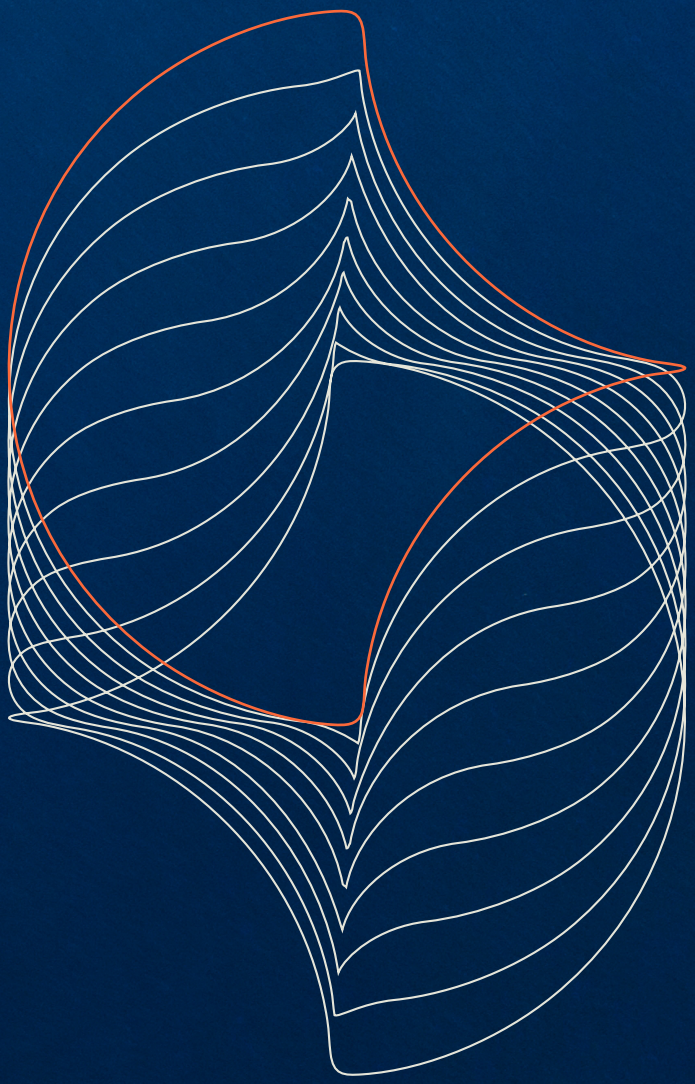


The Invisible Tsunami

How pervasive toxicity threatens human and planetary health

Deep Science Ventures

Overview

This report, created by Deep Science Ventures' science team and funded by The Grantham Foundation for the Protection of the Environment reveals the high likelihood of chemical toxicity to impact global health and planetary ecosystems.

Based on an extensive analysis of peer-reviewed literature, it summarises alarming trends from the production and use of toxic chemicals, their transport in the environment and impacts on human and ecosystem health, and furthermore identifies promising technologies for reducing the burden of toxicity.

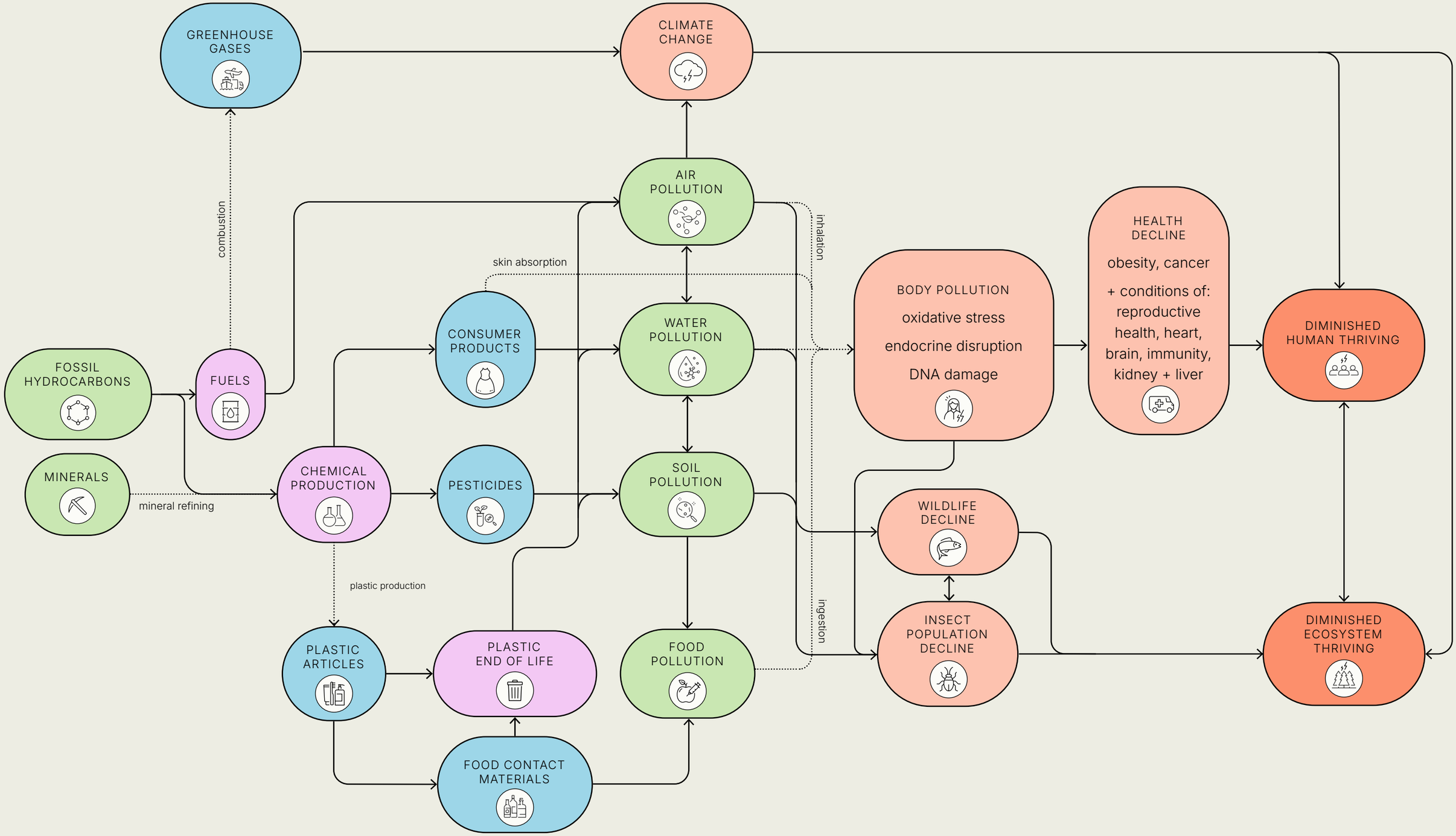
Toxic chemicals are ubiquitous features of modern economic activity and overwhelmingly originate from the industrial sectors. They are present in the air we breathe, the food we eat and the water we drink.

We're aware of many harmful effects from synthetic chemicals, and the full extent of their impact on human and ecological health is still unfolding. Our analysis, however, definitively shows that the damaging consequences of chemical toxicity are greater than is generally appreciated.

Drawing on global peer-reviewed studies and over 50+ interviews with scientists, start-up founders and NGOs, this report sought to identify causal and correlational links across two critical societal aspects stemming from petrochemicals: human health and the environment. The report also investigated the production and environmental transport of toxic chemicals, revealing the extent to which toxic petrochemical production is pervasive in today's society.

We found that public health and toxic chemical pollution are deeply intertwined, with toxicity impacting human health through conditions like cancer, obesity, dementia, infertility, and heart and respiratory problems, as well as causing potential damage to the environment and ecology. Furthermore, we found that toxic chemical production and pollution is intimately linked to the extraction and use of fossil fuels.

Schematic diagram illustrating the flow of toxicity from production to societal outcome



Background

At Deep Science Ventures, we create ventures in underserved areas. These are typically fields that either lack the cross-disciplinary approach needed to capitalise on opportunities, or face a shortage of technical founders and scientists with relevant expertise.

To first understand and define toxicity we set out to answer three key questions in this work:

1. How and why are toxic chemicals produced?
2. How are they transported and transformed in the environment?
3. How do they cause negative effects in the body and in ecosystems?

We found the short answer to the first question is: usually unknowingly.

We found that chemicals which have turned out to be toxic have typically entered the market with insufficient hazard data and have then been found to be toxic once they've been in use for years and people have already been exposed. The key thing is that their production can build up economies of scale in this time and this can make it harder for safer alternatives to compete. While specific properties are important, often a certain chemical is used over others because it is cheap and is, for example, simple to make from refined petroleum products.

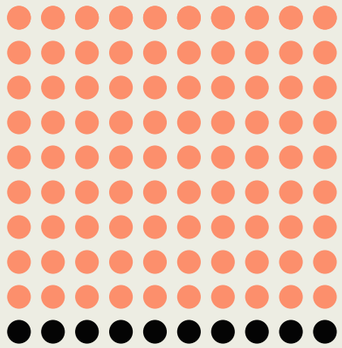
Looking at environmental transport we found that toxicity is mediated by the air, water, and food system. We found the food system to be a locus of many problems: pesticides and fertilisers can pollute water and affect local ecosystems as well as the food we eat, and one of the most dangerous fertilisers is the sewage sludge from wastewater treatment plants which is spread on fields even though it often contains many toxic chemicals.

Looking at health effects we found two common mechanisms for toxicity were chemicals causing oxidative stress and endocrine disruption. We found particularly compelling evidence of negative impacts on fertility from various classes of pesticides via these two mechanisms. But perhaps the most interesting finding was the sheer number of health and environmental issues which had links to toxic chemicals. These included: cancer, infertility, immune disorders, neurological conditions, heart conditions and obesity.

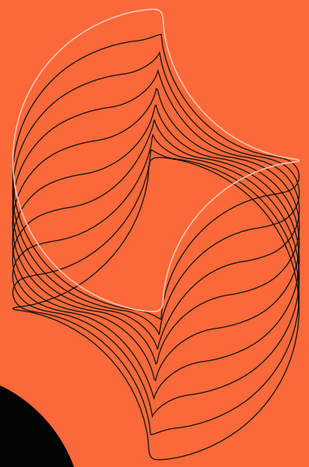
Toxicity is an incredibly complicated topic, with thousands of chemicals and dozens of health and environmental effects, and that complexity can make it challenging to prioritise action.

The evidence is stark:

- Over **3,600 synthetic chemicals** from food contact materials are found within human bodies globally.
- PFAS have contaminated the whole world, with levels in rainwater often exceeding safe limits for drinking water.
- Reproductive toxicology data is only available for **7% of food additives** used in the US.
- There's appreciable evidence demonstrating a global decline in sperm count and that synthetic chemicals we are exposed to reduce it.
- For example, men with high levels of certain PFAS have been found to have **less than half** the normal sperm count of those with low levels.
- The impact of pesticide use on cancer incidence may rival that of smoking and is linked to leukaemia, non-Hodgkin's lymphoma, bladder, colon, and liver cancer. Prenatal pesticide exposure increases the odds of childhood leukemia and lymphoma by **over 50 %**.
- Large production volume endocrine disrupting chemicals are impairing early development as well as adult health. For example, prenatal phthalate exposure is associated with decreased anogenital distance (AGD) in male infants, which is a marker for poor adult reproductive health, while adults exposed to high levels of bisphenol A have **49% higher odds of obesity** compared to those with low exposure.
- Our understanding of toxicity is outdated, relying on the **500-year-old concept** that "the dose makes the poison." Regulators and corporations still mainly rely on an outdated toxicology framework which disregards non-monotonic dose responses, the combined effects of multiple chemicals and sex differences and which uses high doses to estimate safe thresholds and therefore often misses the toxic effects of low exposures, particularly to endocrine disrupting chemicals.
- The industrial economy has created over **100 million new chemicals**; 350,000 are in commercial use today, with production having surged fifty-fold since the 1950s.
- Over **90% of the global population** is exposed to air pollution exceeding World Health Organisation (WHO) guidelines.



As the world grapples with escalating cancer rates, a decline in fertility, and a surge in chronic diseases, it's important to demonstrate the full extent of the picture and create an understanding of technological solutions that need to be and can be created.



Industry + Regulatory Gaps

Despite the current level of evidence, noticeable gaps persist in how industry and regulatory bodies address chemical toxicity:

Outdated regulatory frameworks

Loopholes in US regulation have allowed more than 200 new food additives into the food system without undergoing pre-market approval. Even the EU's precautionary ethos, typically based on the "no hazard data, no market" principle, allows too many exceptions. The majority of commonly used chemicals lack adequate public data for their long-term health and environmental impacts.

Outdated testing methods

The "Good Laboratory Practice" toxicology framework, first introduced in the 1970s and typically used to determine tolerable intakes often underestimates the hazards of low level exposure to ubiquitous endocrine disrupting chemicals, leaving the public vulnerable to harmfully high exposures. The EU recently reduced the tolerable daily intake for BPA by a factor of 20,000 after including data from non Good Laboratory Practice studies.

Insufficient monitoring and data

While biomonitoring studies provide us with a good understanding of which chemicals people are exposed to, we often lack crucial information about the specific activities and products that lead to the highest exposures. This gap in data significantly limits our ability to identify and mitigate the most problematic sources of chemical exposure.

Siloed approach

The fragmented approach to managing chemical risks, often separating human health from environmental health, fails to acknowledge the interconnectedness of these systems. Toxic chemicals frequently have detrimental effects on both human and animal health, contributing to observed wildlife loss.

Limited innovation in safer alternatives

While clean chemistry is gaining traction, the findings demonstrate that the focus has been skewed in particular towards climate and broader environmental impacts (global warming potential, water use, and eutrophication). This emphasis means the pace of innovation and adoption of safer chemical alternatives is too slow to counter the growth of potentially toxic substances that could directly harm the health of people and ecosystems.

Recommendations

To avert a potential crisis and safeguard human and planetary thriving, we recommend:

Reform of global chemical regulation

As a first step, the precautionary core principle of REACH chemical regulation: “no hazard data, no market” which applies in the European Economic Area and the UK should be emulated as far as possible in other jurisdictions, which often, as in the case of the USA, grant chemicals “innocent until proven guilty treatment”. In countries operating under REACH, efforts should be made to close the many remaining gaps, for example by requiring importers to register articles, not just chemicals and mixtures, under REACH in all circumstances.

Change toxicity assessment

Chemicals, especially those found routinely in our bodies, directly impact human health and deserve rigorous testing and scrutiny. This report advocates for a paradigm shift in how we regulate these ubiquitous compounds. Outdated toxicology protocols typically used by regulators and manufacturers are often unable to detect the toxic effects of chemicals ubiquitously found in the population at low doses, leaving the public, and especially developing foetuses and children at risk.

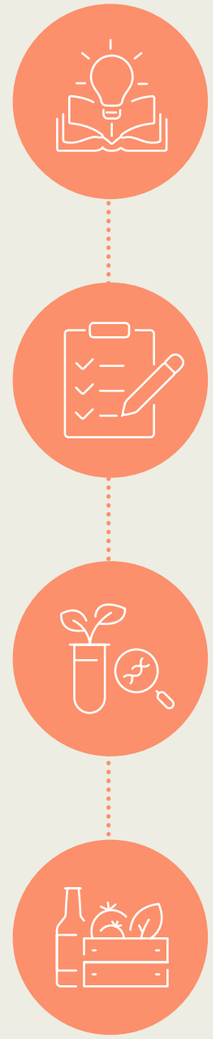
Develop innovations across the key interfaces

Pesticide toxicity

- Enhance the crop’s own mechanisms for self-defence to reduce demand for external inputs where possible.
- Discover novel pest targets and modes of actions that can be easily used in combination by farmers to minimise the risk of resistant pests evolving.
- Develop more accurate tools to detect and act upon pests, with precision modes of action and spatio-temporal application to minimise off-target risks.

Food contact toxicity

- Developing safer: Plasticisers, UV stabilizers, colourants and inks would reduce the toxicity of degradable and non-degradable plastics, as well as paper and cardboard.
- Improve toxin removal in recycling processes, improve recycled paper sorting, develop cost competitive printing inks using edible oils e.g. waste cooking oil.



Based on our findings, failure to act decisively will likely lead to irreversible consequences for both human health and the delicate balance of our planet's ecosystems.

If there is any chance that the fertility declines that we found are as real and as fast as they appear to be, we should be much more careful about the chemicals we allow human exposure to.

Policymakers should consider the impact of toxicity on fertility especially as many countries are struggling to boost it using expensive other incentives. **This is important because human and planetary health is at stake.** For us to ensure our continued development and ability to thrive as a human species, we have to accelerate the growth of innovative, technological solutions and ensure these are funded and scaled at pace.

Executive Summary DSV Toxicity Report 2025

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