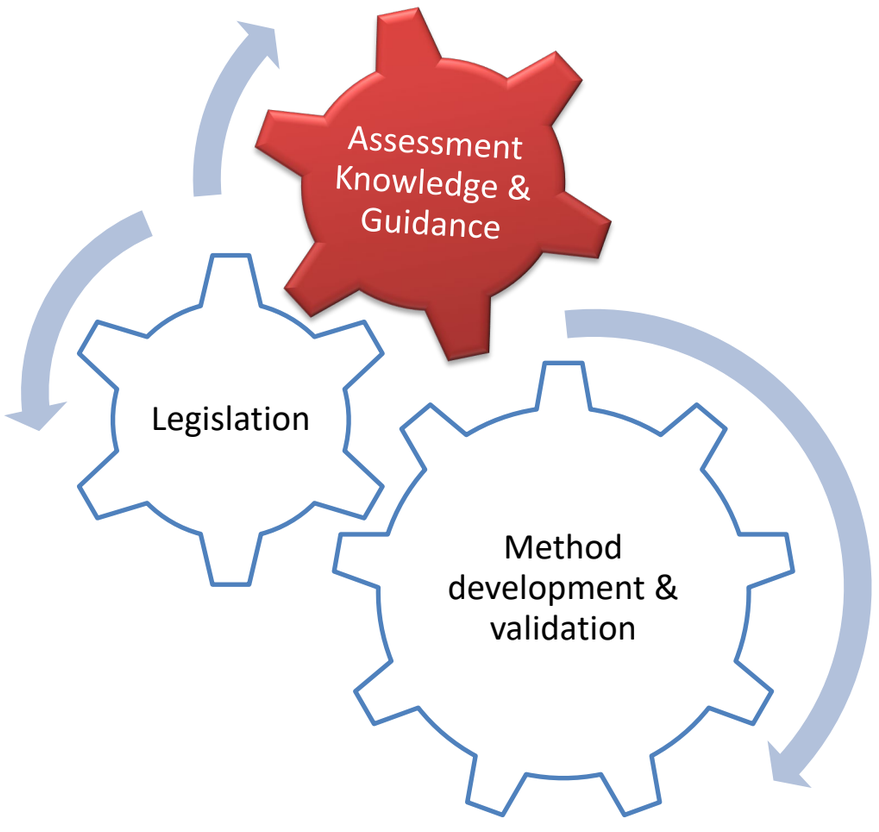
OBJECTIVES

- lower the barriers to change by building knowledge in broader stakeholder groups
- develop webinars and/or other educational materials for
  1. persons with natural sciences background but no education in toxicology
  2. persons with traditional education in toxicology

EXPECTED IMPACT

Decreased uncertainty in interpretation of NAM data

- Increased uptake of specific NAMs in legislation
- Increased acceptance of diverse NAM data to support waiving and read-across



Omics data handling and analysis training programme

The disconnection between the technologies and models used and develop in research paper and regulatory assessment are immense.

Specific tools and framework have been developed and recently published. This initiative propose to develop a programme to train industry and regulator to apply these tools

Transformational Programme

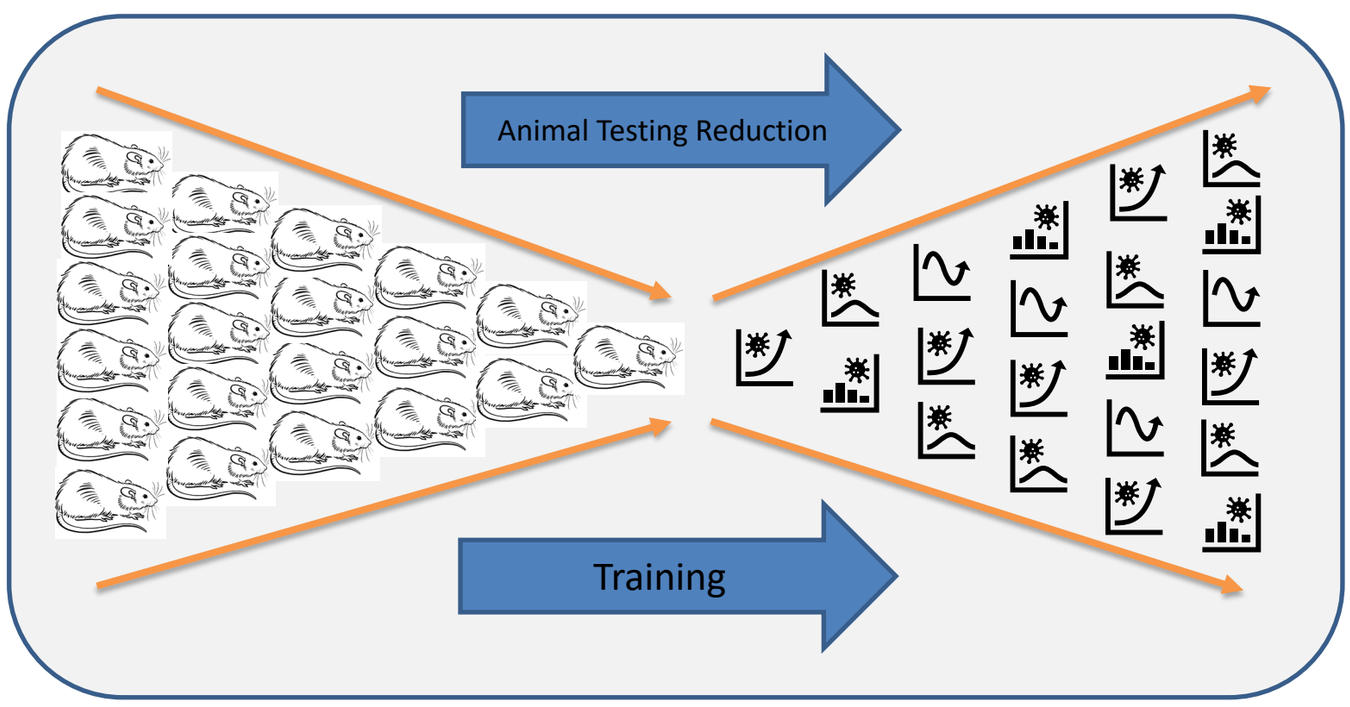
Florian Caiment, Maastricht University

ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- Tools and Framework have been recently developed and published:
  - OECD Omics Reporting Framework
  - R-ODAF : Omics Data Analysis Framework for Regulatory Applications
- The real challenge: data science and regulatory sciences speak different languages

EXPECTED IMPACT

- Bridge multiple worlds:
  - Data scientist – Biologist
  - Academia / Industry / Regulators
- Make sure that previous investment are not lost
- Contribute to the transition to Next-Generation Risk Assessment



OBJECTIVES

- Organize a data handling and analysis training **adapted for biologist**
- **Training** workshop
- Accessible for regulatory agency and industry staff
- Establish online **support**

ADDITIONAL INFORMATION

This programme will aims at training indurstries and regulators in using :

- *OECD Omics Reporting Framework:*

Harrill JA, et al. Progress towards an OECD reporting framework for transcriptomics and metabolomics in regulatory toxicology. *Regul Toxicol Pharmacol*. 2021

- *R-ODAF* :

Verheijen et al. R-ODAF: Omics data analysis framework for regulatory application. *Regul Toxicol Pharmacol*. 2022

ecetoc

Enabling Regulatory USE of Omics by forming an Expert Group to Develop an Omics Data Interpretation Framework for Regulatory Application (ODIFRA)

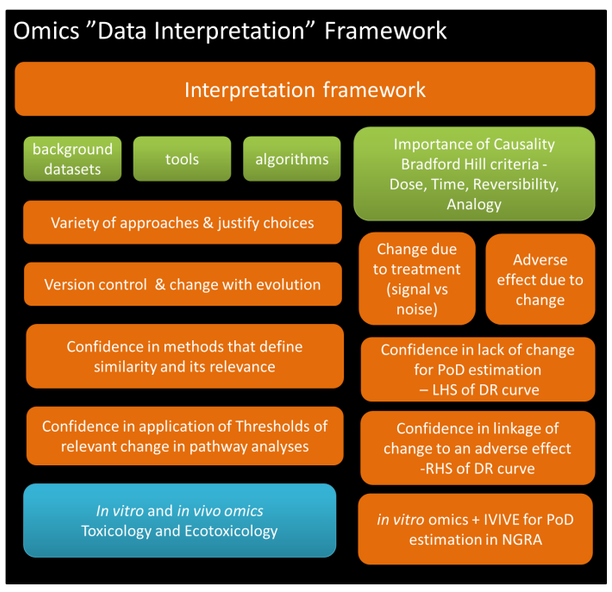
- The existing Omics reporting Frameworks provide technological good practice for robustly identifying and reporting lists of altered genes/metabolites up to Data Analysis and Reporting Modules (Harrill *et al*. 2021)
- A Framework that **increases the robustness of the interpretation** of these omics data and its reporting is required

ODIFRA Expert Group

Richard Currie, Syngenta
David Rouquie, Bayer
Tim Gant, PHE

ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- Lack of consistent reporting framework for omics data interpretation
- Justifications of analysis choices, thresholds and good practices
- Relevance of pathways and thresholds of significant pathway activation



- Quantification and amplitude of effects that drive points of adversity.
- Application of IVIVE with in vitro points of departure to advance risk assessment

OBJECTIVES

- Review the expected uses & technical issues to define what common/unique items need to be included in the framework
- Conduct case examples of using the framework with existing activities to identify areas for improvement
- Publication of framework and case studies
- Presentation to EAGMST and for consideration for inclusion on the workplan for a guidance document

Framework for Interpretation of Omics data (*possible concept!)*

I. Problem Formulation (*delete as applicable*)
   I. PoD
   II. RAx
   III. MoA/AOP
   IV. C&L

II. Section 2: Methods - Analysis approach and Justification (*delete as applicable*)
   I. Tools chosen
   II. Justify thresholds
   III. Versioning

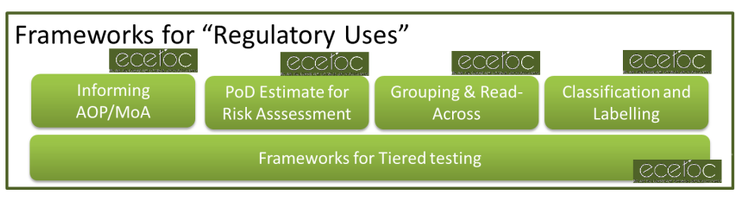
III. Section 3: Results (*delete as applicable*)
   I. Dose response
   II. Temporality
   III. Reversibility
   IV. Similarity assessment
   V. Pathway analyses

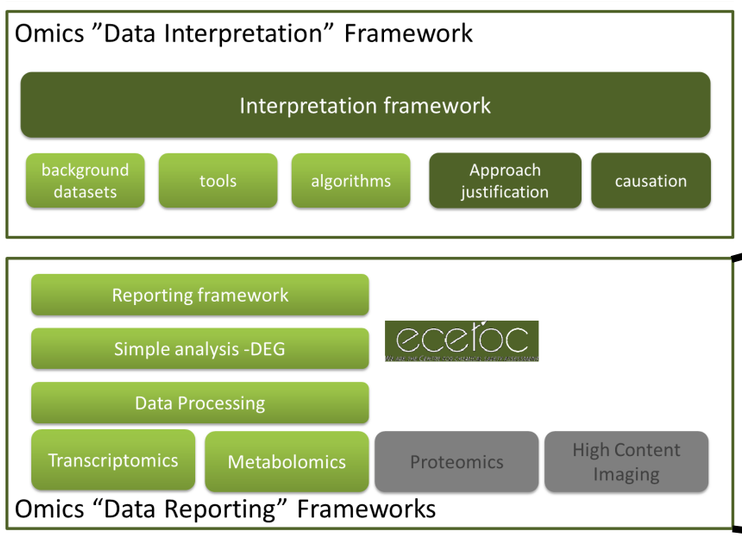
IV. Section 4: Conclusions
   I. Discussion vs problem
   II. Statement of uncertainties
   III. Conclusions

- Generation of teaching materials and outreach activities

EXPECTED IMPACT

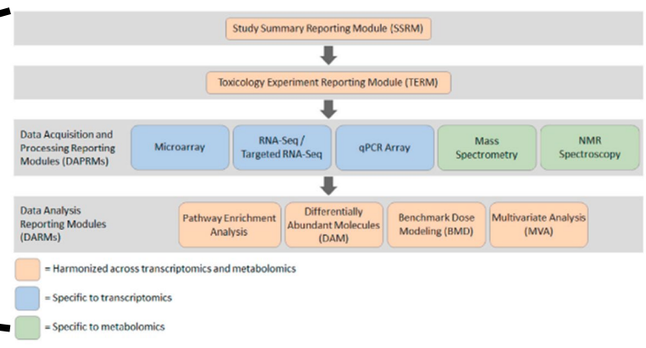
- A common framework to report omics data analyses for regulatory uses
- Inclusion and development by OECD
- Uptake and use of Framework in Regulatory submissions by all potential generators or users of omics data for regulatory purposes in Industry, CROs, Consultancies and Regulatory agencies





ADDITIONAL INFORMATION

Harrill et al Regulatory Toxicology and Pharmacology 125 (2021) 105020



Quantitative validation of New Approach Methodologies (NAMs) across interdisciplinary data domains

The challenge for scientific progression in risk assessment has always been the regulatory acceptance of new methods in favor of the traditional animal studies.

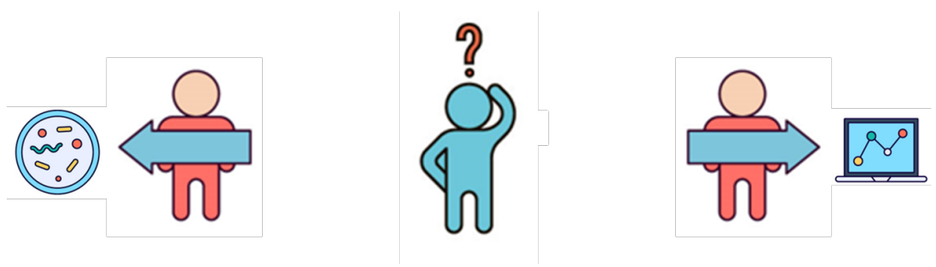
To achieve regulatory acceptance of New Approach Methodologies (NAMs) we need to bring together an interdisciplinary group of experts to discuss and integrate expertise from various disciplines to provide guidance for validation of NAM-driven risk assessment.

EXPERT GROUP

Neeraj Shandilya, TNO

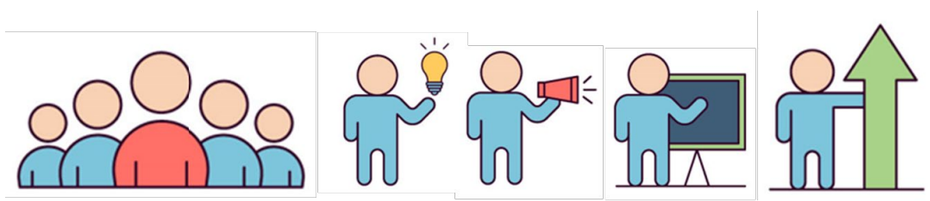
ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- Fragmented human health risk assessment
- Disconnect between experts and types of data
- Application of suitable in vitro and in silico models
- Human data to validate against



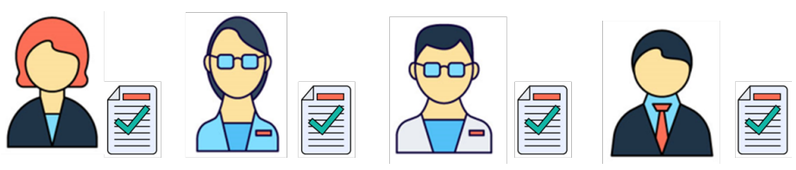
OBJECTIVES

- Integrate expertise
- Provide guidance



EXPECTED IMPACT

- Balance in what is
  - needed
  - possible
  - reliable
  - cost-efficient



ADDITIONAL INFORMATION

The integration of interdisciplinary expertise and data can be achieved within a timeframe of 12-18 months, because the intended activity of this proposal does not require the generation of new data or the development of new models.

Rethinking validation of NAMs

The development of new approach methodologies (NAMs) is gaining more and more attention, especially considering the European Green Deal and the objective to avoid animal testing as much as possible.
To use NAMs in a regulatory context, it is indispensable that the methods are validated thoroughly which is resource and time consuming. Review of the validation process for NAMs to find solutions to make the process more efficient.

TASK FORCE

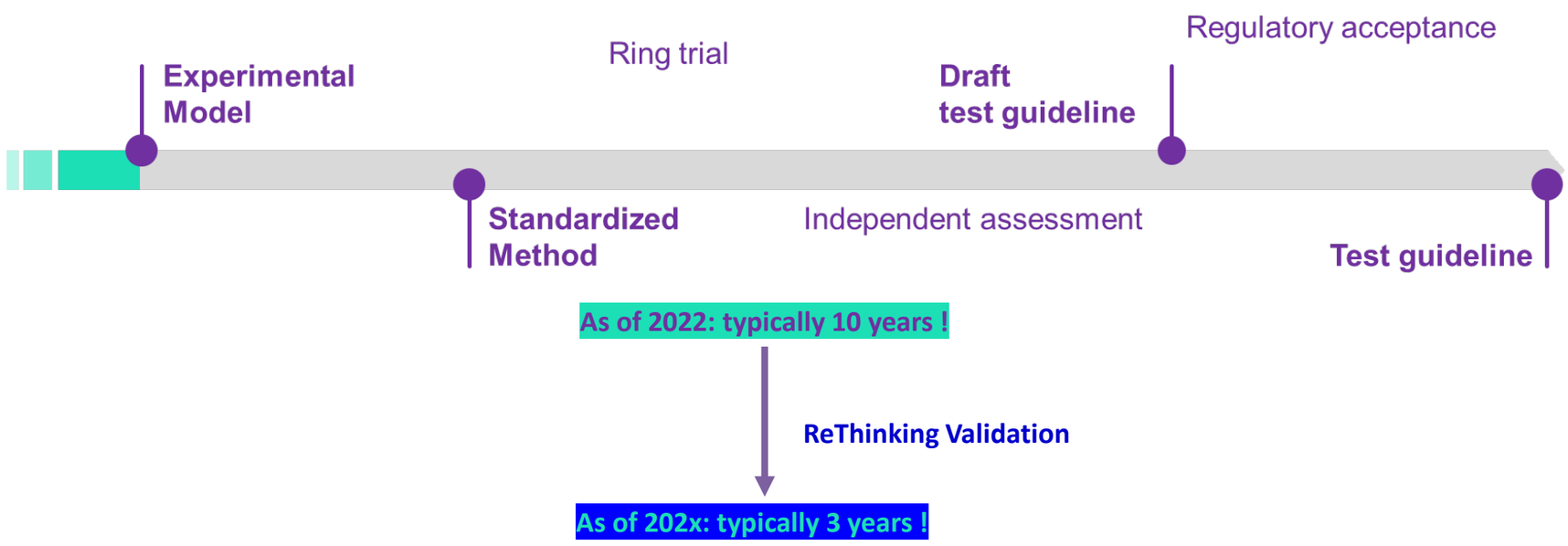
Susanne Kolle & Carolin Bischof,
BASF SE

ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- As of 2022: validation for regulatory acceptance of NAMs takes approximately 10 years
- It will take decades to fully replace animal testing:
- E.g., approximately 30 organs examined in OECD TG 408. If each is assessed by 5 NAMs and OECD adopts 5 methods per annum it will take 30 years to replace animal testing

OBJECTIVES

- To develop a validation concept for mechanistic NAMs for which there is no straightforward reference data (unlike e.g. for skin sensitization)
- Validation concept needs to be effective, efficient and accelerated



EXPECTED IMPACT

- Towards a smart, effective, and efficient validation process for NAMs
- Reliable NAM results
- Stakeholder involvement
- Fulfilling regulatory needs regarding hazard identification and risk assessment

ADDITIONAL INFORMATION

Mutual Acceptance of Data

OECD Guidance Document on the Validation and International Acceptance of New or Updated Test Methods for Hazard Assessment

In silico/QSAR Tools – comprehensive review of applicability and applicability domains of the different tools

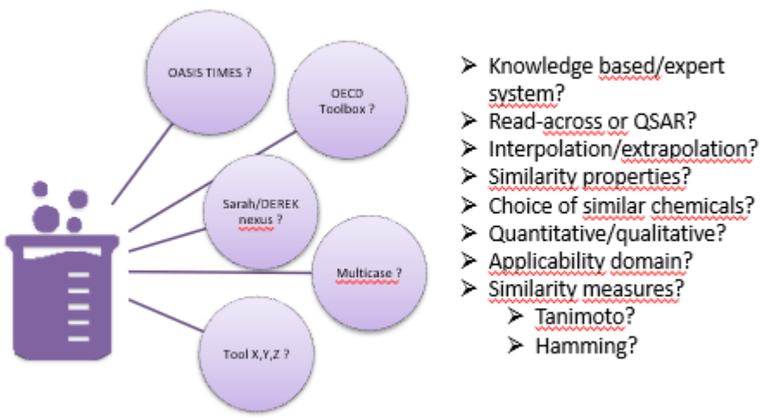
To achieve one of the main goals of the European Green Deal – the production of chemicals which are safe and sustainable by design, a lot of chemical structures will have to be screened with *in silico* methods for several toxicological endpoints/mode of actions to decide on the most promising candidates.
However, there is lack of standardized protocols and defined consensus approaches for the use of *in silico* tools and the interpretation of their results.

EXPERT GROUP

Carolin Bischoff and Caroline Gomes, BASF SE

ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- There are many *in silico* tools available. However, the toxicological endpoints for which they are applicable, are limited
- For users of *in silico* tools it is quite complicated to find the right tool for a particular scientific question



EXPECTED IMPACT

- Finding the right model for your specific question
- Consistent use between all stakeholders
- Broader regulatory acceptance
- Reduction of animal testing

OBJECTIVES

- Guidance for users of in silico tools
- Guidance for developers
- Regulatory acceptance

ADDITIONAL INFORMATION

A European Green Deal | European Commission (europa.eu)

OECD Quantitative Structure-Activity Relationships Project [(Q)SARs] - OECD

Towards a formal incorporation of predictive models in chemical hazard evaluation

Chemical hazard assessments often rely on *in-vivo* test data involving species from different taxa to capture varying species sensitivities.

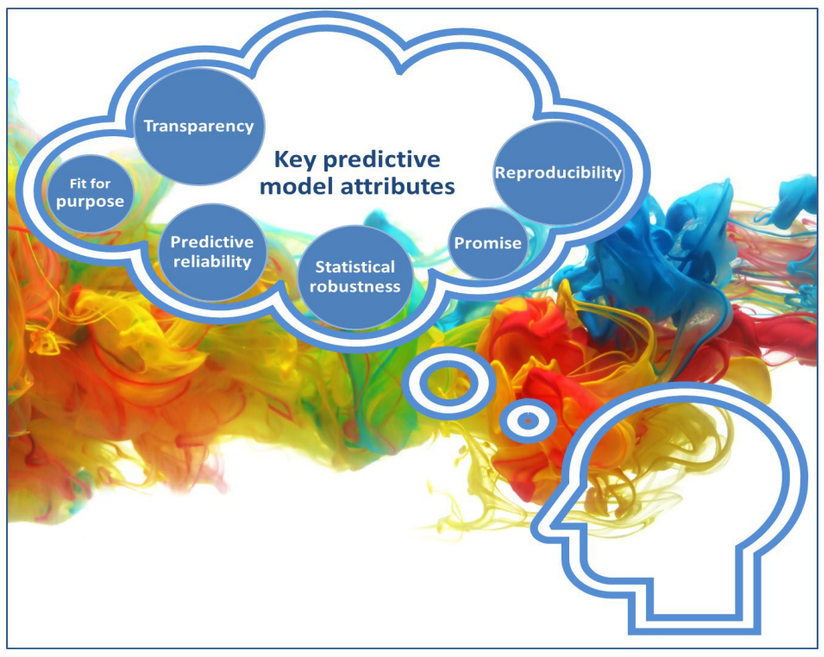
***In-silico* predictive models can fulfil regulatory requirements, but a formal process is needed for their incorporation into practice. Increased confidence can be achieved through a clear strategy for their evaluation**

WORKSHOP

ADRIANA C BEJARANO, SHELL GLOBAL SOLUTIONS

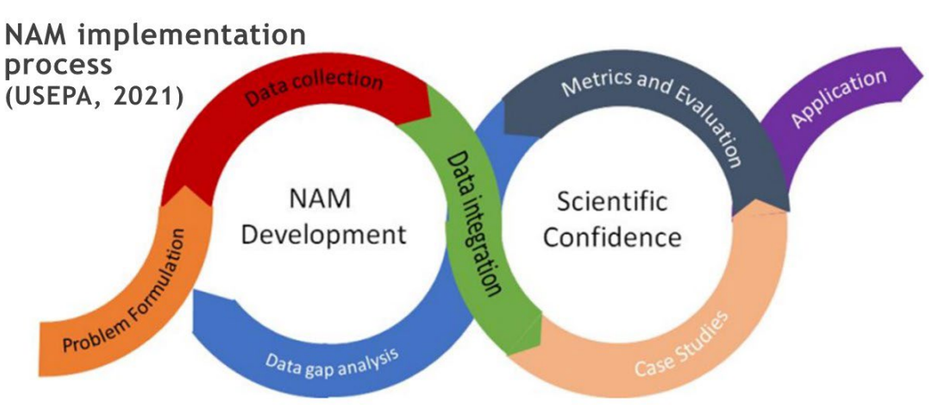
ASSOCIATED KNOWLEDGE/ METHODOLOGY GAPS

- Fit-for-purpose models leverage existing data
- Knowledge gaps and factors impeding broader use need to be identified
- Addressing challenges would increase confidence in model performance, transparency and use



EXPECTED IMPACT

- Formulate a clear and globally harmonized strategy for regulatory consideration:
  - General principles and guidelines
  - Minimum acceptability requirements
  - Case studies for select predictive models
- Strategic roadmap for establishing scientific confidence



OBJECTIVES

- Multisector Expert Group
- Achieve regulatory acceptance and implementation through an evaluation of factors, including:
  - Limitations
  - Data requirements
  - Acceptability criteria (e.g., endpoint; applicability domain; goodness-of-fit, robustness, etc.)

ADDITIONAL INFORMATION

"Acceptance of [predictive models] could be achieved by creating a process for their incorporation into practice, but the establishment and acceptance of principles and guidelines describing minimum requirements are needed. Such a process is necessary to increase confidence in their use as nonanimal alternatives and NAMs"

Bejarano & Wheeler, 2020

https://doi.org/10.1002/ieam.4286

eceToc