

EPFL

2022

# Annual Report

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# Foreword

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2022 was another productive year for IRGC, and this annual report briefly presents our project work with links to additional information.

Looking to the future, what motivates the pursuit of our mission around governing risk? In a way, the perception of risk around us has never been so acute, leading some to say that the world is less safe and secure than before. Is this due to a failure of those whose job is to manage risk? Or is it due to an increase in expectations? What should we prioritize?

- Is it developing safety and risk management as matters that can be fixed? In many domains, chemicals or digital security, for example, the appetite for safety or security 'by design' reveals expectations that risks can be contained or controlled in advance, even though reality often proves this is an unrealistic goal;
- Or should we prioritize resilience building to prepare for whatever shocks might happen and develop our ability to rebound, recover and adapt to a new state?
- Or do we need to lower expectations towards safety, security, risk and resilience, and prepare for the worst-case scenarios, in a world confronted with global systemic risks such as those caused by Covid-19 and the war between Russia and Ukraine?

Risk governance is about all this, but IRGC is too small to pretend it can be relevant everywhere. Hence the question: what

should IRGC do? Should it continue its work in risk governance? Has IRGC done as much as it could, since 2004, to develop frameworks and guidelines for dealing with complex, uncertain, ambiguous, emerging and systemic risks? Is the job done?

On the risk governance agenda, challenges related to emerging and systemic risks continue to worry us. This is illustrated by artificial intelligence (AI): Where will generative AI lead us? Are the draft EU and US framework regulations on AI outpaced by the pervasive power of the new algorithms and quantum computing systems? This is also the case with climate change: What role can climate engineering play in mitigating risks? What will remain valid, whatever happens, is that understanding and learning how to work with uncertainty is a major asset for dealing with risks involved in complex socio-ecological-technological systems. Those able to navigate uncertainty and risks while pursuing their goal and opportunities will be better equipped to face unexpected events. Resilience is part of this, but it is not the only solution. First, decisions to invest in resilience must follow comprehensive risk assessment and must be seen as complementing other types of risk management actions. Second, resilience is costly. For example, vaccination is what protects from the Covid-19 virus, but investing in developing good health for resilience is probably what prevents from being seriously ill. We've seen in the past two years how difficult it is to make decisions when risks cannot be quantified and when value systems come into play, especially

if decisions involve arbitrating trade-offs between obtaining immediate benefits in the short term, but in a way that increases risks in the long-term; or between doing things that benefit private interests, and investing in the protection of the common good.

This prompts me to close with a few remarks about sustainability, i.e., meeting the needs of the present without compromising the ability of future generations to meet their own needs, and balancing economic, environmental and social priorities. Together with responsible behavior, fairness and ethics, sustainability is what gives meaning to risk governance. While risk governance is primarily a neutral process that can be pursued for diverse goals, the search for sustainability provides a normative ideal that makes sense of actions to manage risk and opportunities. Sustainability was one of our core focus in 2022, because if systems are built to ensure sustainability, they are more resilient and cope better with uncertainty and shocks. We are particularly concerned when emerging technology development, funding and deployment do not consider the potential unsustainability of future outcomes. For example, when carbon dioxide removal (CDR), pursued for the need to remove carbon from the atmosphere, does not consider long-term effects. The risk of impermanence or reversal of the CO<sub>2</sub> stored in biomass or soil must be considered before encouraging or deploying nature-based or hybrid CDR techniques. Similarly, if advanced chemicals, which are often adaptive and responsive to the environment in which they are deployed, are developed before the tools for assessing

their safety and risk are fully ready, there is a risk that decisions made today will be regretted in the future. One of the conclusions of our work on how to ensure that potential applications of emerging technologies (see page 4) are sustainable in the future is that standard methods for prospective life cycle assessment (LCA) are developed, used and perhaps mandated by those who conduct early-stage technology assessment.

Would it be more appropriate now for IRGC to adopt a normative goal such as sustainability or responsibility and develop risk-based approaches to this end?

2023 will see significant changes for IRGC. The EPFL Center will close in July, and we are working to transfer activities back to the Council (International Risk Governance Council, a Swiss foundation). So, the next time you hear from us, it will probably be from there.

Marie-Valentine Florin  
April 2023

# IRGC's project work in 2022

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In 2022, IRGC's main activities were organised around its project on ensuring the environmental sustainability of emerging technology outcomes, an expert workshop about governing risks related to the development of digital currencies, the continuation of two EC Horizon 2020 projects, and some follow-up and outreach activities on previous projects.

- Ensuring the environmental sustainability of emerging technologies
- Governing risks and opportunities of digital currencies and assets
- Governance of digital technologies
- Nanotechnology risk governance
- Space debris risk governance
- Carbon dioxide removal

# Ensuring the environmental sustainability of emerging technologies

The potential negative impacts of some of today's emerging technologies on the natural environment could occur at an unprecedented scale and speed, and be irreversible. Is it still possible to let people innovate and then, later on, address negative externalities with regulation?

In 2021, IRGC started a three-phase project about the issue of “ensuring the environmental sustainability of emerging technologies” (ESET). The project reviews concerns about the potential environmental unsustainability of some emerging technology outcomes, i.e., that would unfold in the future. It evaluates the extent to which these concerns could be more effectively addressed in technology design and development, before implementation.

## Phase 1

A report published in March 2022 discusses these concerns, types of response strategies, and some overarching recommendations. It illustrates those in five technology domains: advanced materials, gene editing, digital technologies, carbon dioxide removal and sequestration and space technologies.

## Phase 2

In 2022, IRGC invited authors to produce papers about specific emerging technologies and instruments or approaches to identify and address potential adverse consequences on the environment early in the technology design process. The edited volume is introduced by a summary of common themes across papers.



Phase 1



Phase 2

## List of papers published in the edited volume

- [0] **Common themes**  
Introduction
- [1] **Learning from the past**  
Risk governance of emerging technologies:  
Learning from the past
- [2] **Gene drives**  
Gene drives: Environmental impacts,  
sustainability, and governance
- [3] **Chemicals**  
Smart materials and safe and sustainable-by-  
design – a feasibility and policy analysis
- [4] **Using bio-based residues**  
Ensuring the environmental sustainability of  
emerging technologies applications using  
bio-based residues
- [5] **Electric batteries**  
Lithium-ion batteries for energy and mobility:  
Ensuring the environmental sustainability of  
current plans
- [6] **Space technologies**  
Ensuring the environmental sustainability of  
emerging space technologies
- [7] **Carbon dioxide removal (CDR)**  
Ensuring the environmental sustainability of  
emerging technologies for carbon dioxide  
removal
- [8] **Cultured meat**  
Is cultured meat environmentally sustainable?
- [9] **Ex-ante life cycle assessment**  
Practical solutions for *ex-ante* LCA illustrated by  
emerging PV technologies
- [10] **Anticipatory life cycle assessment**  
Anticipatory life cycle assessment for  
environmental innovation
- [11] **Liability systems**  
Liability's role in managing potential risks  
of environmental impacts of emerging  
technologies
- [12] **IRGC's guidelines**  
Ensuring environmental sustainability of  
emerging technologies – the case for  
applying the IRGC emerging and systemic risk  
governance guidelines

## Phase 3

In 2023, IRGC works to develop some form of guidance for various stakeholders that will consist of possible strategies to guide lawmakers and regulators, technology developers, research funding organisations, technology investors, industry and standard-setting organisations in their efforts to ensure 'better safe and sustainable than sorry'.



# Governing risks and opportunities of digital currencies and assets

What are the socio-economic challenges and needs that distinct forms of crypto or digital currencies could address from various stakeholders' perspectives? What fundamental shifts could this imply?



The possibility to capitalise on technological expertise applied to finance, the need to modernise payment and broader monetary systems, and other reasons, have triggered the development of a flurry of digital currencies, including privately-issued cryptocurrencies such as Bitcoin or Ether (there are more than 10'000 cryptocurrencies of various types), stablecoins, projects for Central Bank Digital Currencies (CBDCs), crypto assets such as Non-Fungible Tokens (NFTs), and associated trading platforms.

## Some facts

- Central banks and regulated financial institutions are no longer the only actors in money creation. New private actors in decentralised finance are challenging existing regulations and practices.
- The dramatic growth in the use of digital currencies has significant positive and negative implications for various economic actors, particularly consumers, investors and businesses. It poses several critical risk governance challenges.
- The collapse of FTX (the second largest crypto exchange) in November 2022 indicates a loss of trust in crypto assets and severe deficits in regulation and/or implementation.
- Technical concerns exist around security, privacy, scalability and efficiency. Governance aspects include impacts on financial inclusion, the illicit and informal economies, consumer protection, regulation and others.
- As in many other domains, risks and opportunities are systemic. The potential for cascading effects across domains is high, so response strategies must be coordinated among many actors.

On 25 and 26 October 2022, IRGC organised an expert workshop with the Swiss Re Institute and Horizon Group Geneva to discuss alternative scenarios about the future of digital currencies and assets, which would have implications for different stakeholders and governance approaches.

- What are the socio-economic challenges and needs that distinct forms of crypto or digital currencies could address from various stakeholders' perspectives? Which societal problems may require new currency instruments and new payment systems?
- Which fundamental societal shifts can be supported or triggered by various types of DCs over the next 5 to 10 years?
- What options are available to manage various stakeholders' needs, expectations and risks?

A background paper informed the workshop, and IRGC subsequently released ten key points that were highlighted during the discussions.



# Governance of digital technologies

Trigger Horizon 2020 project 2019–2022  
Developing and monitoring the influence of Europe on global governance



The Trigger project, completed in May 2022, provided EU institutions with knowledge and tools to enhance their actorness, effectiveness and influence in global governance.



Over the three-year project, IRGC's role was primarily to illustrate and provide some guidance to improve the governance of and by digital technology. Our efforts have involved reviewing existing governance regimes and EU initiatives on AI, examining the relationship between

governance and technologies, identifying opportunities, and conducting in-depth analyses on data protection. IRGC's work concluded with nine recommendations for the governance of AI systems in Europe, presented in a short Spotlight on risk article.

# Nanotechnology risk governance

Nanorigo Horizon 2020 project 2019–2023  
Risk governance of nanotechnology-enabled products and systems



In 2022, IRGC continued to work on ways to improve the governance of risks related to nanotechnology-enabled products and systems, including a multi-disciplinary framework and suggestions for a new European organisation that would support the implementation of the European Chemicals Strategy for Sustainability (CSS).

The work carried out by IRGC, along with other Nanorigo partners and two other NMBP-13 projects (Gov4Nano and RiskGone), defined some necessary conditions to foster the safe and sustainable development, use and disposal of products and systems containing nanomaterials in Europe, including advanced (nano) materials. Conclusions include that a new organisation could primarily play a role in providing:

- More connectivity and broader engagement with key stakeholders to collect opinions and concerns, and critical expertise that may not be captured in technical hazard and risk assessment alone and need to be well understood to ensure effective risk management.
- Access to multi-disciplinary knowledge and expertise, particularly for more systematically integrating social sciences in assessment and decisions.
- Better quality data, and easier access to data sets and appropriate risk assessment tools.

Nanorigo's view is that, without some form of organised and institutionalised multi-stakeholder and interdisciplinary collaboration, it would be difficult to address upcoming challenges related to advanced materials (future risks and benefits) and the adoption of 'safe – and sustainable-by-design' as a requirement for all chemicals in Europe, towards circularity.

# Space debris risk governance

## Low Earth orbit kinetic space safety workshop

### Enhancing the safety of operations in low-Earth orbit

IRGC's project on space debris risk governance was completed with the publication of two reports. The first report examines the current status of collision risk from space debris, reviews challenges to addressing it and discusses potential response strategies. The second report is a policy brief that presents a range of policy options to improve the assessment, evaluation and management of collision risk, intending to ensure the safe and sustainable use of space.

As a follow-up activity, the 'Low Earth orbit kinetic space safety workshop' co-organised with LeoLabs, ClearSpace, AXA XL and Secure World Foundation on 4–5 May 2022, brought together at EPFL a diverse group of distinguished space professionals for two days of active discussions. Representatives of spacecraft operators, research institutes, space agencies and governments discussed the most promising approaches to enhance space safety.



Keynote speeches presented state-of-the-art approaches. Interactive panels engaged the audience in discussions, assessing different proposals by comparing their benefits, costs and maturity. The participatory and engaging conversations at the workshop highlighted the need to

find the proper balance between leadership and international cooperation within a multipolar world. It is of vital importance that we start taking action now, as reaching agreements among multiple actors will take time. The main conclusions drawn from the discussions are available in a [workshop summary](#).

# Carbon dioxide removal

All options for removing CO<sub>2</sub> from the atmosphere and sequestering it for the long term must be assessed for their potential to contribute to reducing climate change risk, but also for their uncertainties, limits and possible adverse impacts

Removing CO<sub>2</sub> from the atmosphere and sequestering it in biomass, geological formation or elsewhere is a necessary strategy to complement climate change mitigation and adaptation. However, this will inevitably cause new uncertainties and risks, which policymakers should work to identify and address before any large-scale deployment of CDR.



A short article on “How could policy address risks from carbon dioxide removal?” reviews several aspects relevant to CDR policy and suggests three guiding principles: reversibility, robustness and adaptive governance.

## About IRGC

The International Risk Governance Center at EPFL (IRGC) brings together knowledge about the increasingly complex, uncertain and ambiguous risks that impact human health and safety, the environment, the economy and society at large. We act as a neutral platform for multi-stakeholder dialogues on risks and opportunities. IRGC's mission includes developing risk governance principles and guidelines and providing generic risk governance policy advice to decision-makers in the private and public sectors on key emerging or neglected issues. It emphasises the role of risk governance and the need for appropriate policy and regulatory environments for new technologies where risk issues may be important.

The Center works in close collaboration with the IRGC Foundation, which has shaped the global agenda on international risk governance since it was established in 2003, and which continues to play a guiding role in the work of the Center.

**IRGC Center Management Committee:** James Larus (Academic Director), Marie-Valentine Florin (Executive Director).

**IRGC Council Foundation Board:** Granger Morgan (Chairman), Martha J. Crawford, Ortwin Renn, EPFL represented by Caroline Kuyper (until 31.12.2022) and Anna Fontcuberta i Morral (since 01.01.2023).

**Advisory Board:** David Bresch, Catherine Burger, Gérard Escher, Janet Hering, Kenneth Oye, Janos Pasztor, Arthur Petersen, Rainer Sachs, Jonathan B. Wiener, Lan Xue.

**IRGC team at EPFL on 31.12.2022:** Marie-Valentine Florin, Anca G. Rusu, Luana Huguenin.

For further details, visit [irgc.epfl.ch](https://irgc.epfl.ch) and [www.irgc.org](https://www.irgc.org)

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