

Partnership for the Assessment of Risks from Chemicals

Enhancing chemical risk assessment for EU competitiveness

PARC's actions



Partnership
FOR THE
Assessment
OF
Risks
FROM
Chemicals



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Preamble

This note has been prepared as a way to demonstrate to key stakeholders (notably policymakers and regulators in the Governing Board (GB)) how PARC can help foster a competitive chemical industry at national and EU level. It has been drafted by the PARC coordination with the support of the Management Board (MB). This note has also been presented and discussed with the MB and GB members.

Executive summary

Overview and Mission

The Partnership for the Assessment of Risks from Chemicals (PARC) is a large-scale European-wide public-public research and innovation initiative covering all aspects of chemical risk assessment contributing to protect human health and the environment. By facilitating the transition to next generation risk assessment (NGRA) and supporting the roadmap for phasing out animal studies through development of advanced alternatives, as well as addressing critical needs in chemical risk assessment, PARC aims to prove that safety-related innovations can boost competitiveness. By bridging the gap between science and policy, it supports industry in managing the “twin-transition” toward climate neutrality and a toxic-free environment and continuing to protect human health.

Strategic Innovation: Safe and Sustainable by Design (SSbD)

One key element of PARC’s strategy is the implementation of the **Safe and Sustainable by Design (SSbD)** approach. This approach helps industry to move from a reactive “damage control” model to a proactive innovation-driven strategy. By integrating safety and sustainability at the earliest R&D stages, companies can:

- **Avoid “regulatory shocks”** such as late-stage product bans, expensive reformulations, or recalls;
- **Accelerate time to market** by identifying non-viable chemical candidates early;
- **Gain a “first-mover” advantage** in global markets that increasingly demand safer and more eco-friendly products.

Next Generation Risk Assessment (NGRA)

PARC facilitates the transition to **Next Generation Risk Assessment (NGRA)** by promoting **New Approach Methodologies (NAMs)**. These biological and computational tools (such as *in silico* modeling) provide faster, more precise, and cost-efficient safety data compared to traditional animal testing. By investigating standardisation of “batteries” of NAMs, PARC provides industry with clearer understanding of scientific and regulatory requirements, helping to limit duplication across different regions and reducing overall costs.

Data Transparency and the PARC Chemical Risk Assessment Hub

To support regulatory predictability, PARC is developing the **Chemical Risk Assessment (CRA) Hub**. This metadata platform follows **FAIR principles** (Findable, Accessible, Interoperable, and Reusable), ensuring that research data is translated into formats suitable for direct use in industrial and

regulatory risk assessments. This infrastructure supports the EU's "One Substance, One Assessment" framework by improving access to high-quality, transparent data.

Socio-Economic Impact and Strategic Autonomy

The knowledge and methods generated within PARC will help society avoid future economic impacts associated with chemical exposures. For example, the annual costs attributable to exposure to endocrine-disrupting chemicals have been estimated at €100–300 billion, while the societal costs associated with PFAS pollution could potentially reach €440 billion. By contributing to reducing exposure, PARC helps lower healthcare costs and productivity losses.

Key actions include:

- **Occupational Health:** Monitoring worker exposure in sectors like waste management and healthcare.
- **Support for Circularity:** Identifying hazardous substances that hinder safe recycling and the reuse of materials.
- **Strategic Autonomy:** By fostering R&D within Europe, PARC supports the EU's ability to retain oversight of key technologies and maintains its role as a global standard-setter for chemical safety.

Conclusion

Ultimately, PARC contributes to alignment of industrial success with sustainability objectives. It provides tools and harmonised standards to support a resilient, competitive, and transparent chemical sector that can meet both market demands and the highest regulatory standards to protect human health and for a pollutant-free environment.

Key messages

- (1) PARC contributes to turning chemical safety from a cost into a competitive advantage;
- (2) NGRA and NAMs accelerate market access and cut R&D costs;
- (3) SSbD prevents costly late-stage bans and reduces risks associated with investment;
- (4) the avoided environmental burden of disease translates into measurable economic savings.

Introduction

Chemicals are crucial for a wide range of applications in strategic sectors such as energy, transport, communication, food sectors, cleantech and digital transition. Europe therefore needs to keep a strong chemical industry. At the same time, the industry needs to transition to a clean and circular economy model, embracing innovation, strengthening its global competitiveness and ensuring the protection of human health and the environment¹.

According to CEFIC, the European chemical industry currently stands at a "**breaking point**," facing an unprecedented crisis where production volumes have declined by 14% since 2021¹⁻³. Within the context of the **EU Green Deal**, the industry must simultaneously navigate a "twin transition" toward climate neutrality and a toxic-free environment while attempting to restore its global competitiveness. PARC turns the cost of chemical safety into a source of competitive advantage —

¹ European Chemical Industry Action Plan (July 2025)

through faster assessment, regulatory predictability, and first-mover positioning in high-value markets.

The EU Green Deal, in particular the Zero Pollution Action Plan for air, water and soil, and the Chemical Strategy for Sustainability (CSS) aims at reducing the planetary health impact from chemical exposures. Environmental Burden of Disease (EBD²) makes it possible to quantify the impact of current chemical exposure on health in EU populations, prioritise preventive or mitigatory actions to be taken, and estimate the EBD and costs avoided as a result of EU policies and regulations. To address this, the EU is evolving its main regulatory frameworks—**REACH and CLP**—to create a "**strategic synergy**" where high safety standards act as a catalyst for innovation and market differentiation.

Endocrine disrupting chemical exposure cost estimates range between 100–300 billion Euros per year in health and productivity losses (EEA, 2024³; Trasande et al, 2015⁴). Recent studies have also confirmed the huge and growing costs of PFAS pollution: current levels of “forever chemicals” pollution could cost the EU approximatively 440 billion Euros by 2050⁵. These costs are covered by citizens, healthcare systems, and employers. The impact of exposure to some well-known hazardous chemicals *via* the environment has been demonstrated (e.g., lead, methylmercury, arsenic, chromium VI, pyrethroids - direct health costs related to ADHD (Attention Deficit/Hyperactivity Disorder) ranged between 0.3 and 2.5 million EUR yearly per million inhabitants for five European countries⁶) but the data are still scarce and the overall burden of diseases due to chemical exposure has not been estimated yet. However, based on existing data, the cost related to these diseases is already very high and reducing exposure to chemicals of concerns will have a significant positive impact on the European Economy.

PARC is an EU research initiative, adopting a science-to-policy approach. It brings together ministries, national public health and risk assessment agencies, research organisations and academia and three EU agencies (ECHA, EEA, EFSA)⁷ and gathers scientists from different communities: toxicology, exposure, risk assessment, but not only as we also mix communities from environment and human health. PARC was established during a time of political focus on reducing exposure to chemicals of concern and pollution as a whole (e.g. CSS and Zero Pollution).

In this context, PARC was designed as a public-public partnership with structured industry engagement through the stakeholder network and the national Hubs. This safeguards regulatory independence while keeping a strong interface with industry. Indeed, PARC has connection with private actors: we have set up a network of stakeholders and key players from the European industry are represented there (e.g., Cefic, Cosmetics Europe...); Besides that, at national level, within the Hubs, stakeholders are also informed and mobilized. They can contribute whenever appropriate to some PARC activities including prioritization rounds, trainings, case studies, etc.

PARC’s mission is to address current, emerging and novel chemical safety challenges and to enable the transition to the NGRA. PARC is addressing challenges related to the implementation of NAMs for chemical risk assessment, thereby overcoming challenges associated with substance-by-substance risk assessment. By providing data, tools and methods to support a better environment and health,

² Harm to human health from air pollution in Europe: burden of disease status, 2025 | Publications | European Environment Agency (EEA)

³ Burden of disease based methods for estimating the socio-economic cost of environmental stressors | BEST-COST | Project | Fact Sheet | HORIZON | CORDIS | European Commission

⁴ The costs to health and the environment from industrial air pollution in Europe – 2024 update | Publications | European Environment Agency (EEA)

⁵ Trasande et al., 2015 ; Estimating burden and disease costs of exposure to endocrine-disrupting chemicals in the European Union." Journal of Clinical Endocrinology and Metabolism 100(4): 1245-1255.

⁶ https://environment.ec.europa.eu/news/new-study-confirms-huge-and-growing-costs-pfas-pollution-2026-01-29_en

⁷ Mission, vision and objectives | Parc

⁸ PARC WP6.4 Deliverable

PARC contributes to substantially reducing negative impacts on human health and biodiversity. PARC's general objective and the lasting impacts we are looking to achieve is to consolidate and strengthen the EU's Research and Innovation capacity for chemical risk assessment to protect human health and the environment (see Fig.1).

PARC brings us a big step closer to the EU goal of a pollutant-free environment and thus makes a significant contribution to sustainable development in Europe. As such, PARC will contribute to reduce the burden of disease and environmental damages due to the exposure to chemicals and the consecutive costs of these damages.

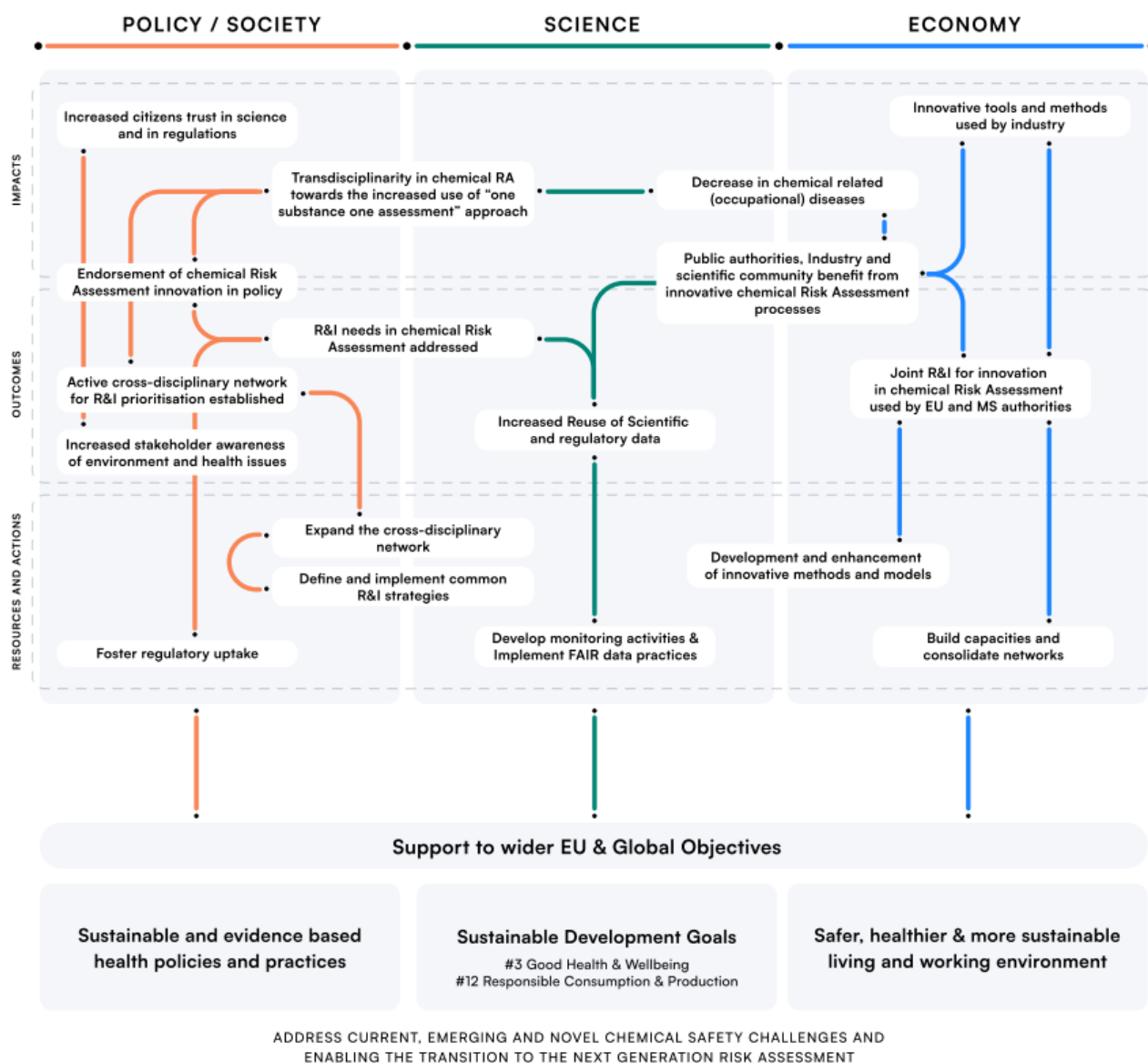


Fig. 1 - PARC's pathway to impact

1. Role of PARC in the safety assessment of chemicals during their entire life cycle

The guiding principles of PARC are the One Health approach, the science-to-policy interconnectedness and the innovation & competitiveness focus. PARC brings together many different activities, contributing to improving chemical risk assessment in Europe, amplifying the impacts, beyond what each activity could achieve alone. PARC is also contributing to clear and harmonised risk assessment supporting evidence-based risk management rules, which is also key to increase competitiveness.

PARC's activities cover the entire life cycle of chemicals, from the pre-marketing phase to post-marketing monitoring (see Fig. 2). Upstream, PARC contributes to hazard identification and risk assessment prior to a product's market release by developing innovative methods, modelling tools and integrated approaches to anticipate potential impacts on health and the environment. In addition, during the production of a substance or a product/article, workers might be exposed to chemicals, while releases during the manufacturing could lead to contamination of environmental compartments. PARC is developing tools and methods to better monitor these exposures and provide guidance to avoid those of concerns.

For substances that have been authorised and put on the market, PARC develops analytical methods and prioritization tools to support monitoring, early warning, the collection of toxicological and environmental data, and the updating of assessments in line with new scientific knowledge. This sequence of actions – from substance prioritisation to risk characterisation, followed by post-authorisation management and re-evaluation – illustrates PARC's commitment to covering all stages of the chemical life cycle in order to ensure the long-term protection of people, the environment and ecosystems. To better assess the impact of chemicals on human and environmental health, it is important to consider the complete life cycle of the substances, which is also important in the context of improving reuse and recycling of products and articles. PARC also has projects that assess the risks associated with the end of life of chemicals and provide recommendations to increase the sustainability of their use.

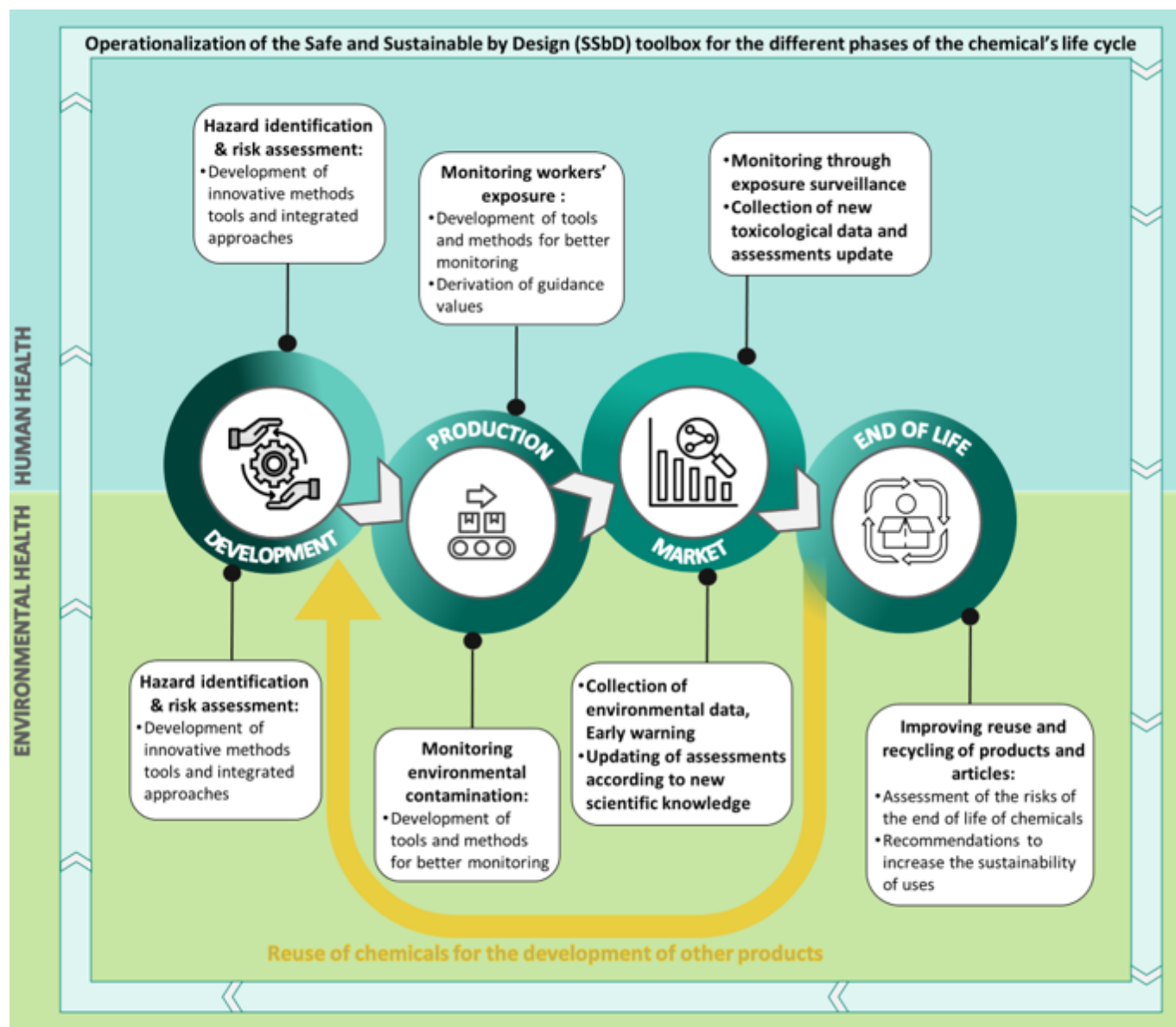


Fig. 2 - PARC's contribution to the chemical's life cycle

The fragmented nature of policy approaches fails to consider human and environmental risks across the full life cycle of materials and products. While efforts to promote resource efficiency and material recovery are central to circular economy models, without an integrated chemicals policy, such practices may unintentionally reintroduce environmental health risks in the name of “promoting recycling” and achieving the EU recycling targets.

This highlights also the need for a more holistic approach to policy development, even in the waste management sector; one that bridges the current divide between environmental sustainability goals, circularity rate and chemical safety. The lifecycle thinking approach, which is coupled with human biomonitoring data/exposure data, is proposed as a critical tool to support evidence-based decisions that prevent hazardous exposures, among the people working in recycling plants and common people in general who are using the consumer products derived from recycled material, such as recycled plastics. This would ensure materials re-entering the economy do so under conditions that are safe, transparent, and supported by robust risk assessments.

Living in a safe environment is important for the health and well-being of the citizens and of the workers. By reducing pollution and exposure to harmful chemicals, Europe will be more attractive for companies.

PARC supports the health and well-being of European citizens in two main ways.

2. Integrating safety and sustainability from the design stage and throughout the life cycle

The implementation of the **SSbD** approach represents a paradigm shift that enables the European chemical industry to move from a reactive "damage control" model to a **proactive innovation strategy**, thereby restoring global competitiveness. By integrating safety and sustainability as primary parameters at the earliest stages of research and development (R&D), companies can avoid "**regulatory shocks**", such as late-stage product bans, recalls, and expensive reformulations.

2.1. Safety and Sustainability already in the Design level: SSbD

SSbD of chemicals and materials is the key prevention approach that guides and fosters innovation in such a way that it supports competitiveness and incorporates fundamental and longstanding societal benefits such as safety and sustainability. SSbD, originating from the EU's Green Deal and its Chemicals Strategy for Sustainability (CSS), is now firmly linked to the Clean Industrial Deal (CID) and the Chemicals Industry Action Plan (CIAP).

SSbD is a strategic innovation approach to develop and evaluate new chemicals and materials and evaluate existing ones, keeping in mind the functionality and minimising negative impacts on human health and the environment. The EC developed a framework to assess if a chemical substance or material can be considered SSbD⁸. The EC SSbD framework provides an approach (supplemented by a methodological guidance) on how to address hazard, risks, environmental impacts and socioeconomic impacts. **The SSbD approach helps to position EU at the forefront of research and innovation in industries and SMEs and promotes the use of the latest scientific knowledge. It supports a non-toxic innovation and sustainable silver bullet and minimises innovative risks.**

By adopting the world's most rigorous safety standards early, European firms position themselves as global standard-setters, gaining a competitive edge in international markets that increasingly demand safer and more ecological products. The framework's holistic life cycle assessment (LCA) ensures that hazardous substances are not replaced by alternatives that later prove equally problematic, thereby minimizing future liability and protecting brand reputation.

The SSbD approach strengthens EU industry by shifting competition away from low-cost production toward high-value innovation. By promoting safer and more sustainable products, it helps reduce trade barriers on global markets. Anticipating risks at the design stage also lowers the likelihood of late-stage bans, product recalls, and costly reformulation, as prevention is far less expensive than remediation or compensation. In addition, SSbD creates greater regulatory predictability, supporting more informed and secure investment decisions. Ultimately, it positions EU companies as global standard-setters, enhancing their long-term competitiveness.

⁸ In March 2026, EU Published a Revised Framework for Safe and Sustainable by Design Chemicals and Materials [EU Publishes Revised Framework for Safe and Sustainable by Design Chemicals and Materials](#)

Moreover, financial institutions increasingly use "Chemical Safety" as a key metric in **Environmental, Social, and Governance (ESG) ratings**; companies utilising SSbD can "de-risk" their operations, leading to **improved access to capital** and lower borrowing costs. As global manufacturers overhaul supply chains to maintain access to the lucrative EU market, European standards effectively become the **default global benchmark**, allowing EU firms already compliant with these rules to streamline their worldwide operations.

SSbD accelerates the time to market by identifying safety and sustainability issues at low Technology Readiness Levels (TRLs), innovation managers can quickly eliminate non-viable candidates and focus resources on a **small number of promising, marketable solutions**. SSbD facilitates the transition to NAMs and *in silico* modelling tools, which provide faster and more precise hazard assessments than traditional animal testing, thereby **reducing R&D costs and timeframes**.

By acting upstream, SSbD reduces societal costs while providing European companies with greater regulatory predictability and a first-mover advantage in global markets that are increasingly demanding safer and more sustainable products. When underpinned by robust, science-based risk assessment, SSbD enables innovation, lowers long-term compliance costs, and strengthens Europe's leadership in high-value, knowledge-intensive industries. In this sense, SSbD is not a cost to competitiveness, but a tool to protect it.

2.2. PARC activities on SSbD

In close collaboration with the Joint research Center (JRC) and other European projects (IRISS), SSbD tools developed under PARC help designers and innovators assess chemical products for safety, sustainability and – crucially – considerations like end-of-life and recyclability. These tools guide innovation toward chemicals and materials that are compatible with circular economy principles. PARC makes SSbD credible and implementable for Industry. PARC is indeed supporting the operationalisation of the SSbD framework developed by the EC using four interlinked sets of activities:

- Operationalisation of the EC SSbD framework
- Development of a dedicated toolbox
- Testing the toolbox by use cases
- Knowledge sharing and education

PARC aims to bridge the gap between policy goals and safety and sustainability assessment tools by contextualizing SSbD in innovation practice. Successful real-world operationalisation of SSbD requires a focus on case specific details and effective coordination between a variety of actors (e.g., innovators, value chain actors, safety and sustainability experts and regulators).

PARC is developing the SSbD toolbox ⁹ by incorporating computational tools that are currently being developed within and outside of PARC acting as an umbrella platform that brings together and operationalises the state of the art in SSbD assessment for chemicals, materials and products. This approach also involves developing the FAIR databases and scientific knowledge bases needed to assess current and future risks in order to enrich the QSAR models used for read-across and increase their applicability domain. In this way, PARC SSbD toolbox will facilitate the transition towards NAMs

⁹ [SSbD Toolbox | A structured collection of tools to support designers, developers, risk assessors of chemicals and materials from industry, academia and governments in addressing questions about functionality, chemical safety and environmental sustainability.](#)

including *in silico* modelling tools, which provide faster and more precise hazard assessments than traditional animal testing, thereby reducing R&D costs and timeframes.

“Designing safety in is cheaper than regulating harm out.”

“SSbD protects citizens, but it also protects European companies from future regulatory shocks.”

2.3. Providing support for circularity

Chemical recycling can play an important role in reducing the EU’s dependence on virgin, fossil-based resources for plastic production and valorise end-of-life products¹⁰. **Although PARC does not directly implement circular economy systems, its outputs help identify chemicals that may hinder recycling or safe reuse (e.g., persistent or hazardous chemicals).** By improving risk assessment methods and data quality, PARC informs:

- Substitution of harmful chemicals with safer alternatives amenable to recycling or reuse.

By measuring chemical exposures through environmental and human biomonitoring and by developing monitoring tools, PARC helps identify chemicals that persist or accumulate, which is essential for decisions on recycling and reuse—avoiding chemicals that hinder circular material flows.

- Identification of problematic chemicals in waste streams that may require special handling in circular systems.

By filling gaps in toxicity data and developing new methods and tools for hazard evaluation, PARC identifies hazardous properties of chemicals, which is foundational to choosing safer chemicals (i.e., toxic-free or less harmful substances) that are more suitable for reuse, recycling, and remanufacturing.

By evaluating how currently available information structures on substances in products and materials can be used for enforcement activities and by developing proof-of-concept methods of chemical identification for use in the enforcement of chemical safety legislation, e.g. for broad PFAS restrictions, PARC supports a more efficient enforcement of chemicals legislation, thereby preventing hazardous chemicals from entering the material cycles.

PARC strengthens chemicals enforcement and supports safer recycling and circular material flows.

3. Developing tools and standards for transparent and harmonised safety assessment

Having transparent and stable rules that can be anticipated, helps industries to secure their regulatory environment and to engage in long term activities and investments.

The European Commission will continue working to modernise chemical testing and to accelerate the transition to animal-free approaches. As part of the One Substance, One Assessment laws, which entered into force on 1 January 2026 a new Common Data Platform on Chemicals due to be operational within the next three years¹¹, will improve access to chemical data. By implementing the

¹⁰ https://environment.ec.europa.eu/news/new-rules-streamlining-chemical-assessments-enter-force-2026-01-05_en

roadmap for phasing out the animal studies in chemical safety assessment, the EC paves the way to the NGRA based on a combination of biological and computational methods.

PARC contributes to regulatory predictability for industry by harmonising scientific standards, operationalising proactive design frameworks, and creating a transparent data infrastructure that aligns industrial innovation with regulatory expectations.

3.1. Chemical Risk Assessment Hub

To support the Commission, PARC is developing the Chemical Risk Assessment (CRA)¹² Hub, which is a metadata platform to facilitate reuse of PARC-reused or generated data in line with FAIR principles. The CRA Hub will support data publishers, data owners, and CRA experts, from both research and regulatory sectors. The CRA Hub builds upon and enhances existing CRA data resources and standards. It will have full complementarity and interoperability with the existing regulatory and FAIR data resources and initiatives, supporting the translation of regulatory research into formats suitable for use in CRA in practice. The CRA Hub will provide tools and interfaces to find, visualise, and access existing CRA resources, such as PARC-reused or generated data, data providers, laboratory capacities, or best-fit repositories for newly generated data.

This platform ensures that research data is translated into formats suitable for direct use in industrial and regulatory risk assessments. It will contribute to the implementation of the Common Data Platform on Chemicals by sharing PARC experience in data management according to FAIR Principles¹³.

3.2. Next Generation of Risk Assessment (NGRA)

The ambition of PARC is to facilitate and accelerate **the transition of New Approach Methodologies (NAMs)** for toxicological hazard and chemical safety assessment, from a research phase into regulatory practice. NAMs offer modern science-based tools to provide information for chemical hazard and risk assessments. They are key to accelerating risk assessments and closing data gaps and are cost-efficient tools. By establishing clear "batteries" of relevant NAMs for complex endpoints like neurotoxicity, immunotoxicity etc. and by providing a list of reference chemicals, PARC helps academia to understand regulatory needs and industry to understand exactly what scientific evidence is needed to meet regulatory requirements.

The current lack of validated and globally recognised test methods included in the list of OECD Test Guidelines in some existing and emerging areas, also means that for many chemicals, advanced materials and endpoints, tests (including tests with laboratory animals) need to be repeated in multiple countries throughout the world, as the resulting data are not mutually accepted through the OECD Mutual Acceptance of Data (MAD) system. This leads to unnecessary societal costs, including costs for industry to meet regulatory requirements for the placing on the market of substances, mixtures or products in various regions. In collaboration with OECD member states and EU contact points, PARC contributes to different case studies and Guidance development.

Validation is a scientifically anchored process that serves to demonstrate the reliability and biological relevance of a method for a particular purpose, building trust and confidence, within a regulatory context of use and within a market ecosystem. Appropriately designed validation

¹² [Chemical Risk Assessment Hub | Parc](#)

¹³ Understanding the regulation on the common data platform and monitoring and outlook framework for chemicals - ECHA

activities are often central to producing much of the scientific evidence that feeds into these confidence building frameworks. PARC supports the **pre-validation steps of different NAMs**¹⁴ and the building on *in vitro* battery for several endpoints, in close collaboration with other R&D national and EU projects (e.g., ASPIS Cluster, RiskHunt3R).

Ultimately, one important measure of the success of PARC will consist of the tangible positive impact PARC will have made on regulatory processes and decision-making contexts. There is a deficit of validated methods to address current needs, including the societal demand for animal-free methods.

New substances and materials (e.g., nanomaterials) are much needed for societal transitions, but due to the above, the development and validation of test methods to establish their safety lags behind.

PARC contributes to strengthening the industry's innovative capacity and so ensuring that new substances and materials can continue to be marketed, by developing the necessary tests at a faster pace. This contributes to Europe's welfare and strategic autonomy, as well as to maintaining a high level of protection of health and the environment.

Also, concepts developed by PARC will allow industry to come to conclusions faster and more efficiently (at lower costs). As approval of substances is assumed to come faster with NGRA, this helps the European Chemicals Industry to be more competitive.

3.3. Reuse of Data

An important complementary route to test guideline development, to employ new testing and assessment approaches in hazard and risk assessment, is to **enhance the usability of data produced within research studies** that use non-guideline methods, where the results are typically published in peer-reviewed scientific journal articles. Regulatory use of such literature data requires a critical weight of evidence assessment. Many regulatory decision-making processes already try to make use of such data in their assessment processes since, it is a legal requirement in most regulations that all existing data be considered in hazard and risk assessment. However, the main challenge to the use of such data is to improve the quality, reliability, relevance, transparency and availability of data produced by non-guideline tests through various means. This includes weight of evidence assessment and tailored proof-of-concept studies, together with demonstrating readiness for test guideline development and regulatory application.

PARC enables all the scientific communities involved in chemical RA, as well as risk managers and stakeholders, to have access to high-quality data by facilitating their accessibility, interoperability and usefulness for research. In the context of Open Science, PARC promotes harmonisation of data and exchange between different actors (scientific community, health agencies, regulators, policy-makers, etc.) and disciplines (exposure science, toxicology..., etc.) to promote transparency, support RA, and allow for reuse. It ensures data and associated information is FAIR and addresses the challenges for data exchange in line with the GDPR related challenges for data exchange.

Having standardised innovative approaches for risk assessment of chemicals that are widely accepted by the community will allow mutual acceptance of data and secure the development of chemicals in a more predictive regulatory environment.

¹⁴ See Annex II of the Deliverable D5.1 [PARC_D5.1.pdf](#)

3.4. Integrative and interoperable computational tools

NGRA uses computer modelling to perform predictive toxicology and analyse surveillance data to verify model consistency, detect emerging trends, identify key hazards, propose interventions and assess their relevance in terms of public health or environmental protection. By developing an integrative framework for available data sources and tools for integrating this data, PARC is helping to provide regulatory agencies, risk managers and industry with common tools that are transparent and meet regulatory requirements and international recommendations. These tools are developed to be auditable and comply with FAIR principles.

Computational tools developed through collaboration between academia and regulatory agencies as **public goods**—such as the **OECD QSAR Toolbox**—offer several strategic and technical advantages over proprietary commercial tools. These advantages centre on **transparency, regulatory acceptability, and economic accessibility**, particularly for small and medium-sized enterprises (SMEs). PARC developed tools are designed to be "toolbox" systems rather than "black boxes". They offer "**mechanistic transparency**," allowing users to understand and explain the toxicological mechanisms through which a substance might cause harm.

Commercial developers are often unwilling to share background training data because it is proprietary. In contrast, public tools allow regulators to see which substances and data points were used to build a model, which is essential for verifying the **domain of applicability**. PARC tools often include a **workflow** that guides non-expert users to build a narrative and reasoning process that makes sense to regulators. Working in close collaboration with EU and national agencies, PARC contributes to the development of data repositories and benefit from "**data donations**"—the will of various actors to connect and provide joint access to toxicity databases following the example of the OECD QSAR Toolbox which integrates **59 databases covering 100,000 substances** and three million data points.

PARC facilitates the transition of NAMs from research phases directly into regulatory-ready tools, ensuring the industry will have access to the most modern, animal-free science.

4. Helping workers to be in good health

PARC is gathering data from across Europe on the level of exposure of workers in several sectors. We started with two sectors with significant exposure potential, such as waste management and health care. **In waste management**, workers might encounter hazardous chemicals while handling recycled materials, a concern heightened by the industry's growth and its importance to the circular economy. The project focuses on metals, flame retardants, phthalates and other plasticizers, bisphenols, PFAS and PAHs, addressing also some effect biomarkers. Sampling campaigns were completed in the 13 participating countries. **In the healthcare sector**, workers are also exposed to many harmful substances. The project focuses on hazardous medicinal products, inhalation anesthetics, and disinfection/cleaning products. These exposures have been studied in hospital settings in 11 countries.

Through its actions, PARC is contributing to decreasing chemical related occupational diseases and enhancing sustainable competitiveness for European industry.

PARC is now starting new occupational HBM surveys in textile waste management and welding sectors. We also would like to see if using biomonitoring can help keep track of worker's exposure

levels and health. In addition, we are studying which groups of workers are regularly exposed to potential risks at work.

By reducing occupational diseases and keeping a healthier workforce, Europe will maintain productivity, reduce absenteeism and healthcare costs, in the end enhancing industrial output.

By embedding prevention-oriented chemical risk assessment into regulations and workplace practice, PARC directly minimises occupational chemical hazards while fostering innovation and regulatory coherence. This results in healthier workers, cost savings, regulatory clarity, and industrial competitiveness aligned with the EU's vision of a toxin-free, sustainable economy.

5. Assessing the quality of our environment

PARC efforts are directed towards the establishment of a European environmental and multi-source monitoring system. Monitoring the environment and the various sources of chemicals is crucial for assessing chemicals risks in Europe and avoiding exposure to harmful chemicals which may impact not only biodiversity, but also the health of Europeans. Early information on unexpected exposure pathways and evidence of widespread environmental pollution or increasing environmental concentrations strengthens the basis for regulatory action by enabling the implementation of targeted measures to decrease emissions during production, use and disposal before far-reaching restrictions of uses or a full ban become necessary. Where needed, research to identify suitable substitutes can be initiated in a timely manner, supporting transitions to safer alternatives and improving regulatory predictability for industry. High-quality monitoring data improves exposure modelling and risk characterisation, particularly for complex mixtures, and enhances confidence and predictability for industry.

Although EU countries have monitoring systems in place for individual environmental compartments, mainly water, there is a need for establishing an EU-wide environmental and multi-source monitoring. **In PARC, we have developed a monitoring cycle that can be used as a basis to establish a novel, cutting-edge, and universally applicable monitoring scheme, that provides valuable information for assessing chemicals risks across Europe.** In close collaboration with existing network (NORMAN), the partnership has operationalized a six-step monitoring cycle—comprising prioritisation, knowledge review, study design, monitoring, data analysis, and feedback—to assess chemical risks across air, water, soil, and biota.

Using this monitoring cycle, PARC designs and conducts activities to trace the sources and pathways of chemical exposure, supporting the development of an early warning system to promptly detect potential risks, and prevent the costs of late mitigation and replacement actions that can be excessive both for industry and the public.

A key component is the establishment of a feedback mechanism to assess whether the regulatory needs that prompted the monitoring efforts are met. This mechanism can also identify emerging scientific or regulatory needs, which can then inform future monitoring activities.

The monitoring cycle was assessed through a pilot study focusing on two prioritised substance groups: per- and polyfluoroalkyl substances (PFAS) and endocrine disrupting chemicals (EDCs). The pilot study aims to establish a baseline of PFAS and EDCs, assessing background environmental concentrations resulting from decades of production and use. It also seeks to characterise exposure routes and to evaluate the effectiveness of current management practices.

Future and ongoing studies focus on indoor and outdoor compartments as source for human exposure, siloxanes, PMT compounds such as TFA in different environmental compartments and chemicals in soils.

PARC is contributing to monitor and provide early warning signals about chemical of emerging concerns in the environment. They support the development of the scientific and technical frameworks to measure the environmental progress (EU indicator frameworks).

The EU and MS are willing to reduce pollution of our environment and to reduce human pressure on the planetary boundaries in a “One Planet” approach. Assuring the stability and resilience of the Earth and in particular in Europe will make our region more attractive for new clean industries.

6. Monitoring in the general population

HBM is an essential tool for assessing how people are exposed to environmental pollutants. HBM plays a crucial role as a quantitative tool for monitoring exposures, tracking trends, validating policy effectiveness, and identifying emerging risks.

By analysing biological samples like urine, blood, breast milk, hair, etc., PARC HBM studies can identify chemicals present in the body. This helps us to understand the extent of exposure in an integrated way, considering all sources and routes. Beyond mere detection, PARC also assesses potential health effects: by combining external and internal exposure with biomarkers of effect and health data, PARC operationalises the exposome along the One Health continuum. This holistic approach helps pinpoint potential adverse health impacts and evaluate the effectiveness of measures to reduce pollutant levels. Moreover, human biomonitoring contributes also to trigger early warning signals, which can be assessed and interpreted by regulatory agencies, and provide opportunities to efficiently limit human exposure and restore consumer confidence in European products. This is illustrated by this example: following notification by ECHA and EEA regarding significantly increased levels of mono-n-hexyl phthalate (MnHexP) detected in the urine of children in Germany and in adults in Denmark, PARC responded quickly to identify the source of exposure and to make recommendations on better manufacturing practices.

PARC is contributing to the implementation of EU aligned HBM studies by developing harmonised sampling procedures, analytical methods, laboratory networks, QA/QC schemes and FAIR data infrastructures respecting General Data Protection Regulation (GDPR). This work supports the integration of HBM data in the One Substance, One Assessment framework¹⁵.

Conclusion

By advancing the development of safer and more sustainable chemicals, PARC contributes to reduce the burden of diseases, and doing so the costs associated to them. It also helps foster a competitive chemical industry that is resilient and able to meet both regulatory standards and market demands. At the same time, PARC contributes to Europe's strategic autonomy by promoting research and development within Europe, ensuring that the EU has control over the technologies and solutions which are critical to its economy.

¹⁵ https://environment.ec.europa.eu/news/new-rules-streamlining-chemical-assessments-enter-force-2026-01-05_en

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PARC supports circularity and sustainable chemical product development under the broader umbrella of safer and more sustainable chemicals management. PARC itself is a scientific public partnership focused on chemical risk assessment (not a circular economy programme), but many of its activities feed into frameworks such as SSbD, policy tools and risk-based decision-making that enable more circular, safer and sustainable chemical products.

PARC fosters collaboration across research institutions, regulators, and industry actors — building knowledge networks that can link chemical risk science with sustainability and circular economy initiatives (e.g., SSbD, life-cycle assessments). These synergies help ensure that scientific findings contribute to broader circular design and regulatory practices.