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Security



Theme E – Excerpt of the CASRI Strategic Research & Innovation Agenda (SRIA)

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Security – *Theme E*

Abstract

Environmental security is an increasingly important dimension of sustainable development and effective environmental governance, relying on both trustworthy environmental data systems and socially inclusive climate adaptation. Two interconnected challenges are central: ensuring the security, integrity, and interoperability of environmental data, and addressing social vulnerabilities arising from climate change and adaptation measures. Rapid digitalisation, artificial intelligence, and expanding sensor networks generate growing volumes of environmental data while introducing new security risks. Simultaneously, climate impacts disproportionately affect vulnerable populations, highlighting inequalities and weaknesses in adaptation governance. Research and innovation can address these challenges by strengthening secure environmental data infrastructures, improving monitoring systems, and facilitating trusted cross-border data exchange and cooperation. In parallel, improved understanding of social vulnerabilities can support more equitable adaptation strategies, reduce maladaptation risks, and ensure that climate measures respond to diverse societal needs. Effective governance frameworks, supported by European and international policy initiatives, are essential to translating these advances into practice. Integrating technological security with social resilience can strengthen institutional capacity, evidence-based decision-making, public trust, and inclusive sustainability transitions. This theme therefore contributes to the implementation of the European Green Deal and EU Adaptation Strategy, supporting particularly SDGs 9, 10, 11, 13, and 16, with emphasis on trustworthy institutions, climate resilience, and reduced inequalities.

Keywords

Environmental Data Security; Climate Adaptation; Social Vulnerability; Data Governance; Institutional Resilience; Climate Justice

Expected Impacts

Comprehensive data security and environmental data (Topic E1)

Position environmental data security as a structural enabler of effective and credible sustainability policies — strengthening the collective capacity to make informed decisions and respond effectively to environmental crises through reliable, secure and interoperable data that improve monitoring accuracy, cross-border cooperation, and provide a robust evidence base essential for policy effectiveness and legitimacy.

Social vulnerabilities of multi-scaled climate adaptation (Topic E2)

Strengthen the fairness, inclusiveness and long-term effectiveness of climate action across Europe by enabling policymakers to design adaptation measures that reduce rather than reinforce existing inequalities — ensuring that the costs and benefits of climate adaptation are distributed fairly across social groups, generations, and territories.

Further Information

For topic-related information on Background & Rationale, Significance and CASRI added values, expected outputs of the research questions and synergies with other relevant R&I initiatives, please refer to the full SRIA (Dictor et al., 2026).

Topic E1 - Comprehensive data security and environmental data

***Keywords**: environmental data security; cybersecurity; interoperability; trusted data*

Description: Comprehensive data security addresses risks related to the generation and use of environmental data.

Impacts: Research and innovation in environmental data security strengthen informed decision-making by ensuring reliable, secure, and interoperable data for environmental monitoring, cross-border cooperation, and evidence-based policymaking. They help address risks such as cyber threats, data manipulation, disinformation, interoperability failures, and biases in digital and AI systems. Improved data governance enhances ecological monitoring across areas such as air quality, biodiversity, and water resources. It also builds trust among citizens and scientific communities, supports citizen science and knowledge co-production, and facilitates public-private cooperation. Robust technical, legal, and organisational frameworks therefore provide a structural foundation for effective and credible sustainability policies and contribute to the European Green Deal and European Data Governance Act.

Contribution to Environmental and Sustainability Challenges: Safeguarding the accuracy and reliability of environmental data is fundamental for responding to E&S challenges. Security concerns stem from rapid technological developments, challenges related to open data, a lack of clear legal frameworks, inconsistencies of data governance, and inadequate data infrastructures and processes for sharing environmental data across international borders. Addressing security and privacy concerns builds trust among stakeholders (governments, researchers, NGOs, local communities) and increased trust fosters greater collaboration in sharing data and prevents misuse.

Transnational Societal and Policy Relevance: Security considerations are a prerequisite for effective international environmental data sharing and cooperation – without robust data security and governance, trust erodes, collaboration stalls, and the potential for data-driven solutions remains unrealized. Collaboration requires an understanding of transnational data governance and knowledge regarding how geopolitical tensions and varying national security interests influence data sharing willingness.

Systemic Knowledge Needs: Comprehensive security requires a deeper, more systemic understanding of the legal, technical, and societal factors that underpin data sharing and how these factors interact to create vulnerabilities. Systemic knowledge needs relate to an understanding of legal and governance issues related to national laws and practices, optimal technical design models of complex environmental data systems across different sectors and security protocols by EPAs and other organisations, the ethical implications of data use and privacy concerns related to environmental data sharing, and liability and fair use.

Transversal Knowledge Needs: Transversal knowledge needs highlight a need to move beyond siloed approaches to data security. It requires fostering communication, collaboration, and adaptability across disciplines and organisational boundaries to create more resilient and responsible data-sharing practices. Recognising and communicating links between robust data security and broader goals of environmental sustainability is essential. Rigid and siloed frameworks hinder innovation and responsiveness, highlighting the need for governance structures that are flexible and adaptable to changing threats and emerging technologies.

Actionable Knowledge Needs: There is a gap between high-level recommendations and practical guidance needed to implement effective security measures. Addressing them requires creating concrete resources, tools, and training programmes that empower individuals and

organisations to take proactive steps to ensure the intended use of secured data. Knowledge needs include specific technical guidance on designing and implementing secure environmental data systems, learning from best practices, and skill-building and training programmes (e.g. cybersecurity for environmental professionals).

Research and Innovation (R&I) Questions Include at Least*:*

- How can environmental data governance frameworks be effectively coordinated across European, national, regional and local levels while maintaining interoperability, trust and regulatory coherence?
- How can existing European and national data security frameworks be translated into practical guidance, operational tools and governance models for environmental data producers and users?
- Which technical and organisational approaches are most effective in ensuring the long-term integrity, traceability and resilience of environmental data across distributed monitoring systems?
- How can environmental monitoring infrastructures, including sensors, smart-city systems and private measurement networks, be protected against cyber threats, data manipulation and system failures?
- How can environmental data remain open, accessible and reusable while ensuring appropriate levels of security, privacy and protection of sensitive information?
- Which capacity-building, training and institutional support mechanisms are most effective in strengthening environmental data security practices across public authorities, research organisations and private actors?

Topic E2 - Social vulnerabilities of multi-scaled climate adaptation

Keywords: *climate adaptation; social vulnerability; maladaptation; climate justice*

Description*:* Systematically addressing social risks and vulnerabilities related to climate adaptation actions. A broad understanding exits of how economic and social systems contribute to social vulnerabilities, often by exacerbating them. The interlinkage of these systems to actions of climate adaptation in (urban) planning are often piecemeal, leaving considerable gaps to be addressed if one were to create a larger roadmap for decision-makers to follow. A more holistic and systematic understanding of the impact of urban climate adaptation on social vulnerability would create a clearer picture for decision-makers.

Impacts*:* Research and innovation on social vulnerabilities in multi-level climate adaptation can strengthen the fairness, inclusiveness, and effectiveness of climate action across Europe. As vulnerable populations face disproportionate climate risks and have fewer resources to adapt, evidence-based policies must address diverse needs and distribute adaptation costs and benefits equitably. Socially inclusive adaptation strengthens community engagement, reduces inequalities, and helps prevent maladaptation, social disruption, and climate-related health impacts. Research on vulnerability mapping, participatory adaptation, and equity-sensitive policy evaluation can support more effective national and local adaptation planning. These efforts contribute to the EU Adaptation Strategy, the Just Transition Mechanism, the European Green Deal, and international commitments under the Paris Agreement and Sendai Framework.

Contribution to Environmental and Sustainability Challenges: Sufficiency concepts and just transition frame the desired impact of climate adaptation in urban areas. However, the desired transition must also explicitly address social dimensions, which are essential for ensuring broad societal acceptance. This includes deeper insights into processes of societal engagement, as well as aspects of socio-ecological justice. From the building level regarding urban renovation and energy retrofits, to the district level with the creation of urban green spaces and the potential for district-wide gentrification, to city-level impacts of policy goals: the problem being tackled here is to coherently understand the impact and interaction of these actions for equitable and just development for heterogeneous socioeconomic groups. Only by having a full view of social vulnerabilities caused or exacerbated by urban processes can just transition be achieved.

Transnational Societal and Policy Relevance: Climate change poses a common challenge, but local adaptation needs are highly variable and dependent on socio-ecological context. Comprehensive strategies that are both practical and just need to be developed through cross-disciplinary and cross-country collaboration.

Systemic Knowledge Needs: Addresses Green Deal goals (renovation wave, climate adaptation) with social dimension.

Transversal Knowledge Needs: Collaboration between various levels of government and involvement of civil society and private sectors is crucial for tailored and effective climate adaptation strategies. Involved EU policy (New European Bauhaus, climate neutrality, Nature Restoration Law), national agencies (looking for general societal impact), cities, and communities.

Actionable Knowledge Needs: Outputs include roadmaps for social acceptance for climate adaptation measures.

Research and Innovation (R&I) Questions Include at Least:

- Which indicators and evidence thresholds are most effective for evaluating socially just adaptation outcomes across spatial scales and across short/medium/long-term timeframes?
- What frameworks and decision gates are needed to translate justice principles into permitting, procurement and monitoring procedures at multiple spatial levels?
- How can adaptation planning incorporate early-warning systems for social side-effects such as green gentrification, displacement or unequal access to new amenities, and which predictive socio-spatial modelling tools can anticipate such unintended impacts?
- How can adaptation strategies be reframed to treat climate resilience as a sociopolitical challenge rather than a purely technical one, integrating decision-making inequalities and power dynamics into adaptation planning?
- What policy mechanisms can prevent vulnerable groups from bearing disproportionate adaptation costs and ensure that benefits are equitably distributed across social groups?
- How can adaptation policies anticipate and respond to climate-induced migration and demographic change while ensuring social cohesion and equitable access to resources and services?
- How can monitoring systems capture evolving social vulnerabilities over time, including cumulative climate risks, demographic change and adaptive capacity?
- How to strengthen integration of climate adaptation with water management, health, tourism, spatial planning and ecosystem resilience.

Background on CASRI SRIA

SRIA Objectives, Positioning And Targeted End-Users. Europe is facing interlinked environmental, economic, technological and geopolitical pressures. Sustainability transformation therefore remains essential to Europe's long-term resilience, competitiveness and security. Sustained access to resources, resilient production systems and supply chains, climate-resilient infrastructure, healthy populations, functioning ecosystems, effective regulation and the societal capacity to manage transformation all depend on robust and actionable knowledge. Against this background, European Environmental Protection Agencies (EPAs) and EPA-like sustainability expert organisations have worked with actors across Europe through the project CASRI – Collaborative Action coordinating and enhancing systemic, actionable and transversal Sustainability Research and Innovation – to co-create this Strategic Research and Innovation Agenda (SRIA), which have been developed in close connection with the EPA Network Interest Group on Sustainability Research and Solutions (IG EPAS)**.** The CASRI SRIA consolidates transnational knowledge needs identified and further developed through the CASRI co-design process, providing a basis for further prioritisation, programming, collaboration and implementation. It is not a fixed research programme or a formally agreed policy position of European EPAs. Its topics and priority levels reflect the evidence, participants and timeframe of the CASRI process and are intended to be further developed with funders, policymakers, researchers and implementation actors. The SRIA addresses European and national funders, programme owners and partnerships seeking opportunities for coordinated programming and investment, as well as research organisations, businesses, public authorities, cities, regions, civil society and EPAs developing collaborative R&I and implementation activities. Through the SRIA, CASRI invites these actors to jointly develop and apply systemic, transversal and actionable knowledge for a sustainable, competitive, democratic, resilient and liveable Europe.

SRIA Content and Topic Prioritisation. The CASRI SRIA comprises 8 interconnected themes and 20 transnational Research and Innovation topics. For each topic, it describes expected impacts, background and rationale, the systemic, transversal and actionable knowledge needs, and the significance and added value of further Research and Innovation, including links and gaps in relation to existing initiatives. The topics were developed to different levels of detail according to the interest and evidence emerging through the co-design process.

CASRI SRIA Co-design Process. The SRIA was developed through a bottom-up co-design process involving EPAs and EPA-like organisations as National Contacts who invited National Key Stakeholders and European experts with backgrounds in knowledge production, funding, implementation, politics and use. Around 600 national knowledge needs were identified, clustered and consolidated into 20 transnational Research and Innovation topics, which were subsequently discussed, prioritised and further elaborated through surveys, online exchanges and workshops. The resulting agenda therefore combines national implementation experience with transnational analysis and European dialogue.

CASRI Added Value and Next Steps. The SRIA provides two mutually reinforcing contributions. First, it offers an evidence-based agenda of shared R&I needs, showing where systemic, transversal and actionable knowledge can support sustainability transformation. Second, it provides a basis for collaboration with EPAs and between those who identify knowledge needs, fund research, generate knowledge and innovation, and implement, regulate or scale solutions. EPAs can make a distinctive contribution to this collaboration because they operate between environmental science, monitoring, policy advice, regulation and implementation. Their data, institutional knowledge, stakeholder relations and experience with implementation barriers can help connect research agendas and innovation with real-world needs and support continuous learning between research, policy and practice. Implementation is understood as an iterative process rather than a final stage following research. CASRI will therefore explore how the SRIA can inform agenda-setting, funding and programming, collaborative Research and Innovation, practical implementation and learning, while developing structures for continued cooperation beyond the project.

Further information

Within the EPA Network, the Interest Group on Sustainability Research and Solutions (EPAS) serves as a collaborative platform to support the implementation of the SRIA and advance this thematic priority through knowledge exchange, cooperation and joint action. In case of interest, please contact **Stephan Bartke – German Environment Agency (stephan.bartke@uba.de)**.

Visit the CASRI website at CASRI.eu for more information.

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