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D1.2 TOWARDS A SOCIALLY ACCEPTED AND SUSTAINABLE 6G

Policy Brief

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Abstract	This document explores how 6G technology can be developed and implemented in a manner that is both socially accepted and sustainable. By adopting a value-driven approach, this document aims to inform legal, technical, and governance decisions from the outset, ensuring that 6G serves real human and societal needs. Drawing on the evidence grounded on insights from citizens, experts, and the SNS-JU community, the brief identifies areas where societal values may be compromised and where current policies or legal

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frameworks fall short. It then proposes tailored options to address these gaps, support inclusive design, and foster democratic governance through transparency and public participation, defining **four different policy briefs**. This document frames social acceptance as an evolving process that contributes to the legitimacy and long-term sustainability of technological innovation.

Keywords 6G, social acceptance, sustainability, societal values, governance, privacy, inclusion, technological sovereignty, Responsible Research and Innovation (RRI), policy options, ethical foresight, digital transformation, public participation.

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SEN	*Sensitive, limited under the conditions of the Grant Agreement*	
Classified R-UE/ EU-R	*EU RESTRICTED under the Commission Decision No2015/ 444*	
Classified C-UE/ EU-C	*EU CONFIDENTIAL under the Commission Decision No2015/ 444*	
Classified S-UE/ EU-S	*EU SECRET under the Commission Decision No2015/ 444*	

* R: Document, report (excluding the periodic and final reports)

DEM: Demonstrator, pilot, prototype, plan designs

DEC: Websites, patents filing, press & media actions, videos, etc.

DATA: Data sets, microdata, etc.

DMP: Data management plan

ETHICS: Deliverables related to ethics issues.

SECURITY: Deliverables related to security issues

OTHER: Software, technical diagram, algorithms, models, etc.

EXECUTIVE SUMMARY

This document, *D1.2 Towards a socially accepted and sustainable 6G. Policy Brief*, addresses primarily **EU policymakers** and **R&I funding programme designers**, and consolidates the results of the **policy-oriented analysis** conducted by the 6G4Society project. Its overarching objective is to support a **6G research, innovation and governance in alignment with European values, democratic principles, and sustainability goals**.

More specifically, the work elaborates on how choices made at the level of technology design and development **interrelate** with the concepts of *values*, *social impact*, *social acceptance*, *acceptability* and *sustainability* –constituting the primary focus of 6G4Society activities. **6G4Society has explored the relationships among these concepts** – all of which are understood as value-dependent processes – and has analysed how they are being interpreted and channelled throughout the work of the SNS-JU and 6G-IA ecosystem. The work builds on **empirical evidence** drawn from sustained interaction with the Smart Networks and Services Joint Undertaking (SNS JU) community through participatory workshops, a survey of SNS JU projects, interviews with experts and policy makers and project advisors, and supplemented by a citizen survey.

The document structures its analysis around **two overarching concerns** surrounding 6G, which call for anticipatory reflection despite the technology's early stage of development. These concerns act as **early indicators** of where current research and innovation (R&I) practices, governance arrangements, and policy frameworks risk falling short in **anticipating societal impacts, embedding values**, and **sustaining long-term trust**.

The **first concern** focuses on the **governance, culture, and practices of research and innovation** within the SNS JU ecosystem, and on how certain dynamics risk weakening the capacity of 6G innovation to anticipate **societal impacts, integrate diverse values, and maintain public trust**.

The **second concern** focuses on **specific societal values and rights at risk of being jeopardised** in the current trajectory of 6G development, notably **privacy**, **inclusion**, and **technological sovereignty**. The analysis shows how governance shortcomings identified under the first concern may translate into concrete societal risks, widening the gap between public expectations and institutional pathways shaping next-generation connectivity.

On this basis, D1.2 establishes the analytical foundation for **four policy briefs.** By translating societal concerns into identifiable risks, identifying regulatory, policy, and cultural gaps, and outlining emerging needs, the four briefs operationalise the D1.2 framework, with each brief advancing targeted **policy options and recommendations.**

The ***Policy Brief on Values and Impact: The Path to Acceptance and Sustainability*** addresses risks associated with a persistent techno-economic logic in innovation practices, which remains misaligned with European **Research and Responsible Innovation** (RRI) principles. The analysis shows that **sustainability** is often reduced to environmental metrics, **social impacts** are only partially anticipated, **stakeholder engagement** remains largely instrumental, and **KVIs** are frequently treated as compliance tools rather than as reflexive instruments. These shortcomings risk undermining holistic sustainability and social legitimacy. In response, the policy brief recommends **social desirability** as a transformative driver of innovation; strengthening anticipatory and value-based impact exploration; expanding ethical and social research on immersive communication. In relation to **sustainability**, the text emphasises the need to overcome approaches framing sustainability primarily in terms of **compliance or trade-offs**, often associating it with notions of constraint or renunciation. To achieve this, it calls for a more comprehensive and contextualised understanding of **environmental and social sustainability** within research and innovation (R&I) processes, alongside a stronger emphasis on contextual **co-optimisation**. Such approaches, however,

can only be effective if sustainability becomes **substantially and genuinely internalised** within our culture. This means embracing sustainability as **foundational value and core strategic driver,** shaping not only technology design, but also business models, market positioning, and value propositions. The role of **narratives**, as well as of the broader cultural and value frameworks is highlighted as critical in shaping how sustainability is **understood and enacted** throughout society.

The ***Policy Brief on Safeguarding Privacy in 6G*** responds to risks arising from the data-intensive, AI-native, and globally distributed nature of future 6G networks. 6G's architecture introduces qualitatively new privacy challenges: Integrated Sensing and Communication (ISAC) capabilities enable continuous environmental monitoring; AI-native network operations process vast behavioural datasets in real time; and ambient intelligence systems blur the boundary between network infrastructure and personal space. Evidence highlights concerns related to loss of **user control** over personal data, opaque **profiling and automated decision-making**, **human oversight**, fragmented **accountability** across multi-vendor ecosystems, and exposure to **cross-border or foreign government access**. These risks threaten fundamental rights and public trust, and may significantly undermine social acceptance. The policy brief proposes targeted recommendations to **address existing regulatory and policy gaps**, restoring user agency, modernising privacy governance for next-generation networks, clarifying responsibilities across complex value chains, regulating AI-driven profiling and automated decisions, strengthening safeguards for international data transfers, and reinforcing privacy and data protection literacy alongside coordinated policy and research support.

The ***Policy Brief on Ensuring Inclusion-by-Design for 6G*** addresses risks linked to the reproduction or amplification of existing digital divides. 6G's deep integration with essential services (healthcare, education, employment, and civic participation) transforms what was once a connectivity gap into a gateway of fundamental opportunities; exclusion from high-quality 6G access increasingly means exclusion from the services and capabilities that define quality of life. Project findings show persistent gaps in **access**, **affordability**, **skills**, **accessibility**, and **participation**, alongside limited consideration of **distributive and procedural justice** in infrastructure-related decisions. Inclusion is understood here not merely as connectivity, but as a multidimensional governance principle encompassing who benefits, who bears costs and risks, and who participates in shaping infrastructure decisions. Without early and proactive intervention, 6G risks deepening social inequalities and undermining democratic legitimacy. To mitigate these risks, the brief focuses on **existing regulatory and policy gaps** with the aim of guaranteeing equitable infrastructure access and affordability; building sustainable, local digital-skills ecosystems; shifting towards outcome-oriented monitoring of social benefits; embedding accessibility-by-design across systems and services; strengthening participatory governance; and reinforcing targeted research and coordinated policy support for inclusive deployment.

The ***Policy Brief on Securing Europe's Technological Sovereignty in 6G*** responds to risks related to Europe's **dependence on external actors** for critical technologies, supply chains, and standards-setting processes. 6G's AI-native architecture demands advanced semiconductors and software capabilities that Europe currently imports almost entirely; its design as the operational backbone for energy grids, healthcare systems, and industrial automation means that foreign control over 6G infrastructure could enable economic coercion, surveillance, or targeted disruption of essential services. These vulnerabilities raise **concerns about security, resilience, democratic oversight, and Europe's capacity to embed its values** in future network architectures. Framing sovereignty as open strategic autonomy rather than technology isolation, with the aim of **addressing existing regulatory and policy gaps**, the policy brief recommends strengthening supply-chain resilience and European industrial capacity; building independent governance and technical assessment capabilities; coordinating European positions in global standardisation bodies; enhancing protections

against foreign interference; harmonising Member State approaches; and developing specialised expertise for 6G governance.

The four policy briefs converge on a **common conclusion**: the path towards a socially accepted and sustainable 6G **is no more a technical challenge than a governance challenge**. It requires rethinking how values are operationalised in innovation, expanding participation and reflexivity, and aligning legal frameworks, policy instruments, and R&I funding programmes with societal priorities.

In line with the analysis, social acceptance and sustainability are framed **as evolving, collective and socially negotiated processes**, grounded in **legitimacy**, **trust**, and **alignment** with societal values, rather than target outcomes or user- or performance-focused metrics. Also, given the current stage of 6G development, emphasis is placed on *acceptability*, a critical aspect in the early phases of innovation as it helps to determine whether, and under what ethical conditions, technological pathways should be pursued. This directly connects to how the values of **privacy**, **inclusion**, and **technological sovereignty** – addressed in this work – are integrated into the innovation process. Embedding these values at the core of 6G development is therefore not only an ethical imperative but also a prerequisite for long-term **resilience**, **democratic accountability**, and **public trust**.

Overall, this work emphasises that important aspects and goals should be pursued through a value-based approach—that is, by embedding them as **guiding principles from the earliest stages** of development, and by **negotiating them through governance mechanisms**, rather than treating them as downstream outcomes or arrangements. By promoting a coherent, value-driven approach to governance, D1.2 contributes to the EU ambition to lead the development of next-generation connectivity that is technologically advanced, ethically grounded, socially legitimate, and environmentally responsible.

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ABBREVIATIONS

Abbreviations about the project structure and deliverables

WP: Work Package.

Dx.x: Deliverable (e.g., D1.1, D1.2).

DMP: Data Management Plan.

Abbreviations about technological and methodological concepts

6G: Sixth Generation (of mobile networks).

ICT: Information and Communication Technology.

AI: Artificial Intelligence.

IoT: Internet of Things.

XR: Extended Reality.

SAT: Social Acceptance of Technology.

KVI: Key Value Indicator.

KSI: Key Sustainability Indicator.

TAM: Technology Acceptance Model.

UTAUT: Unified Theory of Acceptance and Use of Technology.

Abbreviations about organisations and processes

SNS JU: Smart Networks and Services Joint Undertaking.

6G-IA: 6G Smart Networks and Services Industry Association.

ENISA: European Union Agency for Cybersecurity.

ITU: International Telecommunication Union.

EDPS: European Data Protection Supervisor.

EDPB: European Data Protection Board.

BEREC: Body of European Regulators for Electronic Communications.

SERI: State Secretariat for Education, Research and Innovation.

R&I: Research and Innovation.

RRI: Responsible Research and Innovation.

EIA: Environmental Impact Assessment.

Abbreviations about legal and policy frameworks

GDPR: General Data Protection Regulation.

EECC: European Electronic Communications Code.

GIA: Gigabit Infrastructure Act.

NIS2: Network and Information Security Directive.

RRF: Recovery and Resilience Facility.

CEF: Connecting Europe Facility.

STEP: Strategic Technologies for Europe Platform.

Other Abbreviations

SSH: Social Sciences and Humanities.

STS: Science and Technology Studies.

NEETs: Not in Education, Employment, or Training.

TRL: Technology Readiness Level.

GHG: Greenhouse Gas (emissions).

EMF: Electromagnetic Field.

1 INTRODUCTION

The work presented in this document builds on the scope and objectives of the 6G4Society project. It consists of a preliminary analysis which builds upon and consolidates the project's research efforts and findings, with the aim of providing four different policy briefs, each addressing a specific area of concern for the stakeholders involved in the analysis.

Its overarching goal is to support better alignment between legislation, policy frameworks, R&I funding programmes and R&I practices, to strengthen their alignment with Responsible Research and Innovation (RRI) and with the targeted EU environmental and social priorities. Accordingly, it identifies legislative and policy gaps, as well as cultural and organisational barriers.

The main contribution expected from 6G4Society, as per the original call for proposal, concerned a **deeper exploration of the relationship between 6G and society, with a focus on social acceptance, social impact, and the process to identify Key Value Indicators (KVIs), in particular to support sustainability**. In line with these expectations, 6G4Society has focused on investigating the social dimensions of the 6G technology environment, addressing the central question of how 6G development can be guided to ensure meaningful social and environmental contributions. In particular, it examined the way 6G development interacts with societal needs, ethical considerations, and sustainability objectives.

Tuned to these main trajectories, this document derives from the analysis of key project findings, and is grounded in evidence gathered throughout the 6G4Society project. It combines expert insight from inside and outside the SNS-JU community, with the lived experiences and perspectives expressed by non-experts, ensuring that its contents are both context-aware and socially grounded. It is designed to be inclusive of a wide range of views, responsive to the collected inputs, and transparent in its analytical approach.

The approach taken to formulate the four policy briefs consists in a structured, **multi-step methodology**, beginning with an **analysis of project findings** and the **identification of two key concerns**. The concerns identified belong to two main analytical dimensions. The first dimension relates to cultural or practical approaches, within the technical R&I context, liable of conflicting with RRI principles or of hampering the attainment of environmental or social goals (Concern 1); the other dimension regards the potential impact of 6G technologies on societal values (Concern 2). **Those concerns highlight four areas: one related to the first concern and three to the second, each of which is the focus of a separate policy brief.**

Concerns are then **linked to potential risks,** prompting a **gap and need analysis** on current Responsible Research and Innovation (RRI) practices as well as on existing legal and policy frameworks. This process reveals areas where legislative reform or additional policy guidance may be required, as well as issues falling outside formally recognised legal and policy frameworks – such as ethical, cultural, or societal issues. For these issues, whenever no specific legislation or policy can be identified, gaps are translated into emerging needs, reflecting the concrete requirements necessary to address these shortcomings and supporting the development of actionable options.

Finally, based on these analyses, a **set of tailored policy options is proposed** for each concern, with the aim of supporting the development of 6G in ways that align with social priorities, democratic values, and sustainability objectives.

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1.1 Relation to project work

The activities contributing to the present assessment leverage the findings and contributions emerging from WP1, WP2, and WP3, spanning societal impact analysis, public engagement, coordination with 6G SNS projects and the SNS-JU community, interviews with experts, as well as strategic foresight, towards fulfilling the objectives of project *Task 1.4: Policy and regulatory monitoring, mapping and recommendations*.

The present document is thus based on the work reflected in the following project deliverables, which also contain the project findings at the basis of our analyses. All those findings will be presented and further analysed in this document to ultimately ground the formulation of options for policy makers and the R&I funding programmes.

- **D1.1** [1]**:** It elaborates on the nature and pervasiveness of the social impact of ICTs and of communication environments, highlighting currently unexplored implications; it provides the foundations to understand the complex interplay between values and technology, and sets preliminary steps to identify key values and derive relevant KVIs, in the context of sustainability; it provides insights on the acceptance dilemma, analysing the complex nature of social acceptance in the 6G context; it introduces the SAT frameworks, to support the integration of social aspects into 6G development**.**
- **D2.3** [2]: Based on the analysis of a citizen survey, it elaborates upon the perception of participants about 6G, providing inputs on public acceptance of 6G technology.
- **D3.2** [3]: It provides the project positioning on the 6G technology acceptance concept, the description of the methodological framework called SAT and a list of main project findings derived specifically by the engagement of SNS-JU projects and experts.
- **D3.3** [4]: It elaborates on the challenges and practices related to the identification of KVIs to support sustainability, in the context of 6G Technology.

1.2 Structure of the document

Section 2 introduces the **conceptual basis** for the four policy briefs. Starting from the presentation of the two main pillars around which the project was developed—social acceptance and sustainability—the connection between these objectives and the value dimension of society is introduced, as well as the need for value-based technological development. It also presents the multi-step approach adopted to move from project findings to actionable policy options targeted at EU policymakers and research and innovation (R&I) funding programmes.

Section 3 presents all **project activities** across WP1, WP2, and WP3, and connected sources, which constitute the foundation for the reflections and conclusions elaborated in this deliverable.

Section 4 identifies and elaborates on the two **most critical concerns** emerging from this body of work: **Concern 1** related to practices and governance of R&I within the SNS-JU community, for which a specific area of analysis has been identified in the definition of the pathway to sustainability and acceptance, through the study of values and impacts**; Concern 2** focused on three specific values (i.e. privacy, inclusion, technology sovereignty) at risk of being insufficiently covered, inconsistently addressed, or overlooked in the current trajectory of 6G development.

Sections from 5 to 8 host the analyses of each specific area related to the 2 identified concerns, conducted in terms of risk and gap analysis. **Risks** focus on the possibility to

jeopardise the attainment of authentic social desirability, the integration of relevant social values, and the realisation of effective holistic sustainability, highlighting in particular the tensions some social values and fundamental rights may be subjected to. **Gaps** are identified either at the level of R&I policy and practice – e.g., strategic agendas, funding requirements, approaches – or in terms of gaps within existing EU legal and policy frameworks. Finally, in correspondence of gaps, arising **needs** are identified.

Section 9 describes project **conclusions** based on the evidence of the analysis conducted in two project years with the diverse stakeholders engaged during the project lifetime.

The policy analysis has resulted in the identification of a set of **actionable recommendations** and **policy options** for EU policymakers, addressing legal frameworks and policy measures, including those related to research and innovation (R&I) funding programmes and mechanisms. **Together, they form the basis for the development of the four project policy briefs,** one for each specific area of concern**,** as illustrated in the document **Appendix I to IV**.

2 TOWARDS ACCEPTANCE AND SUSTAINABILITY OF 6G

Acceptance* and *sustainability constitute the two main drivers behind the work of 6G4Society. All 6G4Society's approach to better understanding and describing the **social and societal dimensions** of 6G revolved around the ambition of better highlighting the path towards *acceptance* and towards *sustainability*. This was done through the reflections on the **social impact** of ICTs, the exploration of **public controversies** and **stakeholders' values**, the processes required to identify **key values** and corresponding **KVIs** relevant to support all dimensions of sustainability. Accordingly, the definition of the resulting policy briefs is driven by the aim of supporting the transition towards a sustainable and socially accepted 6G technology, more closely aligned with societal expectations.

Considering these premises, the importance of ***values*** becomes central, as an underpinning thread to these considerations. The document is therefore grounded on the following assumptions stated in [1], related to driving role of values in all aspects of our work, including acceptance and sustainability:

- **Values and Acceptance:** Values both shape and are revealed through acceptance. Technologies are more likely to gain acceptance when they visibly embody values important to their intended users or communities. For instance, a 6G application that promotes privacy and digital autonomy may resonate more strongly with users concerned about surveillance. Sustainability, if presented and assimilated as a key and priority **value**, can become a competitive advantage and facilitator of acceptance. At the same time, exploring the reasons for public controversies can highlight which values are perceived as neglected or violated, offering important insights into societal priorities. Acceptance, however, comes into play only when a technology is already part of everyday life, relating to how people perceive and respond to the technology in practice.
- **Values and Acceptability**: values, through value-based design practices, are those guiding and defining *acceptability* conditions. *Acceptability* examines a technology under the aspect of compliance with **norms**, **values**, **ethics**, and **expectations**, assessing whether it could be socially *acceptable*. In the context of emerging technologies and low TRL research, when concrete technologies do not exist yet, a discussion on *acceptability* becomes more relevant and influential than that on *acceptance. Acceptability* – being tight in its essence with the notion of **values** – is equally relevant to considerations towards *sustainability*, whenever the latter is considered as fundamental requirement and value to be embedded into technology design – as it is currently the case for the ambition of the Sustain-6G lighthouse project [5].
- **Values and Impact**: values are those guiding ethical foresight and value-based impact evaluations, essential to gauge potential ethical and societal concerns or expectations when many of the implications of emerging technologies are not yet fully understood or experienced; also, values are at the basis of any trade-off consideration.
- **Values and sustainability**. In the European approach, sustainability is conceptualised as a three-dimensional model encompassing environmental, societal, and economic pillars. These dimensions are deeply interwoven with a broad set of values, and this value-based perspective is explicitly embedded in the European Commission's vision for 6G. Sustainability can also be perceived as a value itself, against which priorities are weighted, and trade-offs untangled.

These concepts – and especially values – will be addressed in the four project policy briefs under two main levels: first, as concerns practical approaches and cultural assumptions driving

R&I practices, which could be at odd or in line with a fruitful consideration of values; second, as concerns those values considered by citizens, experts, the SNS community and 6G industry as to be under threat, or insufficiently addressed and currently overlooked.

2.1 From findings to action – Overview on the approach

This document uses a combination of **primary empirical research and systematic analysis of existing materials** to let evidence guide its priorities. Through citizen surveys, expert interviews, and direct engagement with the SNS-JU community, combined with analysis of secondary sources from project initial literature review and materials produced by other SNS-JU projects (detailed n Section 3), the document collects evidence about which priorities and concerns were most frequently and strongly expressed across different sources and stakeholder groups. This mixed-methods approach allows to focus the policy analysis on the issues that consistently emerged, rather than attempting to address every theoretically possible concern.

In order to transform project findings into actionable recommendations that shape policy options, 6G4Society applied a tailored multi-step approach, as outlined in Figure 1.

FIGURE 1: 6G4SOCIETY MULTI-STEP APPROACH

This process begins with the elicitation of two main **concerns**, grounded in the analysis of project **findings** (steps 1 and 2).

Then, each identified concern is described (step 3 to 6) highlighting related **risks** as well as **gaps** in the current European legal and policy frameworks and/or current research practices.

The analysis identifies emerging **needs** and corresponding **policy options**. Options intend offering forward-looking and responsible manners to address those needs, including within the context of R&I funding programmes.

Each step receives the output of the previous step as input. The following table describes the adopted approach steps in terms of activities, ratio, and outputs.

TABLE 1: 6G4SOCIETY APPROACH STEPS

Step	Activity	Ratio	Output
Step 1. Findings analysis	Analysis of project findings related to research activities conducted mainly within WPs 1, 2 and 3	Systematic analysis ensures comprehensive coverage of stakeholder perspectives and empirical evidence	Description of project findings
Step 2. Concerns elicitation	Concerns are derived from findings. In the 6G4Society context, concerns relate to key societal values that are object of potential threats; or to governance and methodological issues, resulting in misalignments between practice and those values.	Concerns elicitation focuses limited resources on the most pressing and widely-shared issues	The list of key concerns
Step 3. Risk analysis	For each of the identified concerns, potential risks are identified	Risk assessment determines potential impacts and identifies areas needling policy intervention or practice alignment	The list of key risks for each concern
Step 4. Gap analysis	Depending on the concern, the gap analysis might focus on screening the relevant EU legal and policy framework or the current research practices for each specific risk. In some cases, certain concerns or risks may not correspond to any existing regulation or policy. However, this does not mean they should be dismissed; on the contrary, their absence highlights a potential gap that deserves attention and may point to areas where new measures are needed	Gap analysis reveals specific deficiencies in current regulatory and research frameworks	The description of the key legal/policy/research practices gap related to the identified key risks
Step 5. Emerging needs elicitation	Gaps are translated into what stakeholders actually need	Gaps describe what is absent or insufficient in current policies, legal frameworks and research practices, while needs identification translate analytical findings into actionable requirements for policymakers	The description of the emerging needs for the identified gaps

Step 6. Final options	A tailored set of policy options are proposed to inform recommendations that respond to the identified emerging needs	Tailored options provide implementable solutions addressing identified gaps and needs	A structured set of policy options. These policy options are tailored to risks, gaps and needs identified in the earlier stages of the process

3 PROJECT ACTIVITIES AND SOURCES

This section lists and describes the main project activities and related sources, from which the inputs at the basis of Step 1 (Findings; section 5) and of Step 2 (Concerns; section 4) of the adopted multi-step approach, were collected.

The Social Acceptance of Technology (SAT) framework [6] [7] [8], described in project deliverables [1] and [3] as one of the frameworks enabling the integration of social considerations into technology development, was used to **elicit the main findings** associated with the development and deployment of 6G technologies.

The SAT framework was applied since the early stages of the project, including the activities described in the following subsections for the understanding of the major impacts, sustainable key values and controversies on 6G, as well as for the engagement of 6G relevant stakeholders.

3.1 LITERATURE REVIEW AND STUDY ON SOCIAL ASPECTS OF 6G

A **desk analysis** of existing literature and publicly available material was conducted in the first phase of the project (WP1), as a foundational and preparatory step for subsequent actions. This work focused on the exploration of four main topics: 1) societal impact of 6G; 2) KVIs; 3) public controversies on 5G; 4) social acceptance in the 6G context [1] [9].

In particular, the **societal impacts** of 6G were described, as envisioned in the 5G-PPP experience and ongoing 6G SNS initiatives. These narratives were then complemented through a critical overview of major societal impact trends linked to hyperconnectivity and immersive communication, as per the contribution of social theories and media studies. The work then focused on gathering insights on the current effort of SNS projects in incorporating **key values** into 6G technological development, with a view to elaborates the background necessary to build a framework for **Key Value and Key Sustainability Indicators** (KVIs and KSIs). Moreover, particular attention was given to analysing **public controversies** emerged during the rollout of 5G, which serve as valuable heuristics for identifying likely public sensitivities and resistance to 6G. Finally, some specificities of the 6G socio-technical context were identified, as a foundational step to contextualise considerations on **social acceptance**. In addition, 6G4Society has explored **assumptions** related to research and innovation orientations, questioning what core drivers have fundamentally shaped the development of information and communication technologies (ICT).

3.2 LISTENING TO THE VOICE OF CITIZENS

In parallel, a **survey** was designed in WP2 [2] with the aim of collecting views and concerns expressed by citizens. The data gathered from 1358 **citizen survey** questionnaires were then complemented and triangulated with a series of **participatory engagement events** designed and facilitated by the project. These sessions combined presentations on ICT and 6G societal implications, with participatory group work on specific use-cases, facilitating the discussions on perceived risks and priority values. The feedback from these activities provided a bottom-up perspective on public expectations, highlighting recurring concerns, hopes or misunderstandings about future 6G development and deployment.

3.3 DIRECT INVOLVEMENT WITHIN THE SNS JU COMMUNITY

Insights on 6G technology were gathered through different activities within WP3, performed in the context of the SNS JU projects community and the 6G-IA, in direct contact with the actors actively shaping the future of 6G in practice. These activities involved 1) a critical and research-driven exploration of projects through two rounds of a dedicated **survey** [10]; 2) the engagement of projects' experts in dedicated **interviews**; 3) the active participation of the 6G4Society consortium within SNS JU communities' **working groups**, including the contribution to thematic **white papers** ([11], [12]). These research and engagement activities have altogether yielded not only insight, but also a clearer picture of how values, governance practices, and public concerns are (or not) being addressed in the current research and innovation landscape [3] [4].

3.3.1 Exploring SNS JU research projects through a survey

Evidence was gathered through two rounds of a structured survey [10] aimed to explore how SNS JU projects would tackle concepts and approaches such as KVIs, social acceptance, and the societal impact of 6G. The survey was circulated in 2024 and in 2025, gathering in total, **63 responses** – 22 from the first round (targeting Call 1 and Call 2 projects) and 41 from the second (focusing on Call 2 and Call 3, with a few Call 1 participants). These responses offered a cross-sectional view of how widespread – and uneven – the integration of societal dimensions remains in 6G R&I. The surveys were meant as a first, exploratory step in order to subsequently provide, as a CSA, a more aware and targeted support to the community, as well as to leverage synergies within the SNS JU landscape.

3.3.2 Engaging projects' experts in dedicated interviews

In-depth interviews were conducted to deepen project understanding of the systemic challenges linked to addressing social acceptance, sustainability, and responsible innovation within projects' practice. **Twelve experts** were engaged, representing **nine SNS JU projects** (i.e., VERGE, TRIALSNET, FIDAL, HEXA-X-II; 6G-PATH, SUSTAIN-6G, FLECON-6G, NEXASPHERE, and AMBIENT-6G). These interviews were then complemented by the consultation of **two additional experts:** a senior research officer in telecom industry, and a social scientist specialised on public controversies on science and technology.

3.3.3 Direct participation in SNS JU Working Groups

6G4Society partners have actively contributed to the work of the SNS-JU and 6G-IA communities through direct observation and participation in a number of working groups. This more embedded and formal form of interaction allowed the consortium to gain complementary insights on various aspects of 6G technology.

- SNVC (Societal Needs and Value Creation) Working Group;
- SNS JU Sustainability Task Force, later SNS JU Sustainability Working Group [11];
- Workshops on social acceptance, KVIs and social sustainability organised with and for the projects of the SNS JU;
- Cooperation with SUSTAIN6G - The 6G lighthouse project on Sustainability;
- EUCNC sessions (meant for their role in engaging and co-creating knowledge within the community).
- Contribution to the SNS JU White Paper "6G for Media and Entertainment" [12]

3.4 FEEDBACK FROM POLICY MAKERS AND EAB MEMBERS

Equally important resources for the drafting of this document were some policy makers, and the members of this project's External Advisory Board. **Five meetings were organised with policy makers,** both at European (3 individual interviews) and national level (1 individual and 1 group interview), to verify the relevance and validity of some of our reflections. A **specific meeting** was also organised with the members of the project **EAB** in order to collect suggestions and feedback.

4 MAIN IDENTIFIED CONCERNS

Grounded on the synthesis activities and results, a number of key interrelated findings were identified, in line with the project foci –societal impacts, acceptance issues, innovation culture, underpinning driving values, values at risk. The critical analysis of these findings – described within the subsequent thematic sections – led to the identification of **two main concerns**.

Concerns consist of the intersections and combinations of a diversity of **issues** that translate into **material consequences for society**. Within each concern, **institutional governance, normative, cultural or practical** tensions have been identified and analysed: **points at which norms or practice generate contradictions, or values are visibly under strain**, and where corrective actions may have the greatest legitimacy and transformative edge.

The **first concern relates to practices and governance of R&I within the SNS-JU community**, and elaborates at the level of institutional orientations, R&I practices, and governance dynamics and arrangements. **Innovation practices within the SNS JU community** have been analysed against the shared commitment of building a 6G environment based on sustainability and values important for society. Results show aspects, in terms of how R&I governance is conceived and operationalised, that generate odds with the aforementioned ambitions.

Building on existing visions of 6G and its anticipated futures, the analysis elaborates on limitations as concerns capturing social needs, understanding societal impact, and incorporating values within the innovation process. These gaps affect how sustainability is defined and enabled, ultimately hampering the possibility of realising it in a holistic way. As a result—despite strong intentions and ongoing efforts—innovation practices across the SNS JU ecosystem still reveal some mismatches in their ability to meaningfully integrate perspectives that fall outside mainstream industrial culture. The analysis takes the perspective of the Responsible Research and Innovation (RRI)[1] framework [13], analysing the coherence with the RRI principles of reflexivity, anticipation, responsiveness, inclusion and participation.

The **second concern** elaborates on specific **values at risk of being insufficiently covered, inconsistently addressed, or overlooked in the current trajectory of 6G development**. In particular, building upon the governance challenges identified in Concern 1, Concern 2 highlights specific points of tension, as well as gaps in the capacity to recognise and integrate these values that are critical for ensuring the legitimacy and fairness of technological development.

This tendency becomes particularly visible in moments of public resistance (e.g., delays in infrastructure deployment), contestation between different governance levels (e.g., municipalities vs national decision-makers), or when citizens express distrust of close development processes. Marginalisation of those perceptions poses risks for public trust and acceptance of 6G development.

Under the second concern, based on insights gathered from the citizen survey and in two years of project experience, **three main *values* have been selected for a deeper exploration: *privacy*; *inclusion*; *technological sovereignty***. Besides these, additional topics also emerged as prominent alongside the finding's analysis, which could not be granted proper

[1] The Responsible Research and Innovation (RRI) framework provides guidance for integrating ethics and societal considerations into research and development processes, emphasising stakeholder engagement, ethical reflection, and anticipatory governance. Value-sensitive design methodologies are practical tools to operationalise RRI, embedding human values directly into technological design processes and ensuring that societal priorities are considered from the earliest stages of innovation rather than addressed as afterthoughts.

elaboration in the context of this work. Some of these topics belonged to the realm of citizens' perceptions and experiences; as such, they were often framed at a high level of generality, subjectivity, and with less immediate operational traction in current project practices. As such, addressing them adequately would have required a dedicated analysis which would exceed the thematic scope of this particular policy briefs analysis. Therefore, even if acknowledged as relevant in terms of sociological research, some topics were considered better suited for different workstreams and targeted studies. For the aim of this specific work, therefore, we limited our analysis to issues closely intertwined with broader scientific, regulatory, and technical debates, which allowed a different analytical depth.

Topics that have emerged recurrently in terms of priority or concern, both as feedback in the citizen survey and in our desk research, are, for example, Health and Safety, and Environmental Sustainability. Health concerns appeared among the top spontaneous comments in the citizen survey open-ended responses. There, citizens expressed concerns about **unknown or long-term health effects**, mainly linked to high-frequency electromagnetic radiations. In this regard, some reported the technology as harmful to health, feeling that its deployment does **not prioritise human well-being or safety**. Regarding **environmental** concerns, they were voiced through the citizen survey, with some participants viewing 6G as part of a tech-driven race that risks ignoring planetary limits. Common themes include high **energy consumption, e-waste, and overproduction** driven by questionable use cases like streaming or automation. Several respondents see 6G as a continuation of **unsustainable practices**, where environmental costs outweigh societal benefits, especially when 5G itself has not proven its value.

The significance of these data relevance lies in their capacity to expose and describe concerns and fears from the population, as well as needs not explored or not properly taken into account within governance or R&I processes. They shall not to be addressed and interpreted solely in terms of actual scientific or technical legitimacy, but for what they express as instances within a democratic sphere. These topics, and related narratives, are indicators; they point to social needs, on the one hand, and on the other hand to communication or trust gaps within the stakeholder system.

The next sections further elaborate on the **two concerns**. First, the project findings underpinning the synthesis of these concerns are presented; then, the specific risks associated with each area of concern (four areas in total) are analysed, informing and leading to the **four final policy briefs, each addressing a distinct area of concern for the stakeholders involved in the analysis**. These findings are not merely background observations; they establish the interpretative framework through which societal concerns have been selected and examined in this policy brief analysis.

5 VALUES AND IMPACT: THE PATH TO ACCEPTANCE AND SUSTAINABILITY

This section describes the project findings that underpinned Concern 1, *Practices and governance of R&I within the SNS-JU community*. These findings prompted a deeper reflection on the values and impacts that shape pathways towards societal acceptance and long-term sustainability.

5.1 PROJECT FINDINGS

5.1.1 Social impact of ICTs

Information and communication technologies (ICTs) exert a unique and profound transformative potential, long recognised and explored within the social sciences. What distinguishes ICTs from other forms of technology, in terms of their societal impact, is their capacity to operate at – and influence – the **symbolic level** of human interaction. This level – where a fundamental and unique human capacity is expressed – encompasses both the *content* of communication and the *modalities* through which information and meaning are exchanged — including codes, media, sensory capabilities, channels, formats, and processes. Changes introduced at this symbolic level can therefore modify the very frameworks through which meaning and sense are produced, shared and experienced — the **ontological** and **epistemological** structures that shape how reality is understood [14]. Transformations in the information, communication, and media landscape, therefore, have effects that permeate all dimensions of social life. By reshaping how meaning is constructed and shared, ICTs influence our value systems, activate or suppress social practices, redefine priorities and goals, and ultimately guide social development and the foundational structures of civilisation itself. A full and aware acknowledgment of impact-related processes in the 6G environment is ultimately key for realising a full and holistic sustainability, as well as to fully grasp social sustainability. Our work pointed onto two main dimensions where the concept of impact acquires importance:

The impact of ICTs is rarely understood beyond direct and intended effects of technologies, undermining the substance of *sustainability*. Despite the sensitivity of what mentioned above, what we captured is that within the technical and industrial context there still seems not to be full awareness of the broad and profound implications that ICTs trigger in society. Within the industrial context, the notion of societal impact of technology, or of "second order effects" (term currently used by the industrial community) mostly relates to: 1) the description of the intended and direct impact of applications in their specific sector of action; 2) predictable negative effects directly linked to the solution's use. Considerations about the profound and broader societal implications triggered by technologies, beyond the intended and direct impact of applications, rarely enter the radar of projects, and are still not acknowledged nor managed within R&I processes. Sustainability, by definition, is future-oriented and systemic: it concerns the long-term viability of interdependent ecosystems. The way the discourse on impact is framed, will relapse on how projects perceive their work in and for society, influencing their work on needs, goals, values and KVIs. Ultimately, such gaps in scoping societal transformations beyond direct effects will affect the way sustainability is understood and assessed. This will compromise the achievement of genuine, holistic sustainability, and in particular, of social sustainability.

The specificities of the immersive communication environment require attention from the ethics and sociological point of view. Each specific medium, based on its specific physical and technological characteristics, creates a unique communication environment, which not only determines content is produced and conveyed, but structures also the ways

audiences perceive and interact with the environment itself [15]. In doing so, they influence the relational affordances of society [16]: they encourage certain forms of communication while discouraging or even rendering others obsolete, thereby influencing how messages are created, transmitted, received, and interpreted. Representing 6G a paradigmatic shift in the information and communication landscape and in how technology interfaces with society, its transformative potential is expected to extend far beyond direct technological effects, and to trigger profound societal implications. Especially in the immersive communication paradigm, the relationship between human, technologies, media and the environment will be subverted. Human experience will be transformed across the dimensions of space, body, and reality perception, extending human sensory and cognitive abilities, transforming social relationships [17], and the way we generate and interpret meaning [18]. Mediation – although "naturalised" and immanent – will continue to be present and exert a specific influence, participating in the process of meaning creation. It will be therefore important to identify specific aspects of these environments needing further investigation in terms of ethics or sociological implications [1]. Important dimensions being impacted include:

- the reconfigured relationship between body, space, and environment;
- the blurred boundaries between reality and imagination in the virtual world;
- the relationship between physical and virtual social space;
- the perpetration of stereotypes in the virtual world;
- the role of mediation in immersive communication environments.

5.1.2 Assumptions and values underpinning innovation trajectories

Innovation paths still reflect priorities and value systems proper of the industrial sector. The notion of what generates value in society, and therefore deserves to be pursued, tends to be shaped by a specific subset of the population, mainly within the industrial sector, in dialogue with institutions. As a consequence, the value system belonging to this specific group, while representing only part of society, often becomes the prevailing vision and perspective driving the approach to the future of society.

The paradigm currently shaping the vision of humanity's future remains largely technology-driven, rooted in the pursuit of competitiveness and grounded in the assumption that hyperconnectivity is both a primary objective and an unquestioned intrinsic value. This orientation is reflected in the prevailing vision of the future network and media landscape [19], as well as in the global race across successive generations of mobile networks (5G and now 6G) each striving for improved performance, expanded functionalities, and accelerated progress, typically conceived in incremental terms. This prevailing cultural perspective is underpinned by a number of self-reinforcing underlying assumptions, embedded in our innovation culture, which currently seem to shape research priorities and investment decisions, as well as the policies and industrial strategies that guide technology design:

Technological and performance advancement are mostly viewed as inherently positive. The idea that "new" and "more" are valuable ends in themselves – especially when associated with speed, automation, intelligence, virtuality, connection or efficiency – tends to remain unchallenged both in policy frameworks and in how research projects are designed. This is particularly true concerning a number of features underpinning 6G, as for instance hyperconnectivity.

Universal connectivity is considered as inherently beneficial. The assumption has long being driving ICT innovation. At the global and geopolitical level, a strategic decision has been set toward pursuing a future centred on hyperconnectivity. This reflects deep-rooted cultural values favouring connection and efficiency; also, this represents a foundational choice regarding the envisioned role of technology within society. Universal connectivity, however, is

not unconditionally beneficial. Empirical evidence increasingly shows that constant connection can undermine wellbeing and therefore social sustainability, generating cognitive overload, stress or disconnection from reality.

Innovation is frequently associated with technological advancement. It is commonly framed as the process of turning discoveries into societal value, with technology development seen as the primary driver of innovation (with almost no attention to the contribution of non-technological forms of innovation).

Innovation is created by technology push. Investment strategies tend to prioritise technological feasibility and market breakthroughs, often assuming that new applications are inherently necessary and desired. Within this context, market dynamics may take precedence over alternative solutions that could be more closely aligned with public values or societal needs. This can result in a tendency to reinforce existing technological pathways rather than consider broader societal values grounded options.

Technology may be the solution to most of the problems (techno-solutionism). This framing usually stresses the attention on the solutions of a problem, rather than on its determinants, potentially limiting the attention to non-technological strategies for addressing complex societal challenges.

Societal progress is commonly treated as a by-product of technological advancement. Within dominant techno-optimistic narratives, social value is expected to follow from economic and technological growth, rather than being approached as an independent goal. The contribution of non-technological approaches to the creation of social value is only poorly explored.

The point of view of non-specialists is not useful in defining the trajectories of future technology offer or specific solutions.

Considering that innovation choices shape the boundaries and affordances of future human civilisation, the dominance of a partial perspective raises concerns about the ability to genuinely capture the diverse needs of society and to remain responsive to its evolving needs and values. Moreover, such imbalance invites further exploration of gender-related dimensions—both in terms of the priorities and values that guide innovation, and the ways these are reflected in its content and representations [12]. This reflexive exercise leads us to reflect on how the views and priorities of other social groups, or stakeholders, are considered.

5.1.3 Stakeholder needs and values

From expert views collected through interviews as well as from participants at EuCNC, it emerged that innovation paths appear still shaped by a narrow set of actors and values, which leads to reproducing a dominant vision of the future, often based on technological solutionism. Reflections are needed on the capacity of public and community engagement in 6G development to ensure a decisional process that is meaningful, timely, genuinely influential, fair, and transparent. This is due to a number of shortcomings inherent to the way processes and approaches are addressed:

Plurality, diversity, representativeness: not all relevant stakeholders are always consulted. As per our activities and sources, the categories of stakeholders that are mentioned are often focused on the industrial value chain or the designated final users. Low or no attention is observed for social and interest groups beyond the closest circle of stakeholders, or outside the groups of specialists. As a consequence, perspectives that could bring new insights or suggest alternative needs remain underrepresented.

Influence: participation is frequently seen more as an outreach obligation rather than a co-design opportunity. As a consequence, it is often addressed in ways that limit its potential for this practice to shape the initial design and strategic direction of activities. For example, engagement is often performed after key technical and business decisions have been made, and assumptions cannot be questioned or changed. Stakeholders are often consulted at advanced stages of the process, and/or with rather passive methods, aimed at validation rather than deliberation or co-creation. As a result, stakeholders' views can hardly influence the process.

Power dynamics: in other cases, power dynamics set the direction. Some of the experts interviewed highlight a structural gap between the engineering- and corporate-dominated discourse and the imperative for broader public involvement. Despite inputs collected earlier in the process, industrial priorities tend to prevail. This power unbalance appears especially in contexts where alternative views emerge or differ from the mainstream orientation. Some answers to our survey highlight how views that are not in line with the prevailing techno-optimistic narrative can be perceived as less legitimate, are dismissed as a direct consequence of a lack of knowledge.

Purpose: "People do not know what they want". A common objection from industry to the methodological call for stakeholder involvement and co-creation is that users are not reliable indicators of whether a technology is useful or worth pursuing. Technology and business developers often interpret user feedback as inconsistent or contradictory, given that expressed preferences may fluctuate or evolve. This vision is commonly used to legitimise a predominantly technology-driven or technology-push approach, on the assumption that needs can be anyway influenced or created. In fact, this vision demonstrates a fundamental misunderstanding in the objective of engagement, which is not (only) to create demand, and ensure acceptance, adoption, sales and market uptake. The deeper motivation behind participation and stakeholder engagement lies in the effort to orient innovation toward the long-term societal good and the pursuit of social sustainability. Engagement is about creating space for diverse needs, perspectives, and visions of the future. It is about ensuring that values important to society are recognised and have a voice in shaping technological and industrial directions. And this is essential to building processes that are genuinely oriented toward sustainability.

Desirability: Social desirability can be defined as the degree to which an innovation is *worth pursuing* in relation to societal goals, ethical principles, or collective aspirations. Currently, social desirability and societal values have not yet emerged as fully transformative elements within the prevailing technological paradigm. The conception of 6G marks some progress in this regard, making considerations on social desirability and values more explicit in the formulation of use-case scenarios and target applications. This marks a positive evolution in how technology is envisioned, toward a more reflective approach to technological development. Yet, despite these advances, the framework still remains largely technology-driven and performance-oriented, prioritising technical (e.g., performance-driven) or economic (e.g., profitability-driven) rationales. Social desirability and values, while acknowledged in discourse, are still insufficiently embedded in the processes that guide innovation, remaining largely peripheral and uninfluential.

Public controversies: In the exploration of desirability, public controversies shall be looked at as heuristic tools to explore and expose this diversity of priorities and values among social groups, industry, and institutions. As such, controversies should not be seen as obstacles but rather as valuable indicators for better accessing and understanding relevant social needs. Controversies are capable of marking where different interests may collide, marking where the priorities of different social groups may diverge from those of decision-makers (industry or

institutions), and shall bring decision-maker or industry to question the criteria through which we orient our vision for the future we want to build.

Whenever controversies were based upon the misinterpretation and misunderstanding of scientific fact, their interpretative relevance is still not to be dismissed, because they may be indicators of communication or trust gaps within the stakeholder system.

Role of science information and communication. The assumption that public scepticism or disagreement with science results primarily from a lack of knowledge or understanding – and that if scientists simply fill this knowledge gap through better information transfer, public support for science will increase – has been proved wrong by extensive research in the field of Science and Technology Studies (STS). Such an assumption – known as "deficit model of science communication"– presents as principal [20] limitation that of overlooking the role of other forms of knowledge (e.g., cultural or experiential understanding), as well as of values, trust, and context, in shaping attitudes toward science. Critics to the model have eventually highlighted the need to understand science communication beyond a one-way, simple transmission of scientific facts from experts to a passive public; they showed instead that public opinion is more complex than the deficit model suggests and that the model's premise that knowledge directly leads to positive attitudes toward science is flawed [21].

5.1.4 Technology acceptance

Acceptance was addressed differently across projects. Acceptance considerations surfaced often, but were addressed with conceptual ambiguity and inconsistent depth. While many projects claimed to work on acceptance or societal values, only a few demonstrated a structured or operational framework to do that. This might create risks of *tokenism*, where societal values are referenced superficially without being meaningfully embedded in design processes, or of broader misalignment between technology development and actual public needs and values.

Acceptance as an outcome *versus* acceptance as a process. A disconnection exists between how social sciences understand technology acceptance and how it is often framed by industry, engineers, or policymakers. In many cases, acceptance is treated as a goal to be achieved, typically through persuading people of the benefits of technology. This reflects a "technology push" model, where companies create demand rather than respond to real societal needs. Such an approach risks delegitimising alternative perspectives on innovation priorities. In contrast, social scientists view acceptance as an open-ended process aimed at understanding what people want and value. As one Science and Technology Studies interviewed expert noted: "Social science is not here to persuade people that technology is good. We are here to assess social perceptions and concerns, and ask: whose needs are being addressed, and whose are being ignored?".

Acceptance: perception of benefit or induced demand? Qualitative findings from citizen surveys and public engagement activities reveal a widespread sceptical perception as concerns the relevance of 6G to everyday life. Many participants questioned the need for faster connectivity, considering 4G or 5G as already meeting most daily needs, and noting that 5G itself has yet to show clear benefits. These perspectives, which should not be dismissed as simple knowledge gaps, highlight deeper societal tensions and a perceived misalignment between technological agendas and public priorities.

Participants expressed concern that new connectivity generations are driven more by technical or commercial motives than by genuine societal demand, calling instead for technologies that deliver tangible public value, promote inclusion, and address real social needs. Interviews with senior telecom experts echoed similar concerns, noting that "the demand was not there" and that the hype surrounding new technologies often exaggerates their benefits, as seen with 5G.

They questioned whether the public would perceive enough added value to justify new costs when existing technologies already perform well. Representatives from major research projects also warned that industry "technology push" strategies may generate artificial demand rather than meet genuine societal needs.

Acceptance: beyond user experience and adoption. In line with traditional user-experience models such as TAM or UTAUT, the projects explicitly addressing acceptance tended to identify it with user experience, interpreting user satisfaction as an indication of future likelihood of adoption and business viability. This approach exposes three main, interlinked limitations:

- It links acceptance to the role of users, overlooking how other social groups might be impacted by or may respond to the technology.
- It circumscribes acceptance to the context and sector of technology use [22], with limited attention to the wider impact of technology on society.
- It frames the exploration of acceptance solely around ensuring business viability and market success; this undermines the attention to potential rising ethical issues or to significant social transformations that require careful management and guidance.

As such, this approach to acceptance does not always align with the values of the society we aspire to build, nor does it ensure that the accepted trajectory represents the most desirable direction for technological development. As a consequence, the risk is to overlook considerations that are important for social sustainability. 6G4Society promotes therefore an understanding of acceptance that goes beyond measuring user satisfaction, likelihood of adoption, or business viability, emphasising the need to broaden the analytical perspective to encompass other important dimensions that characterise the relationship between technology and society, notably: values, ethics principles, disruptiveness potential and wider social implications.

A more complete elaboration on social acceptance can be found in 6G4Society D3.2 [3].

5.1.5 Key Value Indicators (KVIs)

The research work conducted by 6G4Society across projects of the SNS-JU community, as well as insights from events such as the EuCNC 2025 special session, show a heterogeneous landscape, with many projects genuinely striving to create their own tailored set of KVIs and related methodology. The main emerging open challenges are the following.

KVIs are not used as a design guiding tool. KVIs can serve multiple roles: they can prove a target is met in the short term (similarly to KPIs), to support industry self-monitoring; or show progress potentially enabling sustainability in the long term, to demonstrate sustainability activities to the funders. They may provide transparency for public accountability, or evidence to assess policy implementation. Much depends on the purpose that is attributed to them in a certain process. Different purposes may orient towards different driving values, and therefore different KVIs.

In general projects appear to have varying levels of clarity and consciousness of KVIs purpose. For example, some highlighted how "it's still too early to say how we'll implement KVIs in practice"; others replied that although their project is aligned with sustainability, no means of verification had been defined yet. These responses indicate that the possibility of using KVIs to guide design as of the earliest stages is not yet fully explored. KVIs are often applied retroactively, with unclear ownership or influence. This state of play becomes especially critical when considering how to integrate dimensions such as trust, inclusion, safety, and quality of life into the innovation process, since those dimensions are often cited but still challenging to operationalise at the level of technology or solution design.

6G4Society promotes a vision of KVIs also as a design tool. Used proactively, KVIs can act as a guidance tool to highlight the principles and motivations (the *why*) driving actions and decisions; also, they can support in "embedding values considered important from the start, reflecting them in the core objectives and functionalities of network design" [9].

KVIs in low TRL projects have a function, but remain a practical challenge. A recurrent observation raised by SNS JU projects, collected during the webinars we organised, concerns the difficulty of engaging on KVIs in low TRL and/or strictly technology-focused projects. In the elaboration of this difficulty, it appears that KVIs are often interpreted as tools closely for measuring social impact and social goals (values as a goal), or tools to measure user experience-related aspects. This interpretation, however, only partially reflects their potential scope.

Indeed, values can be engaged also differently, as guiding and founding criteria orienting choices, priorities, and purposes (values as criteria). Therefore, in early stages of technology development, KVIs can also be used to measure the extent to which certain values have been reflected into requirements for technology design decisions. For this, it is particularly important that value embedding is considered even in low TRL, early enough to influence the technology development process. KVIs can therefore be applied in low TRL technology, although with purposes that differ depending on the contexts of use-cases.

The challenge of accessing stakeholders in early stages of technology development. To elaborate on which values should underpin and guide research, access to a diverse range of stakeholders is essential, as discussed above. However, the structure of projects working on fundamental research or enabling technologies, often provides limited opportunities or incentives to foster openness to stakeholders or dialogue with society. This may lead to a misalignment between research design and the objectives of value-sensitive innovation: by the time a technology reaches a maturity level at which stakeholder interaction is deemed relevant, many design decisions have already been made, rendering the technology less adaptable to change. As a result, stakeholder engagement tends to occur at later stages in the process, serving primarily to validate existing choices rather than to inform or shape them. Consequently, opportunities for co-design become limited, leaving little room for meaningful or structural intervention.

Competences and processes to work with Key Values: In general, the process of translating key values into KVIs can create disorientation for those involved. Teams frequently struggle with fundamental questions: what constitutes a social value; how to identify values and where to look for them; how to derive corresponding indicators; how to quantify indicators and measures for assessment purposes [10]. In many cases, the individuals tasked with this responsibility do not belong to the social sciences field; therefore, they do not possess the necessary tools to capture the full breadth of value created in society. Similarly, they are not always fully equipped to recognise how or whether societal values are embedded within technological development, out of biases. Beyond questions of competences, there are also challenges in the process: KVIs, although intended to represent stakeholder and societal values, are frequently defined internally by project teams, sometimes with limited transparency and minimal external feedback. In other cases, the definition of values precedes the phase of project implementation, as in these cases they are predetermined by strategic decisions made prior to, or outside of, the project teams.

User experience cannot act as a proxy for societal values. This limited methodological grounding can sometimes lead technical experts to rely on user experience as a more accessible, though partial, proxy for societal values. Limitation of this approach lies in the fact that the quality of an individual user experience in a specific use-context cannot serve as a measure of the values incorporated in technology (value as criteria) [23], nor of the values transferred and reinforced in society through that embedding, nor of the broader societal value

and benefits that the solution may generate (value as an outcome). In general, the analysis of user experience does not help accessing or capturing the deeper ethical, cultural, and societal dimensions of technology, nor its systemic impact. As such, UX cannot serve, on its own, as a reliable source for what matters to society (value as criteria), and for the value that is created in society (value as an outcome).

A more complete elaboration on KVIs can be found in 6G4Society D3.3 [4].

5.1.6 Environmental sustainability

Concerns about the **environmental footprint** of 6G technologies are acknowledged within the SNS JU project community, as well described in [11], although with substantial differences, and some gaps, in the way these concerns are reflected into operations. Triangulating data from the SNS JU White Paper and 6G4Society interviews, we highlight the following.

The discourse about environmental sustainability is mostly framed around the need to mitigate negative effects rather than around the end-goal of guaranteeing and creating sustainability. Environmental sustainability is not yet consistently represented as a standalone, positive design driver, nor a long-term environmental commitment and end-goal, guided by ethical responsibility and planetary boundaries.

The relation between economic and environmental sustainability tends to be framed and treated as a trade-off. Environmental sustainability often appears in tension or in opposition to competitiveness, performance and profit goals. Environmental sustainability rarely emerges as a driver of design, tending, on the contrary, to be more easily expendable to economic viability goals – which tend to dominate project priorities. This may limit the capacity to achieve effective environmental sustainability. Currently, the work within the SNS-JU community is directed to identifying relevant sustainability-related trade-offs topics, as well as to create a representation model showing how different blends and combinations of variables impact on the delicate balance between performance, resilience, and sustainability (in particular, Sustain-6G project). The objective is to show how to maximise the benefits derived from all dimensions that shape and support system sustainability, with a view to achieve the best co-optimisation among variables.

Environmental sustainability appears more easily expendable to economic goals, which hampers the achievement of effective environmental sustainability. In particular, **the relation between economic and environmental sustainability is mostly framed and treated as a trade-off**, with environmental sustainability positioning itself in tension or in opposition to competitiveness, performance and profit goals, and economic viability tends to dominate project priorities. Environmental sustainability was almost never mentioned as a driver of design.

Environmental sustainability is mostly framed and addressed in projects in terms of energy efficiency. This stems from two main reasons: 1) the direct impact of energy efficiency on operational cost reduction and savings (and thus on profitability); 2) the easier measurability of energy efficiency and its higher compatibility with existing projects' skills, objectives and KPIs targets.

Important aspects of environmental sustainability appear currently as underrepresented and overlooked in the practice of projects. These aspects include in particular the ethical and sustainable procurement of materials, the transition from finite materials to renewable resources, circularity approaches (including lifecycle design, or the

management of electronic waste), and biodiversity impact. One contributing factor identified is the limited availability of internal competences, within the Telecom sector, to address certain aspects of environmental sustainability, such as GHG emissions or biodiversity [11].

Different sources, as well as interviews conducted by 6G4Society to technical experts and policy makers, confirm a tension between the ambitious vision of energy-neutral infrastructures and devices, and an expected **rebound effect**, or the risk of creating massive "**smart waste**" due to the proliferation of billions of new devices [24] [25]. In particular, representatives from projects like Hexa-X-II and Sustain-6G confirmed the open challenge of **integrating circularity principles into innovation** without compromising technical performance or economic viability. Finally, it was acknowledged that the environmental burdens of technology often fall unevenly across different regions and social groups. Some more specific findings are detailed hereafter.

5.1.7 Social Sustainability and social impact of technology

The discourse about social sustainability is often framed around a generic positive assumption that technologies can solve social problems, implying that if technical objectives are met, positive social outcomes will automatically follow. This perspective tends to treat social sustainability as an inherent benefit of digitalisation, rather than a dimension that requires dedicated analysis, operationalisation, and measurement.

Social sustainability aspects and long-term societal benefits tend to receive comparatively less attention than the environmental and the economic dimensions in projects and experts' discourses. This confirms social sustainability as "the neglected component of sustainability". [26]

The interpretation of *social sustainability* varies importantly in focus, level of granularity and scope across the SNS JU projects community. This highlights the need for a clearer definition and outline for this concept, as well as more suitable metrics to evaluate social impact [11].

Inclusion emerges as the most widely shared interpretation across SNS JU projects, becoming a priority objective under the pillar of social sustainability. The other two most recurrent interpretations of the concept relate to *security* and *trustworthiness.* In some elaborations, the concept of social sustainability has been overlapped with the challenge of social acceptance and technology uptake, linking that outcome to well-conducted social needs explorations and social engagement processes [25].

Important nuances and categories of values, relevant to define social sustainability in the context of future networks and connectivity, are currently not fully taken into consideration within the SNS JU community. The analysis conducted across 27 projects in the context of the SNS JU Sustainability Task Force highlighted aspects of the concept of social sustainability currently not covered in the ongoing debate and in existing approaches. These include nuances of the concepts such as: *mental health and wellbeing, cultural identity and diversity, intergenerational justice, equity, autonomy, social-cohesion, cultural heritage, freedom, or the right to disconnect.*

***Qualitative* is considered problematic.** There is a tendency to prioritise quantifiable metrics over qualitative, yet equally important, values (like trust, inclusion, or environmental impact) because the latter are perceived as "soft" or difficult to measure. This can lead to a de-emphasis of societal concerns unless they can be translated into technical or economic terms.

5.2 POLICY ORIENTED ANALYSIS

On the basis of the above described analysis, six main risks are identified, for which gaps and needs are elaborated, leading to the identification of related policy brief recommendations and options shown in **APPENDIX I**.

TABLE 2: 6G POLICY BRIEF

<table>
<tr><th colspan="4">Concern1: Practices and governance of R&I within the SNS-JU community</th></tr>
<tr><td colspan="4">Values and Impact: the path to Acceptance and Sustainability</td></tr>
<tr><td colspan="4">Risk VIS1 – Innovation trajectories remain disconnected from social desirability and deep social needs</td></tr>
<tr><td colspan="4">In its own mission statement, the SNS JU has set objectives to ensure a human-centric and sustainable internet and to meet public policy and societal requirements alongside technical and market targets (for example in areas like security, energy efficiency, health and inclusion).

In doing so, however, the main and initial driver remains technological feasibility and market potential, or the application of existing technologies. In this way, the orientations guiding research and innovation, and consequently the vision of the future that is designed, pursued, and built through these processes, often reflect the priorities, values, and perspectives conceived within the industrial, technical and scientific community, that is a specific subset of society.

As a consequence, the range of imagined futures tends to be constrained by what technology can achieve, rather than by what society might collectively desire or need. For instance, this dynamic reinforces the persistence of a paradigm that treats hyperconnectivity as an unquestioned and intrinsic value, potentially introduces biases on which foundational elements (technological or otherwise) are prioritised, and therefore on how the future is framed.

Consequently, by overlooking the diversity of other communities and societal perspectives, current research and innovation (R&I) practices risk to project a narrow-scoped vision of the possible futures, limiting or missing opportunities for a broader – and more inclusive – explorations of alternative or disruptive solutions on how human and societal development might evolve and be transformed. Such alternatives could be centred on broader or different priorities and aspirations as to what deeply matters and is socially desirable or needed, realising different visions for value-driven outcomes such as human well-being, equity, and sustainability.

This misalignment of R&I with societal needs is explicitly acknowledged in EU research policy frameworks under the banner of RRI, the EU policy approach aiming at aligning research and innovation with the values, needs, and expectations of society. To this extent, the Rome Declaration on RRI [27] underscores that responsible innovation means ensuring R&I delivers on smart, inclusive and sustainable solutions to societal challenges, engaging new perspectives and talent from across society.</td></tr>
<tr><td>Risk Type</td><td>Human: indirect effects on individuals (e.g., well-being, equity, participation).</td><td>Societal: exclusion of social perspectives, loss of cultural diversity, failure of innovation to respond to collective needs.</td><td>Governance: lack of inclusive and reflexive processes, overlooking of societal impacts.</td></tr>
<tr><td>Gap</td><td colspan="3">Awareness about the criteria orienting Europe’s innovation and technology culture. Although some technological paths may appear inevitable, they can be questioned, and interpreted as the products of specific cultural and historical contexts: each choice or step in the innovation pathway is the result of an implicit cultural framework, underpinned by a series of cultural values, often unrecognised.

Awareness on the relativity of innovation paths, however, is still limited. For industry innovation pathways and choices may appear clear and unavoidable, as naturally reflecting their prevailing values and priorities. Similarly, society – meant as the</td></tr>
</table>

	beneficiaries and users of innovation – may tend to adapt passively to proposed technological future scenarios, without questioning (especially before negative impacts occur) the existence of alternative possibilities or unexplored options. Low awareness of this translates into limitation as concerns the envisioning of our future. **Capacity to involve and meaningfully integrate external voices to shape innovation agendas.** Business exerts a profound influence on society, in terms of b **impact**. For this reason, decisions about the future of society should benefit from the inclusion of a wider range of stakeholders, to capture **diverse perspectives** on what constitutes a desired future. Currently, Innovation paths in the telecom sector appear still shaped by a narrow set of actors and values, lacking solid institutional mechanisms for pluralistic input are missing. Such processes still lack "procedural justice" (lack of fairness and transparency of the decision-making process). Excluding broader participation may limit opportunities to explore **alternative solutions, societal visions, and needs**. This may not only lead to missed opportunities for valuable public input, but can also foster mistrust. Co-creation and co-design are still areas with significant potential for development.
Emerging Need	**Make social desirability a genuinely transformative driver within the technological process.** Research priorities must be able to integrate and embrace social desirability as a criterion informing choices. This requires a cultural shift, overcoming a purely **techno-deterministic, techno-solutionist, and technologist-driven** approach, where feasibility becomes a key criterion of choice, and technology is approached as a fixed and predetermined trajectory. At the core of the shift towards a **desirability-driven approach** there shall be a vision of technology not as a driver and an end from which social good automatically derives, but as an aid to solving problems that shall be investigated independently from technology. The **driving criteria** do not start necessarily from feasibility considerations, but on social needs and values identified outside the technological discourse. **Acquiring desirability as a driver means being open to capture different visions and priorities as to the desired lifestyle for the future** of our society, even in discontinuity with dominant positions. A desirability-driven approach opens the possibility of considering **alternative visions of the future**, with technological priorities, use-case prioritisation, and approaches to problem-solving **shaped around different value systems**, where technology is truly leveraged as a means, and not as driver or end in itself. The role of technology in society should be therefore redefined, and centred on the opportunity to consciously select and prioritise specific human principles and visions for the future – with the awareness that decision at each design phase can shape future societies. A desirability-driven approach, by allowing to complement and resize the weight of the driving values currently at the roots of our economic system, may contribute to create a conducive environment for a more naturally and substantially integrated sustainability. Social desirability can be actioned in R&I through operating at different levels (listed below). The consolidated knowledge from RRI related research activity can open the way to define the “how” – methodologies, key questions, key steps: **Breaking assumptions**: Funders should foresee proper mechanisms and methodologies to facilitate the critical examination and elicitation of the values and assumptions that shape orientations, pathways, and decisions in the research and innovation sector. The objective is breaking with taken-for-granted assumptions for the definition of programmatic priorities in research and innovation. **Redefining Needs**. The concept of *need* shall be redefined**.** It shall not be understood only in the context of **technology push** (where demand and perception of need can be induced through the introduction of supply) or for the purpose of **market success** (e.g. enhancing competitiveness or increasing sales). In a technology push perspective, demand can be stimulated, adoption driven, and commercial success achieved even in absence of proper engagement or a clearly expressed societal need. In turn, **in a social desirability context, exploring need means understanding the orientation and**

	priorities of society, also independently from immediate or technology driven market opportunities, and questioning the need for certain innovations. **Redefining Acceptance, including acceptability**. The approach to acceptance shall be redefined, widening the scope of investigation. To be in line with a social desirability approach, also the approach to the exploration of acceptance shall evolve. A wider range of stakeholders (beyond final users) shall be addressed, and a different scale of the socio-economic contexts (beyond the scenario of use) should be considered – e.g., the socio-political, community or market level. **Creating a broader and more comprehensive approach to the stakeholder system in the telecom sector.** The perspective of who has a legitimate stake in technological innovation shall be extended beyond the community of business, technical and industrial specialists. Meaningful engagement shall include direct interaction with local communities, involving them in decisions related to their territories (e.g. infrastructure placement), including groups or **communities that may be indirectly impacted, negatively impacted**, or which perceive themselves as negatively impacted. This would ensure a comprehensive exploration and elicitation of societal needs across social groups, and relative important social values. The objects of exploration should include needs, priorities, driving values, or potential tensions. Also, transparent communication about risks shall be provided. This is essential is to critically examine which social values are being promoted and reinforced, or challenged, through current innovation trajectories. (The use of virtual reality tools for visualization has been successfully reported by a project in a SNS community as a means of exploration within local communities). **Opening to alternative or controversial voices to explore desirability.** This opening attitude shall also tune towards conflicting or divergent voices, to acknowledge, embrace and manage controversies. As explained above, public controversies on science and technology represent valuable manifestations of where different social groups provide different interpretations of what is desirable in society and for their future, or of how the same concept (e.g. sustainability) may be filled with different meanings. **The quadruple helix model**, long applied in the context of living labs, and grounded on design thinking methods, could offer a relevant reference framework to effectively support the translation of insights from engagement into alternative development choices. It demonstrates how collaboration among academia, industry, government and civil society can foster more pluralist, inclusive and reflexive innovation processes, grounded in real societal expectations and capable of generating more legitimate and socially responsive outcomes.
Risk VIS2 – The diversity of social values remains only partially reflected in the innovation process	
Despite the complexity of the dimension of social values, and the fact that it relates rather to social science and humanities competences, industry and innovation actors are increasingly expected to define, identify, manage the value dimension within technology development processes, both at the level of integration during the design phase, and in terms of reflecting on the societal and ethical implications of their activities. Evidence collected through 6G4Society confirms that many technical experts find it **difficult to recognise the way cultural values shape innovation from its very conception, especially in low TRL levels.** Value-related aspects are most of the time interpreted for the *value created in society*, overlooking what relates to the embedment of values during the phase of technology design. These difficulties, combined with the challenge of identifying and engaging relevant stakeholders early on, result in value-related considerations being addressed predominantly at later stages of the TRL scale and the innovation process. **This determines limitations as concerns the possibility to truly steer technological development reflecting ethics, values and social good** considerations into technology design.	

Risk Type	**Human**: potential impacts on human experience, well-being, and behaviour within immersive environments.	**Societal**: innovation may not align with societal values.	**Governance**: absence of governance mechanisms, foresight, and cross-disciplinary coordination.
Gap	**An important gap relates to the competences required to address the interplay between values and technology across the innovation** process. This means distinguishing between the concept of *values* (the underlying principles driving and shaping choices and decisions), and of *value* (meant as positive social impact created. Also, this means mastering the process of "translation", that is, the different ways to reflect a value into the innovation process depending on different technology or socio-technical contexts, and the different ways a value can be shaped and operationalised into technology development through requirements.		
Emerging Need	**Guidance to manage values in technology.** Dealing with values is inherently complex. Their influence on choices and actions—whether at the individual, corporate, or institutional level—is often implicit and rarely acknowledged in a deliberate or conscious way. To address this gap, practical and structured guidance is required to help practitioners identify and articulate the contribution and effects of the values that underpin innovation directions and objectives. **A first step shall relate to guidance in the elicitation of values in technology work.** The process shall facilitate the exploration of values not only as end goals but also as driving principles that (often implicitly) define purpose and orient strategic or technical decisions. Such exploration helps uncover the deeper cultural and ethical frameworks guiding technological choices. An important counterpart for this phase relates to the capacity of **constructively addressing and managing controversial views.** Controversial discourses on science and technology can serve as catalysts to identify key social groups possibly impacted by technologies, and the underlying values that people attach to their social and environmental context beyond economic considerations (e.g. landscape preservation, quietness, or unspoiled nature – as also noted in an expert interview). As such, the analysis of controversies allows to elicit possible points of tensions in the way different stakeholders prioritise values, as well as the different interpretations and meanings that different social groups attribute to a same value. Developing a technology that addresses social values means precisely to be able to recognise and protect, throughout the innovation lifecycle, also those values that are not part of the mainstream industrial and innovation culture, making them core in how technologies are imagined, funded, and deployed. This would also ensure plurality and transparency. **A second step should focus on building capacity to integrate these values** into design and development processes from the earliest stages of technology conception, through appropriate requirements. This step shall include guidance to what to include, where and when throughout the specificities of the project context. **A third step should support the translation of values into KVIs**, providing clear rationales, methodological steps, and examples to help teams navigate different options.		
Risk VIS3 – The broader societal impact of future network technologies may not be steered			
Within the current innovation culture, there is a risk that industry and technology actors may **overlook the long-term social, cultural, and ethical impacts** of technological advancements, particularly the **unintended or negative effects** that may accompany smart networks and deeply immersive communication ecosystems. A number of social impacts, related to the creation of broader value for society, or linked to the transformative impact of the digital world on our lives, are often not hold into enough considerations in R&I processes and in the pain/gain weighting processes of industrial teams.			

<table>
<tr><td colspan="4">This in part derives from the tendency, within the industrial culture, to act on the assumption of a beneficial effect of technology as concerns the impact on society.

To ensure that technological progress aligns with societal values and well-being it is important that these aspects equally enter in the realm of technology development processes. This can be done especially through embracing the contribution of social science and humanities in the technology development process, as a perspective able to situate technology within its social context, and to bring and anticipatory perspective.</td></tr>
<tr><td>Risk Type</td><td>Human: potential impacts on human experience, well-being, and behaviour within immersive environments.</td><td>Societal: innovation may not align with societal values.</td><td>Governance: absence of governance mechanisms, foresight, and cross-disciplinary coordination.</td></tr>
<tr><td>Gap</td><td colspan="3">Within the technical R&I environment, there appears to be limited awareness of the potential negative social implications that technologies may generate for individuals and society beyond their intended or sector-specific impacts. This is coupled with a consequent weak tradition of systematically exploring so-called “second-order effects” — the broader, indirect societal transformations that technological innovation can trigger. As a result, these aspects are not sufficiently reflected in design or assessment processes.

This weakness affects and compromise, for example, the capacity of:

- duly calculating cost and benefits; pains and gains;
- duly and comprehensively shaping the understanding of the social sustainability dimension;
- devising KVIs with sufficient breath and scope to capture longer-term impacts, beyond the project lifetime;
- timely identifying social values at risk, or the need to recognise new social values or rights to be protected.</td></tr>
<tr><td>Emerging Need</td><td colspan="3">Widening the understanding of “impact”. A new way of approaching and understanding impact is needed in the industrial culture, moving beyond performance metrics or the immediate scope of applications of technology, and combining the study of more immediate and intended social impacts, with the understanding of the broader and complex set of dynamics that technology triggers at the human and societal level.

Building awareness of the broader implications of ICTs on society. Capturing 6G’s potential influence requires awareness on the transformative effect of technology on several fundamental aspects of human experience and social organisation, and on what dynamics are ignited at the cultural, social and individual levels (cognitive, psychological, identity-related, relational, mental health aspects), and understanding that these levels can be problematised, explored and anticipated (although not predicted nor assessed). This will allow to:

- better scoping the concept of social sustainability;
- Identifying better which human or social values are or probably will be at stake, allowing to actuate adaptive measures as early as possible at the level of technology design. This will improve acceptability, i.e. the capacity of being compliant with the legal and ethics framework, as well as in line with cultural norms considered relevant.
- Articulating a well-founded position on the role and importance of disconnection in a sustainable future society, recognizing it as a necessary counterpart to hyperconnectivity—rather than its negation—and as a foundational component of individual and collective well-being.
- directly contribute to build holistic sustainability, by ensuring that innovation choices are informed by ethical reflection, inclusiveness, and long-term public interest.

These aspects shall be addressed as of the onset and earliest stages of the R&I process, to inform orientations and choices, and not only assessed at the end of the</td></tr>
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	process. This requires leveraging complementary knowledge, competences and methodologies, in particular from the social sciences realm. **Importance of integrating social science competences to complement the understanding of complex societal implications.** The exploration of broader societal implications and transformations, as previously discussed, is often confined to the work of social scientists within academia. To adequately address these aspects within the innovation ecosystem, it is essential to integrate competences from the social sciences and humanities (SSH) into the innovation culture and processes of the SNS JU community. Experience from 6G4Society demonstrates the proficuous and complementary contribution that social sciences can bring to future network research, particularly in complementing the comprehension of how technology relates to social and environmental sustainability, or to elicit the way certain technology features could translate into social impacts. Also, integrating SSH expertise enables the identification of key values and corresponding KVIs, while capturing nuanced dimensions of the social and environmental impacts of technology. **A number of anticipatory approaches help bridging the gap to capture the broader, systemic, and long-term transformations** technologies may trigger in society, by revealing potential second-order effects and societal dynamics that conventional methods do not capture. These are, for example: Constructive Technology Assessment (CTA), Value Sensitive Design (VSD), Socio-Technical Integration Research (STIR), scenario building, foresight and backcasting exercises, Technology Foresight Assessment (TFA). In the operations of the SNS JU ecosystem, they would help complement existing innovation practices, by expanding innovation targets from technical feasibility and performance, towards a more substantial pursue of social desirability, long-term societal relevance and ethical soundness.

Risk VIS4 – Ethics and societal issues related to immersive communication environments remain unexplored			
The transformations driven by future network technologies and immersive communication environments are expected to **profoundly reshape society and human experience**. While these developments hold immense potential, they also raise a series of risks and "shadow points" that call for a **more responsible, anticipatory, and reflexive approach to innovation**. The European Commission strategy on Web 4.0 and Virtual Worlds (the "metaverse") [28] acknowledges that virtual worlds (based on persistent, immersive environments) will impact how people live together, bringing both opportunities and risks, and that these new risks must be addressed to ensure the digital sphere remains safe, trustworthy, and aligned with Union values and fundamental rights and ensuring that people are protected and empowered. Here some specific aspects related to the rise of new, deeply immersive communication ecosystems are described, highlighting the opportunities for further research.			
Risk Type	**Human**: potential impacts on human experience, well-being, and behaviour within immersive environments.	**Societal**: innovation may not align with societal values.	**Governance**: absence of governance mechanisms, foresight, and cross-disciplinary coordination.
Gap	**Issue 1 - immersive communication as a new communication mode.** 6G comprises technologies with profound and pervasive social impact potential, at all levels of human life, from micro to macro level, from the inner human level to the organization of social structures, across all spheres of our actions, and at the global level. Despite the pervasiveness and qualitative depth of these impacts, the transformative effects of hyperconnectivity still remain largely unexplored. Immersive communication is considered by some scholars in matters of communication sciences and media theory as a new communication mode. This depends on the way important communication categories - such as space, time, human body presence, non-verbal communication - participate in the communication exchange and to the		

	generation of meaning. However, current research lacks a comprehensive approach to explore immersive communication environments from the social dimension and media theories point of view. We suggest supporting research paths to explore immersive communication environments from the social dimension and media theories point of view, exploring the relevant and constitutive dimensions of this new communication and media paradigm, and in particular the impact connected to the evolution of "mediation". Mediation – although "naturalised" and increasingly immanent – will continue to be present and exert a specific influence, participating in the process of meaning creation, and as such, its capabilities and influence could be investigated. **Issue 2 – narratives, stereotypes and values reinforced in virtual and gaming environments.** The gaming experience evolved lately from pure entertainment into platforms for socialisation, learning, and identity-building, demonstrating the transformative potential of immersive environments on societies. This raises relevant questions (also ethical) as concerns the **development of** contents in the gaming and real games industry. This because through the gaming dimension different **values may be transferred and reinforced in society**: games may be designed to foster exploration, cooperation, diversity, equity or inclusion; conversely, they could reproduce and reinforce stereotypes, as well as violent or problematic behaviours, contributing to consolidate in societies controversial narratives about social roles or interaction modalities and behaviours. This potential opens the need to reflect on both risks and opportunities. **Issue 3 –the relationship between physical, virtual, real, and imaginary spaces.** The immersive potential of XR technology generates vivid experiences and real emotions, transforming the relationship and type of interaction between physical, virtual and imaginary space. The ethical implications are profound: while immersion can enrich creativity, learning, and cultural expression, excessive engagement risks detachment from the physical world and weakens the ability to distinguish mediated from unmediated experience, potentially leading to confusion or disconnection from one's physical surroundings and social relationships.
Emerging Need	Important dimensions being impacted and requiring exploration include: • the reconfigured relationship between body, space, and environment; • the blurred boundaries between reality and imagination in the virtual world; • the relationship between physical and virtual social space; • the perpetration of stereotypes in the virtual world; • the role of mediation in immersive communication environments. **Research topic 1 - immersive communication as a new communication mode (research focus).** From an acceptability perspective it is essential to reflect on which values—autonomy, authenticity, inclusivity, well-being—should be safeguarded as immersive communication and XR becomes central to cultural production and experiences. The risk of emotional manipulation, bodily surveillance, and dependency on immersive environments shall also become objects of reflection. The contribution of SSH disciplines – and in particular social sciences, cognitive sciences, media studies, psychology, etc. – shall be an essential requirement **Research topic 2 – narratives, stereotypes and values reinforced by games (research focus).** Currently, the video game industry is structured in a way that reinforces stereotyped visions of women and biased representations of female characters, promoting a male and sexualised perspective of both women's bodies and their roles in society. In addition, game content is often linked to contexts of competition, violence, or war, reinforcing values such as dominance, conquest, and rivalry. Research shall be supported to investigate the role of gaming experiences in terms of social sustainability, and governance of values. The focus could relate to the way social stereotypes may be reinforced (e.g. in terms of gender or minorities representations). Also, research could focus on the influence of gaming in the shaping of self and identity;

	or on the risk of emulation connected to virtual experiences constituted by violence or aggression. The contribution of SSH shall be an essential requirement. **Research topic 3 –the relationship between physical, virtual, real, and imaginary spaces (research focus).** Further research shall be done on how physical and virtual experiences are articulated across real and imaginary, affecting not only individual well-being but also social sustainability. The contribution of SSH – and in particular social sciences, cognitive sciences, psychology, etc. – shall be an essential requirement.

Risk VIS5 - Sustainability remains perceived as a burden, and the trade-off logic hampers its holistic realisation

Despite the European Green Deal frames sustainability as Europe's new growth strategy, and the European Declaration on Digital Rights and Principles [29] calls for the environmentally and socially responsible design of digital products and services, with minimal social and environmental impact, **sustainability still remains peripheral to industrial R&I agendas, core business models and decision-making processes**.

In most business contexts, sustainability has **not yet evolved into a core guiding principle** – it still fails to contribute to shaping innovation strategic objectives in a **transformative** way, informing the design and development of products or business models. **Nor it is considered a strategic asset and source of business value** – a constitutive element of the value offer, in terms of market positioning, reputation, or product and service offering. Therefore, sustainability is still far from ultimately stimulating a real **paradigm shift**. Sustainability continues often to be **framed as a trade-off**, or as a secondary or external consideration. It remains frequently **associated with notions of constraint or renunciation**, and often perceived as being **in tension or opposition with competitiveness, performance, and profitability**.

The persisting risk is that of an only superficial and **compliance-oriented and tokenism** interpretation of sustainability, with no evolution of it into a **genuine driving force and a source of business value.** This reflects the persistence of a **deeply rooted cultural and value framework** still oriented towards different priorities, and a disconnection or lack of identification with the **fundamental values** that should underpin **responsible and future-oriented development**.

Risk Type	**Societal**: failure to align innovation with sustainability principles threaten the wellbeing of the whole human kind and of the ecosystem.	**Governance**: weaken social trust, legitimacy, and the collective benefits of innovation.
Gap	In the specific context of the SNS-JU, the community has manifested the willingness to transition from a trade-off logic and approach, towards ***co-optimisation* approac**h [11], as a way to guarantee a more holistic alignment between technological advancements and broader sustainability objectives. The capacity to **devise concrete co-optimisation strategies**, however, remains a critical challenge. Appropriate support mechanisms are needed to support industry in this effort, to avoid treating conflicting variables as competing interests, and to ensure that a performance-oriented culture does not overshadow broader sustainability considerations. This process opens a window for a critical reflection regarding **what criteria are to be used to define what is optimal.** Criteria for prioritisation vary across stakeholders, based on their specific objectives, **priorities and value systems**. A full understanding of trade-offs / co-optimisation management, therefore, cannot leave aside a critical reflection on **whose priorities** are influencing the decisional process and priority setting.	
Emerging Need	**Sustainability should be recognised and valorised as a driver of competitiveness. There is a need to overcome the trade-off culture** and to foster a culture where sustainability is not felt as a burden or external constraint, but as an integral, strategic	

	asset, a way of living and working, a principle that naturally guides how activities, products, and systems are designed, produced, and managed. To do this, actions at different levels are needed: **Assigning sustainability a higher priority, making it less negotiable in research and innovation programmes.** In the same way that security, safety, and quality are treated and socially perceived as essential dimensions of performance and value, and not perceived as limiting constraints, so sustainability shall be assigned a higher priority, as an element strengthening long-term resilience and eco-systemic well-being. **Putting circularity at the centre of the transition, as the deepest enabler of sustainability.** The transition towards a circular economy is the most founding aspect of sustainable development, since it relates to the causes of the triple environmental crisis (climate change; biodiversity loss; pollution – while focusing solely on energy efficiency or emissions would merely treat just the symptoms). To address sustainability therefore, all phases of the value chain shall be considered, for their influence and impact for technology development: - The end-of-life phase of products should become as soon as possible an inherent part of the R&I decision-making process, reflecting a broader respect for resources, the environment, and future generations. - Specific requirements shall regard the exploration of business models not based on selling new products / versions, but on product as a service. - Measures shall incentivise models where profit does not derive from selling new products and continuous production, but, for example, from selling services. In these models, the shifting of repairing costs from the consumer to the producer would contrast models based on “programmed obsolescence”. - Developers and users of 6G shall be incentivised to adopt "green purpose" models through subsidies and political attention. **Providing evidence on sustainability as integral parts of businesses value creation – and creating positive narratives**. It is necessary to cultivate narratives where sustainability is not a renounce, but a **shift towards a different construction of value**, more distributed, long-term and holistic. Such new narrative shall be **tailored for the telecom sector**, on the value of sustainability in this specific business. This could take the shape, for example, of a portfolio of virtuous examples from project-level experimentations, or beyond. Examples shall deal with mechanisms on how to change operation modalities and assumptions at different stages of the telecom value chain (from design and infrastructure choices to service provision and end-of-life management), to embrace environmental sustainability goals. Examples shall relate especially to options and experimentations on **circular viable business models**. Such models emphasise *reparability* and *refurbishment* as founding principles; they are often based on “product-as-a-service”, leasing models. Here, the extended producer ownership helps to overcome overproduction and programmed obsolescence as a source of profit. Interesting examples in the SNS community comprise hardware leasing approaches (based on a “product-as-a-service” principle), or the creation of a modulable quality of user experience (e.g. project EXIGENCE). This line of inquiry could be supported within specific R&I or CSA topics or as required activities within more general topics. **Governance mechanisms to support and guide the transition.** Co-optimisation strategies call for dialogue between institutions and industry, as well as governance arrangements to steer truly holistic co-optimisation between different interests. Guidance is needed by industry from policy makers to navigate choices and options, in particular as concerns: - setting conditions and boundaries for use (e.g. applying the principle of frugality to avoid unnecessary bandwidth usage); or for *what it cannot be used for* – in order to avoid later the need for forbidding. - discussing thresholds and limits; - prioritising achievements and targets, incentivising certain uses upon others.

	- establishing rules for what the technology can and cannot be used for; - distinguish between what constitutes a legitimate trade off – expression of specific contextualities – and what represents the perdurance of traditional priorities and values (performance, profitability) at the expense of other interests (e.g environment, the ecosystem, biodiversity, etc.). **Investigating both economic and cultural barriers:** - **Cultural barriers:** reflect from a cultural perspective on why sustainability is still often perceived by businesses as an obligation and burden rather than an opportunity and an intrinsic value. - **International competitiveness barriers.** Investigate ways to integrate sustainability into innovation, investment, and cooperation strategies. In this way, sustainability and competitiveness can be understood as mutually reinforcing objectives, contributing to Europe's leadership grounded in responsibility and excellence. - **Customer acceptance or market adoption** considerations: two things shall be considered, as positive and enabling factors: 1) growing public awareness and strong societal support make sustainability already a powerful source of innovation and differentiation, rather than as a constraint; 2) if it is true that in market needs can be induced, demand created, and value marketed, then innovation and marketing processes should work together to build new narratives on sustainability, to support new forms of products and services, where ethical and socially responsible aspects are constitutively integrated.

Risk VIS6 – Environmental and Social Sustainability are not fully scoped and remain partially addressed		
Currently, the way in which the concept of **social sustainability** and environmental sustainability are interpreted in the context of R&I innovation agendas and practice, fails to incorporate nuances and aspects that are constitutive of the concepts. For example, the concept of **environmental sustainability** is explored predominantly in terms of energy efficiency. While some argue that these aspects are left behind because they are less relevant, linkable, or actionable within the scope of 6G research projects, on the other side, this perceived lack of relevance may derive from: 1) **a low priority attributed** to these topics within programmatic research priorities (work programmes); 2) a **difficulty in establishing meaningful links** with research and innovation priorities, targets and operations; **3) missing specialist competences** to properly address these aspects**.** A proper understanding of these aspects is important to avoid negative social and environmental rebound effects from the digital transformation.		
Risk Type	**Societal**: negative social and environmental rebound effects from the digital transformation.	**Governance**: insufficient integration and operationalisation of sustainability within R&I policies and practices.
Gap	**Aspects relevant to correctly scope the concept of social sustainability**, and currently not fully addressed are: *mental and physical health and wellbeing; cultural heritage; cultural identity and diversity; sense of belonging; feeling of being safe in a community, and of being part of a community; community prosperity; intergenerational justice; equity in the way assets, resources and benefits are distributed; societal resilience; social cohesion; participation and empowerment; autonomy; freedom; dignity; right to disconnect or not to be connected; landscape preservation; quietness and unspoiled nature.* **Aspects relevant to correctly scope the concept of environmental sustainability,** appearing a less addressed within the activities of SNS-JU projects are: *greenhouse gas (GHG) emissions; electromagnetic field (EMF) exposure; circularity; impact on biodiversity; landscape preservation; quietness and unspoiled nature.*	
Emerging Need	**There is a clear need to clarify and contextualise what environmental and social sustainability mean** within the specific areas of action of SNS JU projects. The	

	meaning, nuances and objectives of the concept of both environmental and social sustainability in the context of future network technologies shall be better defined and scoped. **As concerns social sustainability**, the visions and narratives advanced by industry regarding future social scenarios or the approaches proposed to address social challenges shall be analysed, **informed by insights from social sciences.** This would make it possible to highlight ethical or social issues related to specific technological solutions and requirements, requiring attention for their potential wider societal implications. This shall be done also for works at low-TRL or on enabling technologies. **As concerns environmental sustainability**, similarly, there is a need to explore and verify whether or to which extent the current works of SNS-JU projects can actually relate to the aspects left behind, under which respect and focus. The contribution of specific competences (on GHG, circularity, biodiversity) shall be required. Concrete examples and contextual explanations would help illustrate how such aspects may relate, directly or indirectly, to the work of SNS-JU projects, including low TRL ones. This would make it possible to draw a thread linking technical operations with long-term, systemic social impacts.

6 SAFEGUARDING PRIVACY

This section describes privacy as the most prominently expressed concern across all input sources, classified under Concern 2, *Values at risk in the current trajectory of 6G development*.

6.1 PROJECT FINDINGS

In the 2025 citizen survey, 64% of respondents identified privacy and data protection as one of the most significant issues for the future of connectivity. In particular, many respondents to the citizen survey expressed deep concerns about **privacy, surveillance, and data security** in the context of 5G and 6G. While some acknowledge the potential benefits of faster, smarter networks, many are worried that these advances could come at the cost of personal data protection, increased surveillance, and misuse of AI. There is a strong desire for greater transparency, ethical safeguards, and individual data ownership.

These findings were mirrored by SNS JU projects, with over 70% citing privacy in their internal reflections, though with varying degrees of operational clarity. The sheer volume of data anticipated for training AI tools within 6G presents unprecedented privacy challenges. Moreover, a tension exists between the desire for advanced services (e.g., personalised experiences) and users' willingness to **share personal data**, particularly if services are cheaper or free, as noted by representatives from the Sustain-6G and 6G-PATH projects. The deployment of sensing technologies may face resistance in Europe due to differing cultural values around privacy compared to regions like China, specifically highlighted by representatives from the AMBIENT-6G and Nexasphere projects that also touched upon **data ownership** and privacy management. Public awareness regarding the implications of data harvesting and **surveillance** capabilities in new technologies like 5G (and by extension, 6G) is a persistent challenge, as observed by representatives from the Hexa-X-II and FLECON-6G.

Therefore, interviewed experts, particularly from the social sciences and telecom industry, confirmed the shift from conventional privacy concerns toward more structural anxieties over **surveillance architectures, algorithmic control, and the erosion of digital autonomy**. As such, privacy appears to be not only the most recurrent concern, but also the most directly tied to fundamental rights and governance challenges in 6G.

These findings lay to the consideration that **privacy is a multifaceted concept. Privacy as a concern touches on many fundamental values**, so that when we talk about privacy concerns, we are implicitly talking about protecting these connected values. For example, if experts voice privacy concerns about 6G's use of personal data, they are also defending the user's autonomy and dignity, aiming to maintain public trust, and guarding the democratic principle that individuals should not be unjustly observed or profiled. Moreover, privacy, data protection, and security should be understood as complementary but not interchangeable: all three are essential, but each one addresses different dimensions of safeguarding individual rights.

Privacy is a fundamental societal value closely tied to other core values. Privacy has deep connections to **human dignity**, and **self-determination**: protecting individuals' privacy enables people **control over their personal information and space**, which is essential for them to develop their personality freely and maintain dignity. This is particularly relevant in the 6G context, which is characterised by **massive use of IoT and the involvement of multiple vendors**. Both of these factors make it harder for individuals to control their data and raise **accountability** issues. With multiple vendors in the 6G value chain, it becomes unclear who

is responsible for what — this undermines both **autonomy** and the sense of **justice**. At the same time, the 6G ecosystem brings together conflicting interests: telecom operators may seek to monetise user data, advertisers may demand greater access to it, governments may require it for law enforcement, while users themselves aim to protect their privacy. These competing priorities risk creating **power imbalances** that threaten **fairness** and **justice**.

Privacy is recognised as an enabler of other values and fundamental rights. In EU discourse, privacy is not only a social value but a fundamental right, codified in documents like the EU Charter of Fundamental Rights, reflecting its importance for both individual and societal well-being. It allows individuals to decide when, how, and for what purpose their personal data is used, which is crucial for personal autonomy. Moreover, privacy is tightly interwoven with **freedom** and **democracy**. The right to privacy underpins freedoms such as freedom of expression, thought, and association, and thus serves as a foundation of democratic society. The logic is that without privacy, people may **fear surveillance or judgment**, chilling their willingness to speak or associate freely.

Privacy and data protection are closely related but distinct concepts. While they often overlap, they do not coincide. Art. 7 of the EU Charter of Fundamental Rights defines privacy as the fundamental right of individuals to keep their personal life, home, and communications free from intrusion. It is a broader concept rooted in human dignity and autonomy, encompassing not only the protection of data but also freedom from surveillance, freedom of thought, and the right to private spaces.

Art. 8 of the EU Charter of Fundamental Rights clarifies that protection of personal data is the right of everyone to the protection of his/her personal data. It can be exercised within the legal and regulatory framework that governs how personal data must be collected, processed, stored, and shared. This framework provides the tools and mechanisms (e.g., consent requirements, purpose limitation, and access rights), to safeguard individuals' data and support the broader goal of protecting privacy. However, one can comply with data protection laws without necessarily respecting the full scope of privacy rights, particularly when personal data is processed lawfully but still intrusively (for example, in behavioural profiling or excessive workplace monitoring).

Privacy concerns frequently go hand-in-hand with other concerns, such as **surveillance** and **misuse of data**, which, if unaddressed, can erode **public trust** in institutions and technologies. For instance, if citizens worry that a smart city platform is collecting too much personal data without safeguards, this privacy concern is essentially a proxy for multiple values at stake: personal trust in the system, autonomy over one's data, and even democratic accountability of whoever runs the platform. In the 6G context, these challenges become even more significant, particularly when vendors, or the data they process, operate **outside the EU**. In such cases, there are **data sovereignty** concerns, as a non-EU government could pressure a vendor under its jurisdiction to hand over data, creating risks for users' privacy and autonomy.

Privacy interplays with the value of security: sometimes they can be in tension (e.g., extensive surveillance for security may invade privacy), but often they are complementary (strong security measures can protect privacy by preventing data breaches). Modern debates on data governance emphasise finding a balance that preserves privacy without compromising security. In ethical and legal studies, privacy is increasingly seen as part of building "trustworthy AI" or networks, meaning systems that are secure, transparent, and privacy-respecting all at once. In any case, **privacy and security are two different concepts.** While data security focuses on protecting information from unauthorised access, loss, or damage, it does not automatically guarantee privacy. A system can be highly secure in technical terms and still violate privacy if it collects or uses personal data in ways that are excessive, opaque, or unjustified. In the 6G context, the link between privacy and security becomes increasingly complex. **6G networks will connect vast numbers of devices through the IoT, edge computing, and AI-based management, greatly expanding the volume and sensitivity of**

data. While measures such as real-time monitoring can strengthen protection against cyber threats, they may also pose privacy risks if personal data are collected or analysed excessively or without transparency. A 6G system can therefore be technically secure yet still violate privacy. Achieving balance requires **trustworthy 6G networks that uphold both strong security and clear privacy safeguards**, ensuring users remain safe and in control of their data.

6.2 POLICY ORIENTED ANALYSIS

The above project findings present risks, possible legislative and policy gaps, along with emerging needs, shown in the following table. Their analysis leads to the identification of policy recommendations and options shown in the **APPENDIX II** policy brief.

<table>
<tr><th colspan="3">Concern2: Values at risk in the current trajectory of 6G development</th></tr>
<tr><td colspan="3">Safeguarding Privacy</td></tr>
<tr><td colspan="3">Risk PR1 - User loss of control & difficulty exercising rights</td></tr>
<tr><td colspan="3">As highlighted in the EDPS blog [30], 5G offers the potential to enable billions of IoT devices to connect directly to the internet and operate continuously without user involvement. This creates a world where data is constantly being collected, often invisibly, and users have little or no awareness of what data is being processed, by whom, and for what purposes. This can then lead to a feeling and reality of loss of control over personal data along with continuous surveillance, undermining personal autonomy and trust in digital infrastructures, services and operating actors. Traditional models of consent and control become ineffective as well as exercising GDPR rights could be hard when data is distributed across many devices and providers. This situation calls for greater transparency and accountability: individuals should be able to understand how their data is handled and have meaningful ways to manage it.</td></tr>
<tr><td>Risk Type</td><td>Human: undermines individuals' ability to assert their privacy rights, leading to power imbalance.</td><td>Societal: erosion of trust in technology, potential chilling effect if people feel constantly observed.</td></tr>
<tr><td>Gap</td><td colspan="2">GDPR and ePrivacy give rights, the Data Act reinforce them, but the mechanisms to exercise them in telecom contexts are not user-friendly. For instance, there's no simple way for an individual to request "all location logs" from a telecom operator - e.g., through a consumer portal. Also, with many IoT data sources, identifying the controller for each is burdensome. Current regulation does not mandate unified or standardised tools for data access, portability, or consent management in the telecom sector, beyond number portability.</td></tr>
<tr><td>Emerging Need</td><td colspan="2">Ensuring that individuals can meaningfully control their personal data in 6G environments is fundamental to maintaining trust in next-generation connectivity. Strengthening user-centric mechanisms across the ecosystem would prevent situations in which people lose control over their information or cannot effectively exercise their rights, addressing the structural imbalances created by pervasive sensing and fragmented data flows. Enhancing transparency and accessible rights-management tools also aligns 6G with EU principles of fairness, autonomy and accountability, ensuring that individuals understand how their data is handled and can act on that understanding without disproportionate effort. At the same time, clear and harmonised requirements for user controls would provide legal and operational certainty to telecom operators and service providers, allowing them to implement consistent, compliant interfaces for access, consent and redress throughout complex multi-vendor infrastructures. Together, these measures shape a 6G ecosystem that preserves user agency and upholds the EU's commitment to rights-preserving digital innovation.</td></tr>
</table>

Risk PR2 - Cross-border data transfers and foreign government access		
Personal data in 6G networks may be transferred outside the EU (for roaming, using foreign service providers, or through equipment vendors). As outlined in the EU coordinated risk assessment of the cybersecurity of 5G networks [31], within the risk scenario concerning the modus operandi of major threat actors, specifically the risk labelled "State interference through the 5G supply chain", a hostile state actor may exert pressure on a supplier operating under its jurisdiction to gain access to sensitive network assets, either by exploiting deliberately or inadvertently embedded vulnerabilities. This is contrary to the principle of EU **sovereignty** in [32], [33] and [34], as well as poses risk of access by third-country authorities that do not follow EU privacy standards (e.g., intelligence agencies abroad accessing EU telecom data), bypassing the legal protection and **security** of EU citizens as well as potentially compromising individual and institutional **autonomy**, **transparency** and **accountability**.		
Risk Type	**Human**: individuals' data may not be protected by EU rights when abroad or handled by foreign entities.	**Societal**: loss of European data sovereignty, potential mass surveillance by foreign powers.
Gap	Despite standard GDPR transfer mechanisms are in place, and the EDPB has recently issued guidelines [35] on the requirements for recognising judgments or decisions from third country on personal data transfers, enforcement of those mechanisms remains difficult. Moreover, telecom operators might rely on them without fully verifying efficacy (e.g., using standard clauses with a foreign roaming partner but not auditing actual government access in that country). Despite the joint commitment outlined in the Joint Statement Endorsing Principles for 6G: Secure, Open & Resilient by Design [36] to promote trusted technologies that protect national security and individual privacy, and to advance global standards through open, transparent, and consensus-based processes supported by international cooperation, a sector-specific arrangement (such as an adequacy decision tailored to telecom data exchange) has yet to be established. Also, intelligence sharing between countries can bypass individuals' knowledge (one country collects data and shares with another).	
Emerging Need	Strengthening robust safeguards for cross-border data transfers in 6G prevents the exposure of EU citizens' data to foreign surveillance regimes, reducing the risk that sensitive information may be accessed or exploited under legal systems that do not meet EU standards. At the same time, it supports European strategic autonomy and reinforces core sovereignty principles, ensuring that the EU sets the conditions under which personal and operational data may circulate.	
Risk PR3 - Profiling and automated decision-making		
6G's immense data throughput combined with AI allows detailed profiling of individuals' behaviours (e.g., inferring habits from device connectivity patterns) and could enable automated decisions (such as personalised pricing or services) without human intervention. According to [37], automated decision-making and profiling may pose risks to individuals' rights and freedoms, including the possibility of unfair or discriminatory effects and reduced **transparency**, which can make it difficult for individuals to understand the reasoning behind such decisions and to exercise their GDPR rights. It underscores the imperative of **justice** by stressing that people must be informed, have the right to contest decisions, and protected through meaningful human oversight implemented by design, rather than through real-time human intervention, to prevent unjust or opaque outcomes.		
Risk Type	**Human**: undermines individual autonomy, can lead to discrimination or unfair treatment.	**Societal**: large-scale population profiling, filter bubbles, loss of anonymity in public spaces.
Gap	GDPR covers profiling and gives a right not to be subject to solely automated decisions with legal effects (Art. 22), but enforcement in telecom is nascent. Telecom operators and their partners (like advertisers using network data) might exploit data in ways users don't expect. There is a policy gap in guidance on how to apply GDPR's profiling rules specifically to telecom big data analytics, especially when network data is collected in bulk. Also, current sector regulations don't address potential harms of algorithmic network management (e.g., if networks prioritise or deprioritise users based on	

	profiles). In addition, the applicability of the EU AI Act to AI-native 6G network management systems, particularly with regard to high-risk classification (Annex III) and human oversight obligations (Article 14), remains insufficiently clarified for the telecom sector.
Emerging Need	As 6G networks deepen their reliance on AI-driven optimisation and large-scale behavioural analytics, clear safeguards become essential to uphold fundamental rights. Strengthening the governance of profiling and automated decision-making would prevent discriminatory network behaviour and opaque algorithmic decisions, ensuring that individuals are not subject to unfair treatment, hidden prioritisation, or unchallengeable outcomes. Such measures are also central to aligning 6G with the EU's principles of fairness and accountability, embedding transparency, human oversight by design, and clear limits on how personal and behavioural data may be used within network intelligence systems. At the same time, providing targeted guidance and sector-specific interpretations of GDPR and the AI Act especially on how human oversight, risk mitigation and accountability should be implemented in AI-native, zero-touch 6G environments would give legal certainty to operators deploying AI-driven management, enabling innovation while ensuring that automated processes operate within well-defined, rights-preserving boundaries. This balance is critical to ensuring that 6G develops as both technologically advanced and socially legitimate.
Risk PR4 - Dilution of accountability among multiple 6G parties	
6G networks involve a complex ecosystem, e.g., infrastructure vendors, network operators, virtual network operators, cloud providers, software developers. With network slicing and IoT, many actors might handle personal data. The EU Toolbox for 5G Security [38] highlights that using multiple vendors increases complexity and makes it harder to assign responsibility in case of incidents. This fragmentation can undermine **accountability**, a core principle for ensuring **justice and effective redress** for individuals and make it more difficult for them to exercise their rights. ENISA guidelines [39] [40] reinforce this and stress the need for supplier risk assessments and clear governance. As outlined [41], there is a concrete risk of unclear responsibility for privacy compliance (who is the controller, who must respond to breaches, etc.).	
Risk Type	**Governance** risk that affects human rights (if no one is accountable, individuals' rights may not be fully safeguarded or could be overlooked).
Gap	GDPR's joint-controller and processor provisions apply, but in practice it's often unclear in 6G setups who is responsible for what. For instance, if a cloud provider managing a core network slice mishandles data, the telco and cloud may point fingers at each other. The EU Electronic Communications Code (EECC) requires clear contracts for outsourced functions, but regulatory oversight of these complex supply chains is still developing. No specific EU telecom rules detail accountability in network slicing or shared 6G infrastructure scenarios. While the Cyber Resilience Act introduces baseline security obligations for manufacturers, it does not directly solve the challenge of assigning accountability when multiple vendors are involved, especially across borders or under divergent jurisdictions.
Emerging Need	As 6G networks evolve into highly distributed, multi-vendor ecosystems, reinforcing governance structures becomes essential to maintain trust and legal clarity. Enhancing role assignments, contractual obligations, and oversight mechanisms would strengthen accountability in data-rich multi-vendor 6G systems, ensuring that each actor's responsibilities are clearly defined and enforceable. Such measures also help reduce disputes and improve breach handling, enabling faster coordination, clearer escalation paths, and more effective remediation when incidents occur. By clarifying who is responsible for which processing operations, they increase users' ability to identify the parties accountable for their data, supporting meaningful rights exercise in complex infrastructures. At the same time, harmonised accountability models and transparent role delineation would enable regulators to audit complex infrastructures effectively, equipping supervisory authorities with the tools needed to assess compliance across

	interdependent supply chains. Together, these steps are crucial to securing a trustworthy and rights-preserving 6G ecosystem.	
Risk PR5 - Divergent privacy and security interests among stakeholders		
While ENISA in the New Guidelines for Telecom and 5G Security [42], underlines the importance of a common approach to telecom security for the Digital Single Market, different 6G stakeholders might have conflicting goals (e.g., advertisers want more data, telecom firms want to monetise data, governments want access for law enforcement, while users want privacy). Also, manufacturers from outside the EU might be subject to laws requiring them to facilitate surveillance (e.g., compliance with foreign government access demands). These conflicts can weaken the **right of privacy** if not properly balanced, loose **autonomy** undermining **self-determination**, lead to imbalanced outcomes compromising their feeling of **justice**.		
Risk Type	**Societal**: if commercial or state interests override user privacy systematically, society faces erosion of trust and fundamental rights.	**Policy coherence:** multiple regulations intersect, potentially causing fragmentation.
Gap	While EU law prioritises privacy, in practice exceptions and divergent laws (e.g., national security exemptions, e-evidence proposals) may create uncertainty. Despite the issue of balancing conflicting interests, especially between economic, security, and privacy objectives, is well known, there is no clarity on EU policy directly stating the stakeholder tension in 6G.	
Emerging Need	In a 6G landscape where commercial incentives, state security interests, and user rights increasingly collide, coordinated governance is essential to safeguard fundamental values. A balanced and coherent policy approach is needed to avoid privacy being systematically overshadowed by commercial or state interests, ensuring that economic or security objectives do not undermine individual autonomy or trust. Strengthening harmonisation across Member States on how national security exceptions are applied would reinforce EU cohesion, reducing fragmentation and ensuring that privacy protections remain consistent even in sensitive contexts. At the same time, clearer rules and oversight mechanisms can promote legitimate data uses while preventing exploitative or rights-eroding practices, enabling innovation without enabling misuse. By embedding these principles into the regulatory and operational framework for next-generation networks, policymakers can facilitate the socially acceptable deployment of 6G, ensuring that the technology evolves in ways that command public confidence and reflect European democratic values.	

7 ENSURING INCLUSION-BY-DESIGN

Inclusion plays a central role in shaping what a legitimate and socially acceptable 6G system should look like. This section describes this value as part of Concern 2, *Values at risk in the current trajectory of 6G development*.

7.1 PROJECT FINDINGS

It was referenced by 45% of citizens in their responses to what issues should guide future political and industrial development. The theme cuts across geography (e.g., rural exclusion), socioeconomic status, and generational access to technology. It also emerged clearly during participatory engagement workshops conducted by the project, where students and community members linked **access issues** to broader questions of social justice and quality of life. Moreover, some citizen responses raised concerns about **digital inequality**, stating that several rural areas, such as natural parks, remain without 3G/4G coverage. They see 5G as completely useless in rural areas, benefiting ultra-connected urban populations while being disconnected from the needs of those in precarious situations. To this extent, concerns relate to the possible emersion of disparities and inequalities, depending on the gaps between those individuals and communities that can access the opportunities linked to modern ICTs technologies and networks, and those who cannot, due to various factors (socioeconomic status, geographic location, age, education).

In addition, interviews with experts and 6G projects highlighted that socio-cultural factors such as **place attachment, community identity, and the perception of distributive justice** (who benefits versus who bears the risks/burdens) remain largely under-addressed. This echoes longstanding concerns from other technology sectors, such as energy infrastructure development. The risk of **technological promises misaligning with the actual, diverse needs of society** is a recurring theme.

Power imbalances between large corporations pushing new technologies and local communities/residents who bear the impact (e.g., infrastructure siting) are also seen as a significant issue. In countries with large rural populations, issues like geographical challenges and willingness to pay for services not fully received deepen the **digital divide**, as highlighted by a representative from the Hexa-X-II project.

Additionally, several interviewees raised the point that the perception of whether **individuals are "heard"** in decisions about infrastructure location and social advancement is key for "procedural justice".

Therefore, inclusion has emerged as a critical, cross-cutting concern for 6G development, representing Europe's commitment to ensuring that advanced telecommunications serve all citizens while addressing persistent inequalities in access, capabilities, and outcomes from digital engagement. This concern reflects a broader evolution in digital policy thinking, moving beyond the oversimplified notion of a "digital divide" toward a comprehensive framework for meaningful connectivity and equitable participation in digital societies.

However, the challenge of digital inclusion in telecommunications is not merely technical but fundamentally societal, touching core questions about social justice, democratic participation, and the distribution of opportunities in increasingly digitalised economies. In this perspective, inclusion emerges not only as a normative principle but as a practical condition for the legitimacy and sustainability of technological progress.

These findings underscore that inclusion is not simply an outcome of connectivity, but a guiding value that should inform technological design, governance, and policy choices from the outset. 6G's vision of ubiquitous connectivity, AI-native architecture, and deep integration with essential services makes inclusion essential not only for individual opportunity but for collective societal resilience and cohesion. The stakes extend beyond market penetration to encompass fundamental questions about who benefits from technological progress and who bears its costs and risks.

Taken together, these considerations point toward the need for a more deliberate and value-oriented approach to inclusion in 6G development, paving the way for the following reflections:

Conceptualising inclusion in ICT: from digital divide to meaningful connectivity. The evolution of scholarly and policy thinking on digital inclusion reflects growing recognition that connectivity alone is insufficient for equitable participation in digital societies. Early frameworks focused on physical access, the binary question of who had or lacked Internet connections, but research since the early 2000s has demonstrated that inequalities and often deepen even as basic connectivity expands.

Jan van Dijk's [43] influential framework conceptualises digital inequality as four successive types of access: motivational access (attitudes and willingness to engage with technology), material access (physical availability of devices and connections), skills access (competencies to use technology effectively), and usage access (purposes and patterns of actual use). This sequential model reveals how inequalities compound: those lacking motivation or material access never develop skills, while those without skills cannot achieve meaningful usage, and those with limited usage patterns fail to realise valuable outcomes. Van Dijk's "Resources and Appropriation Theory" demonstrates that categorical social inequalities produce unequal resource distribution, which then generates unequal technology access, creating reinforcing cycles where digital inequalities amplify existing social stratification.

Eszter Hargittai's [44] pioneering work on the "second-level digital divide" shifted attention from access to skills and usage patterns, demonstrating through empirical research that even among Internet users, substantial differences exist in online abilities, search strategies, and the capacity to find information, differences that correlate with age, education, and socioeconomic status rather than mere exposure to technology. This work fundamentally challenged the assumption that providing connectivity would naturally produce equitable outcomes.

Ellen Helsper [45] extended this analysis to articulate a "third-level digital divide" focused on tangible outcomes, the actual benefits people achieve from Internet use across economic, cultural, social, and personal domains. Her "Corresponding Fields Model" demonstrates that links between social and digital inequalities are strongest within corresponding domains: economic resources offline predict economic benefits online, cultural capital predicts cultural engagement, and so forth. Critically, Helsper shows that even with equal access and skills, individuals with higher socioeconomic status achieve better outcomes from Internet use, revealing how digital technologies can amplify rather than reduce existing inequalities. This reconceptualises digital inequality from a deficit model (lacking access or skills) to a relational one where structural inequalities shape both engagement and outcomes.

Mark Warschauer's [46] framework on "Technology and Social Inclusion" identifies four essential resources: physical (devices and connectivity), digital (relevant content and language), human (literacy and education), and social (community support and institutional access). Warschauer argues that meaningful inclusion requires simultaneous attention to all four dimensions, as deficits in any area undermine the effectiveness of improvements in others.

This shifts policy focus from providing equipment to enabling meaningful social practices through technology.

At the international level, the ITU's [47] framework for "Universal and Meaningful Connectivity" establishes that connectivity must be universal (available to all), but also meaningful, enabling safe, satisfying, enriching, and productive online experiences at affordable cost. The ITU's 2030 [48] targets emphasise that neither universal connectivity with poor quality nor meaningful connectivity for the few yields significant society-wide benefits; both dimensions must advance together, with each reinforcing the other.

Inclusion in the 6G context encompasses five interconnected dimensions:

1. **Physical and economic access** to high-performance networks, including fair and affordable service offers that account for income disparities and geographic challenges. The EU's Digital Decade targets, gigabit connectivity for everyone and 5G coverage in all populated areas by 2030, represent essential but insufficient conditions, as the quality, reliability, and cost of access determine whether connectivity enables or constrains participation.
2. **Skills and literacies** to use services safely, autonomously, and effectively. The Digital Decade [34], target of 80% of adults with basic digital skills by 2030 reflects recognition that technical access without competencies produces exclusion. For 6G, this extends beyond current digital literacy to encompass emerging interfaces including extended reality, AI-driven services, and increasingly complex privacy and security decisions that users must navigate.
3. **Equitable outcomes** from digital use across employment, connected health, education, public services, and civic participation. This dimension addresses the third-level divide identified by Helsper [45], requiring not just measurement of access and usage but systematic assessment of whether digital engagement produces tangible benefits distributed equitably across social groups. The State of the Digital Decade reporting framework is evolving toward outocome-level disaggregation but remains incomplete.
4. **Accessibility by design** for persons with disabilities and older adults, as mandated by the Web Accessibility Directive [49], European Accessibility Act [50], and harmonised standard EN 301 549 [51]. 6G's novel interaction modalities, including haptic feedback, spatial computing, and AI-driven personalization, offer unprecedented accessibility possibilities but require proactive design to ensure benefits reach those with diverse abilities rather than creating new barriers.
5. **Transparent and participatory processes** around deployment and local use-cases, consistent with EU environmental participation obligations under the Aarhus Convention [52] and EIA Directive [53]. This procedural dimension addresses the "not being heard" concerns raised repeatedly in our engagement activities, recognising that inclusion requires not only technical access but meaningful voice in infrastructure decisions that shape communities.

The urgency around inclusion for 6G stems from the technology's unprecedented integration with critical services and daily life. As 6G becomes infrastructure for healthcare, education, employment, and civic participation, exclusion from high-quality connectivity increasingly means exclusion from essential services and opportunities. The COVID-19 pandemic starkly revealed how digital divides translate into disparities in remote work capability, access to online education, telemedicine, and participation in economic and social life. 6G's promise of ubiquitous, high-performance connectivity must be realised equitably, or it risks widening societal fractures rather than bridging them.

The democratic dimension of digital inclusion cannot be overlooked. As digital technologies increasingly mediate access to information, public discourse, and civic participation, patterns of digital inequality shape who can effectively exercise democratic rights. The challenge lies in ensuring that 6G infrastructure serves as a platform for democratic inclusion rather than a mechanism that concentrates voice, opportunity, and influence among the already advantaged.

Significant gaps persist between EU policy ambitions and implementation realities. The European approach to inclusion emphasises comprehensive policy frameworks rather than market-driven solutions alone, recognising that unregulated markets have historically failed to deliver equitable connectivity outcomes. The EU's policy architecture combines binding targets (Digital Decade 2030 [54]), investment instruments (Recovery and Resilience Facility, Connecting Europe Facility [55]), regulatory frameworks (Gigabit Infrastructure Act [56], European Electronic Communications Code [57]), and social protection measures (affordability provisions for vulnerable users). This approach distinguishes European inclusion policy from purely market-based models that assume connectivity will naturally expand to all profitable markets, or purely state-driven models that prioritise coverage over quality and user needs. The European framework seeks to balance market efficiency with universal service obligations, competition with coordination, and technological ambition with social protection.

However, despite the Gigabit Infrastructure Act and 5G deployment targets, substantial disparities remain between urban and rural coverage, with affordability barriers excluding low-income householders, older adults, and those not in employment, education, or training (NEETs) [58]. Skills development initiatives remain fragmented and often fail to reach the populations most at risk of exclusion. Outcome monitoring focuses predominantly on inputs (infrastructure) and outputs (usage rates) rather than the tangible benefits people derive from connectivity across different life domains.

7.2 POLICY ORIENTED ANALYSIS

The current section takes a more operational turn on the concerns identified in the previous sections. Starting from the findings outlined above, risks are identified, together with possible legislative and policy gaps, and emerging needs in the following table. The final result is the identification of related policy recommendations and options shown in the policy brief in **APPENDIX III**.

Concern2: Values at risk in the current trajectory of 6G development
Ensuring Inclusion-by-design
Risk IN1 - Access gaps: coverage, quality and affordability
Despite the Gigabit Infrastructure Act and Digital Decade 2030 targets establishing universal gigabit connectivity and 5G coverage in all populated areas as binding objectives, **significant disparities persist between urban and rural/peripheral regions** in both coverage availability and service quality. Rural areas continue to experience what citizens describe as "not-spots", areas lacking even basic 3G/4G coverage, including natural parks and remote communities, creating geographic inequalities where residence determines access to essential digital services. **Geographic inequalities** risk entrenching a two-tier digital landscape, where residence determines access to essential online services, education, and economic participation. Beyond geography, affordability barriers further limit digital inclusion, particularly for low-income households, older adults, and NEETs, for whom broadband costs remain high relative to disposable income. The implementation of universal service affordability measures under the European Electronic Communications Code remains uneven across Member States, with some countries **failing to**

activate available policy instruments including social tariffs, targeted vouchers, or devices subsidies for vulnerable populations. Market-driven deployment prioritises profitable urban areas while rural and peripheral regions face delayed infrastructure investment, inadequate backhaul capacity, and lower service quality even where nominal coverage exists. The transition to 6G risks amplifying these disparities as initial deployments concentrate in major urban centres and economically valuable corridors, potentially leaving rural and peripheral areas with obsolete infrastructure for extended periods.		
Risk Type	**Societal**: exclusion from employment, education, healthcare, and civic participation for populations lacking adequate connectivity.	**Economic**: reduced productivity and economic opportunity in underserved regions, reinforcing geographic inequalities and rural depopulation trends.
Gap	The Gigabit Infrastructure Act (GIA) simplifies permitting and promotes infrastructure sharing, yet further efforts are needed to **ensure timely and quality deployment in rural and underserved areas**. While the European Electronic Communications Code (EECC) provides a framework for affordability, its implementation varies widely among Member States, with no harmonised standards for eligibility or service quality. Current "not-spot" identification often relies on operator-reported data that may not accurately reflect real coverage, highlighting the need for stronger verification and citizen feedback mechanisms. Although investment instruments such as the Recovery and Resilience Facility (RRF) and Connecting Europe Facility (CEF) offer substantial funding, coordination and transparency.	
Emerging Need	Accelerate **effective coverage and service quality** in market-failure areas through coordinated public intervention rather than relying on market forces alone; strengthen and harmonise affordability instruments ensuring vulnerable households can access to adequate connectivity; establish transparent monitoring and accountability mechanisms enabling communities to track progress and participate in infrastructure planning.	
Risk IN2 - Skills gaps and usability barriers (second-level divide)		
The EU's Digital Decade target of 80% of adults with basic digital skills by 2030 remains out of reach in numerous Member States, with current trajectories suggesting many countries will fall significantly short. **Training and skills development initiatives** often fail to reach the populations most at risk of exclusion, older adults, jobseekers, migrants, and persons with disabilities, due to fragmented delivery, insufficient funding, lack of tailored approaches, and absence of sustainable pathways from foundational literacy to intermediate and advanced competencies. Current programmes tend toward episodic, project-based interventions rather than **stable, locally embedded learning** ecosystems providing ongoing support as technologies and user needs evolve. This undermines the creation of a resilient, future-ready workforce and limits the capacity of communities to benefit from digital transformation. For 6G, the skills challenge extends beyond current definitions of basic digital literacy to encompass emerging interfaces, AI-driven services, extended reality environments, and increasingly complex privacy, security, and misinformation navigation requirements. As services migrate to advanced platforms, users lacking skills to engage with new modalities risk exclusion even where physical access exists. The absence of common impact metrics and validated learning pathways across the workforce, public sector, and civil society further compounds this risk.		
Risk Type	**Human**: individuals unable to participate in employment, education, and civic life due to skills deficits.	**Societal**: widening inequalities as digitally skilled populations capture opportunities while others fall further behind, undermining social cohesion.
Gap	**Skills development initiatives** remain fragmented across Member States, regions, and delivery organisations with limited systematic coordination and no shared quality	

	standards. The Digital Education Action Plan provides frameworks but lacks **binding implementation mechanisms or dedicated funding** ensuring all Member States develop adequate capacity. Training often addresses basic computer literacy but fails to keep pace with evolving technologies, leaving populations with obsolete skills as platforms advance. Usability standards for public digital services are inconsistent, with many government platforms requiring advanced skills rather than being designed for diverse user populations. Cyber-hygiene, critical evaluation of online information, and understanding of data practices receive insufficient attention despite growing importance for safe, informed digital participation. Common EU-level Key Performance Indicators tracking progress by target group (age, education, income, disability status) with validated assessment methodologies remain underdeveloped.
Emerging Need	Transition from episodic project-based training to **stable, local ecosystems providing sustained learning pathways** from foundational literacy through intermediate competencies and specialised application; integrate digital skills development systematically into employment services, social support, and lifelong learning frameworks; establish **usability-by-design standards** ensuring services accommodate diverse skill levels rather than requiring advanced capabilities; develop common assessment frameworks enabling cross-national comparison and programme improvement.

Risk IN3 - Outcome gaps (third-level divide): uneven benefits from 6G-enabled services

Current monitoring frameworks for digital inclusion focus predominantly on inputs (infrastructure coverage, connection rates) and outputs (usage patterns, time online) rather than outcomes, the tangible benefits people achieve from digital engagement across employment, health, education, public services, and civic participation. This gap **limits the ability to assess whether digital investments and policies reduce or amplify existing inequalities**, as populations may have equal access and usage but systematically different outcomes based on socioeconomic status, education, geographic location, and social capital.

Research demonstrates that **individuals with higher social status achieve greater benefits from Internet use** across economic, cultural, social, and personal domains, even controlling for usage patterns and skills, a phenomenon Ellen Helsper [45], terms “third-level digital inequality”. As 6G integrates advanced digital services into daily life, these outcome disparities risk translating directly into unequal life opportunities, compounding advantages for those able to leverage connectivity effectively.

The State of the Digital Decade reporting framework is evolving toward outcome-level indicators but remains incomplete, particularly regarding disaggregation by social group, territory, and intersecting characteristics. Without systematic outcome measurement, **policies and investments risk addressing symptoms** (lack of access or skills) while **failing to tackle root causes** of unequal benefit realization rooted in structural inequalities, social capital deficits, and institutional barriers.

Risk Type	**Societal:** amplification of existing inequalities as advantaged populations leverages 6G for greater gains while disadvantaged populations fail to realise comparable benefits despite nominal access.	**Policy coherence**: investments and interventions may appear successful based on access metrics while failing to achieve equitable outcomes, misallocating resources and undermining inclusion objectives.
Gap	The Digital Decade monitoring framework focuses on connectivity, skills, and usage **without systematically tracking** whether digital engagement produces equitable outcomes across health, education, employment, and civic participation dimensions. **Disaggregated outcome data** by socioeconomic status, geographic location, age, gender, disability, and intersecting characteristics remain limited, hindering the identification of groups that fail to realise benefits despite having access. **Social impact assessment** for major 6G deployments and public investments is not yet a standard	

	practice, leaving distributional effects unexamined. Research capacity for longitudinal tracking of how 6G integration affects life outcomes across diverse populations is underdeveloped. Public data infrastructure providing open, disaggregated outcome information enabling research, policy development, and accountability remains still inadequate.
Emerging Need	Shift inclusion policy and monitoring from access-focused to outcome-focused frameworks explicitly **tracking whether 6G integration produces equitable benefits across life domains and population groups**; develop targeted interventions addressing structural barriers preventing disadvantaged groups from realising benefits even when they have access and skills.

Risk IN4 - Accessibility barriers for persons with disabilities and older adults

Emergent 6G services, including edge computing applications, non-terrestrial network access, and extended reality interfaces, often **lack accessibility-by-design** from initial development, creating new barriers for persons with disabilities and older adults even as they offer unprecedented potential for assistive applications.

Current accessibility frameworks focus on web content and digital services but have not yet been comprehensively extended to telecommunications infrastructure, network management interfaces, customer service systems, and novel interaction modalities. The harmonised standard EN 301549 provides technical specifications but adoption in public procurement and private sector deployment remains inconsistent. As 6G introduces spatial computing, haptic feedback, AI-driven personalization, and multimodal interactions, the risk exists that these advances create sophisticated experiences for some users while excluding others who cannot access or operate new interface paradigms.

Risk Type	**Human**: exclusion of persons with disabilities and older adults from essential services and opportunities due to inaccessible design.	**Regulatory**: non-compliance with European Accessibility Act and Web Accessibility Directive due to inadequate implementation and enforcement.
Gap	The European Accessibility Act and Web Accessibility Directive are not yet fully operationalised across all Member States and telecommunications services, with **enforcement capacity varying significantly**. Public procurement practices do not consistently require **EN 301549 compliance** as a mandatory standard for telecommunications equipment and services, missing opportunities to drive market accessibility. Operator websites, apps, and customer service systems frequently fail accessibility audits without effective enforcement consequences. Innovation support for assistive technologies leveraging 6G capabilities (real-time captioning, haptic feedback, environmental sensing for mobility) remains limited compared to mainstream application development.	
Emerging Need	Establish **accessibility as a design-time requirement** for 6G networks, services, and applications; systematically involve persons with disabilities and older adults in technology development, standards processes, and use-case design; create innovation ecosystems specifically supporting assistive technologies that leverage 6G capabilities; **strengthen enforcement of existing accessibility requirements** while extending frameworks to cover emerging technologies and interaction modalities.	

Risk IN5 - Participation and procedural-justice deficits in local infrastructure decisions

Planning simplifications for small cells and densified infrastructure under the Gigabit Infrastructure Act reduce administrative burdens and accelerate deployment but do not substitute for meaning **local engagement in infrastructure decisions affecting communities**. Citizens and communities in many European countries repeatedly expressed feeling “not heard” in decisions about infrastructure siting, deployment priorities, and local use-case development, raising risks about procedural justice,

<table>
<tr><td colspan="4">whether affected parties have a meaningful voice in decisions impacting their environments, health concerns (perceived or real), and local development.

Where environmental or visual impact is perceived, participation is essential under the Aarhus Convention (access to information, public participation in decision-making, access to justice in environmental matters) and the Environmental Impact Assessment (EIA) Directive. However, proactive consultation practices in telecommunications remain uneven, with some regions conducting genuine engagement while others treat participation as administrative formality or bypass it entirely.

The challenge extends beyond environmental consultation to encompass broader questions of digital democracy: who decides what technologies are deployed where, which use-cases receive priority, how local concerns are weighted against national objectives, and whether communities can meaningfully shape the digital infrastructure that increasingly mediates their economic, social, and civic life. Rural and peripheral communities are particularly at risk of exclusion, perceiving that deployment priorities, site selections, and use-case development reflect urban assumptions and industry interests without adequate consideration of local contexts, values, and needs [59] [60].</td></tr>
<tr><td>Risk Type</td><td>Societal: deployment approaches that ignore local contexts and values may face resistance, delays, or failure to deliver intended benefits.</td><td>Governance: infrastructure decisions made without adequate democratic input undermines legitimacy and trust.</td><td>Procedural-justice: affected communities unable to exercise participation rights guaranteed under EU law.</td></tr>
<tr><td>Gap</td><td colspan="3">Planning simplifications may expedite deployment, but they often curtail or omit consultation mechanisms without substituting meaningful engagement. Compared to sectors such as energy or transport, both national and EU guidance for public participation in telecommunications infrastructure planning is relatively scant, resulting in a patchwork of practices across Member States and subnational jurisdictions. In many cases, consultation that is called occurs after decisions are largely fixed, or is framed in technical language inaccessible to non-expert audiences. Communities in rural and peripheral regions are particularly disadvantaged: with fewer organised advocacy structures than in urban settings, their perspectives risk being systematically underweighted in deployment decisions. Tools such as territorial impact statements, intended to assess how infrastructure choices distribute benefits and burdens, are seldom mandated in telecom planning. Likewise, it is uncommon to maintain or publish public logs of community submissions, operator responses, and regulatory determinations, which limits transparency and accountability.</td></tr>
<tr><td>Emerging Need</td><td colspan="3">Institutionalise transparent, proportionate, and timely consultation practices as standard elements of 6G deployment rather than administrative obstacles to eliminate; develop engagement mechanisms specifically addressing rural and peripheral community participation deficits; establish public information infrastructure enabling communities to access plans, raise concerns, and track responses; create territorial impact frameworks ensuring deployment decisions account for geographic equity and local contexts.</td></tr>
</table>

8 SECURING EUROPE'S TECHNOLOGICAL SOVEREIGNTY

As illustrated in the following section, technological sovereignty also emerged as a critical concern, under the category of Concern 2, *Values at risk in the current trajectory of 6G development.*

8.1 PROJECT FINDINGS

While less explicitly invoked by citizens, it was a persistent theme among SNS JU projects and policy-facing experts. It relates to the **EU's capacity to govern its own digital infrastructures, minimise strategic dependencies**, and ensure that 6G development aligns with European democratic principles. It is related to concepts like EU resilience and autonomy.

A representative from the SUSTAIN-6G project underscored that a major risk to 6G's long-term success is the global geopolitical situation, which could hinder international collaboration and standardisation efforts. It was also highlighted that the possibility of ending up with **fragmented 6G standards** (e.g., European 6G not interoperable with Chinese or US 6G) is a significant concern, reminiscent of past 3G challenges.

In this context, **balancing market competitiveness with regulatory adherence** to European values is a delicate act. As highlighted by representatives from the Sustain-6G and Hexa-X-II projects, excessive regulation could hinder innovation, while too little could lead to undesirable societal outcomes.

Moreover, several interviewed experts highlighted **sovereignty** not as an abstract geopolitical goal, but as a condition for embedding European values - such as transparency, openness, and human rights - into the core design of 6G. Its selection as a focus bridges the micro-level concerns of citizens (e.g., trust and control) with macro-level governance imperatives.

In addition, citizens surveys highlighted **Europe lagging in global competition**, compared with China and the US, the need of 5G and 6G **interoperability** with other networks and technologies, the **oligopolies** of some restricted big telco, rather reluctant to collaborate with other industries, the technology **unreliability** mining their trust on the 5G/6G network, as well as the **slower legislating** than technology requires.

Therefore, **technological sovereignty has emerged as a critical concern for 6G development, representing Europe's capacity to maintain strategic autonomy over digital infrastructure while preserving democratic values and economic competitiveness**. This concern reflects a broader historical shift in European policy thinking, accelerated by the COVID-19 pandemic and geopolitical tensions, toward reducing critical dependencies while maintaining global engagement [61].

There are some considerations that can be derived by the previous feedback.

Technological sovereignty in telecommunications should not merely understood as a technical or industrial challenge, but fundamentally as a political challenge, touching core questions about democratic control, economic independence, and the values embedded in critical infrastructure. Unlike previous mobile generations, 6G's AI-native architecture and deep integration with critical sectors make technological sovereignty essential for European security, resilience, and industrial competitiveness [62], transforming what was once a market competition issue into a matter of **strategic autonomy**. The emergence of technological

sovereignty as a policy priority reflects Europe's recognition that digital infrastructure has become too critical to be governed solely by market forces [63]. This shift represents a fundamental reframing of the relationship between technology, democracy, and state power, moving beyond the neoliberal assumption that global markets naturally produce optimal outcomes for society.

Technological sovereignty in the 6G context encompasses Europe's ability to design, produce, deploy, and govern critical telecom technologies and data flows in line with EU law and principles, without drifting into closed, non-interoperable stacks. The European Commission framed this after the pandemic as part of the updated Industrial Strategy and "open strategic autonomy", infrastructure according to European values and strategic interests, without compromising on openness and interoperability.

The concept operates across multiple interconnected dimensions that distinguish it from simple protectionism or technological nationalism. Strategic autonomy means Europe can make **independent choices** about 6G deployment, standards, and governance without external coercion or dependency; a capability increasingly questioned as Europe's digital dependencies deepened throughout the 2010s. **Value integration** guarantees that European principles of transparency, human rights, and democratic governance are embedded in the technical architecture of 6G systems, rather than being afterthoughts to technical optimization. Economic sovereignty enables European companies and institutions to **compete in global markets** [64] while **maintaining control** over critical decision-making processes that affect European citizens and businesses.

The urgency around technological sovereignty stems from 6G's unprecedented integration with critical infrastructure. Critical infrastructure, encompassing energy, transportation, healthcare, water, food and financial systems, represent the foundation of modern societies, with disruptions potentially affecting millions of citizens and entire economic sectors. 6G is designed to become the nervous system for power grids, healthcare systems, autonomous transportation, and industrial automation. This integration would create new vulnerabilities where foreign control over telecommunications infrastructure could enable economic coercion, surveillance, or targeted disruption of essential services [65].

The democratic dimension of technological sovereignty cannot be overlooked. As digital technologies increasingly mediate social, economic, and political relationships, the question of who controls these systems becomes fundamental to democratic governance. The challenge lies in expanding digital sovereignty for people and nations while contributing to a more democratic world order, avoiding the trap of digital authoritarianism that uses sovereignty claims to justify surveillance and control. This tension is evident in emerging initiatives like EuroStack [66], which proposes building European alternatives across the digital technology stack through sovereign AI, open-source ecosystems, green supercomputing, data commons, and sovereign cloud infrastructure. Such approaches aim to "reclaim control of Europe's digital future, layer by layer, innovation by innovation," while maintaining democratic values and global interoperability [67].

The European approach to technological sovereignty emphasises "open strategic autonomy", building European capabilities while maintaining interoperability, standards-based development, and global cooperation. This distinguishes the EU approach from more closed, nationalist technology strategies that risk technological fragmentation and reduced innovation through isolation. However, the practical implementation of this balance remains contested, with ongoing debates about how much openness is compatible with genuine sovereignty [68].

8.2 POLICY ORIENTED ANALYSIS

As illustrated in the following table, risks, legal and policy gaps and emerging needs are analysed to finally define policy recommendations and options forming the policy brief outlined in **APPENDIX IV**.

<table>
<tr><td colspan="5">Concern2: Values at risk in the current trajectory of 6G development</td></tr>
<tr><td colspan="5">Securing Europe’s Technology Sovereignty</td></tr>
<tr><td colspan="5">Risk TSR1 - Critical supply chain dependencies in 6G infrastructure and lack of accountability</td></tr>
<tr><td colspan="5">As highlighted in the European Parliament’s 2024 report on technological sovereignty, Europe faces unprecedented dependencies in critical 6G components. The EU imports over 80% of its digital technologies, with 100% of advanced semiconductors required for 6G manufactured outside Europe. This creates single points of failure where geopolitical tensions, trade disputes, or supply chain disruptions with the risk to paralyze European 6G deployment.

The semiconductor dependency is particularly acute, as 6G networks require advanced chips for AI processing, radio frequency components, and high-speed networking that are currently manufactured exclusively in Asia. Beyond semiconductors, Europe lacks control over critical software components, manufacturing equipment, and rare earth materials essential for 6G infrastructure. This dependency web creates a risk that foreign actors could potentially disable European telecommunications capabilities through supply chain manipulation, even without direct cyberattacks.

The global telecommunications equipment market has consolidated to just three major suppliers (Huawei, Ericsson, Nokia), creating oligopoly conditions that limit European strategic choices. 6G’s cloud-native architecture introduces additional complexity through multiple software suppliers, cloud providers, and system integrators, creating accountability gaps where responsibility for security, privacy, and performance becomes unclear across the vendor ecosystem.</td></tr>
<tr><td>Risk Type</td><td>Societal: potential disruption of critical services dependent on 6G infrastructure, affecting healthcare, energy transportation, and public safety.</td><td>Governance: threatens European strategic autonomy and decision-making capacity, potentially subjecting critical infrastructure decisions to foreign political pressures; unclear accountability for system failures or security breaches.</td><td>Economic: European companies and consumers are vulnerable to external economic coercion through supply chain manipulation or price volatility; limited competitive options increase costs and reduce innovation.</td><td>Technical: complex multi-vendor systems, especially when established in EU external countries, create vulnerabilities through integration points and shared responsibilities.</td></tr>
<tr><td>Gap</td><td colspan="4">Despite the EU Chips Act and 5G Security Toolbox, Europe lacks comprehensive mapping of 6G supply chain dependencies. Current frameworks focus primarily on high-risk vendors but fail to address broader ecosystem vulnerabilities including semiconductor design IP, critical materials, manufacturing equipment, and software dependencies. The proposed European Sovereignty Fund was scaled back within the Strategic Technologies for Europe Platform (STEP) with funding currently mostly oriented to defense applications rather than civilian technology sovereignty. No established systematic mechanism exists for coordinating supply chain resilience across Member States, creating vulnerabilities where national approaches diverge. Moreover, current EU regulations including the Cyber Resilience Act and Electronic</td></tr>
</table>

	Communications Code address individual vendor responsibilities but lack frameworks for managing complex multi-vendor 6G ecosystems. No comprehensive approach yet exists for ensuring accountability across cloud-native network functions distributed among multiple suppliers. The EU competition framework has not yet adapted to address oligopoly conditions in critical infrastructure markets where security and sovereignty considerations override pure market competition.		
Emerging Need	Develop European strategic autonomy in critical 6G components while maintaining open markets and international cooperation; establish emergency response capabilities for supply chain disruptions; create alternative supplier ecosystems aligned with European values and security requirements; guarantee clear accountability and liability assignments across complex 6G vendor ecosystems; maintain competitive market conditions while addressing security and sovereignty requirements; establish transparent governance for multi-vendor network operations.		
Risk TSR2 - Insufficient European expertise and capacity for 6G governance			
The complexity of 6G systems requires specialised technical expertise that is currently concentrated in a small number of global technology companies, primarily based outside Europe. European regulators, policymakers, and oversight bodies lack sufficient technical capacity to understand, assess, and govern 6G systems effectively, creating dependencies on foreign expertise for critical sovereignty decisions.			
Risk Type	**Human**: insufficient protection of individual rights due to regulatory capacity gaps.	**Governance**: inadequate oversight capacity undermines democratic control, dependence on foreign expertise for sovereignty assessments.	
Gap	European regulators and policymakers lack sufficient technical expertise to understand complex 6G systems, AI-driven network optimization, and emerging security vulnerabilities. No systematic European programme exists for developing specialised 6G governance expertise. Academic and research institutions have limited capacity for independent 6G system assessment and analysis. Current training and capacity building programmes focus on technical implementation rather than governance and oversight capabilities.		
Emerging Need	Develop European capacity for independent 6G system assessment and governance; reduce dependence on foreign expertise for sovereignty decisions; guarantee adequate oversight capabilities match system complexity.		
Risk TSR3 - Fragmentation of global 6G standards threatening European values integration			
The global race for 6G leadership is fracturing international cooperation in standards development, potentially creating incompatible regional ecosystems that could exclude European values and technical contributions. China currently holds a plurality of 6G-related patents and has established separate technical standards processes, while the US pursues vendor exclusion strategies that could marginalise European technical contributions. This fragmentation risks creating 6G systems that embed authoritarian governance models, prioritise surveillance capabilities, or **exclude European privacy and human rights requirements from their fundamental architecture**. The stakes extend beyond technical compatibility to include the values and governance principles that will be embedded in the digital infrastructure governing European society for decades to come.			
Risk Type	**Societal**: loss of interoperability undermines European digital single market and could isolate European	**Governance**: European values may be excluded from global technical standards, undermining the EU's ability to	**Economic**: fragmented markets increase costs and reduce European competitiveness by forcing companies to develop

	users from global digital services.	ensure its legal and ethical frameworks are respected in 6G systems.	multiple product versions for different regions.
Gap	While European companies participate in 3GPP and ITU standards processes, the EU lacks coordinated strategy for ensuring European values are embedded in 6G technical specifications. Current European participation in standard bodies is fragmented across Member States and companies suffer a lack of systematic coordination or shared strategic priorities. There is currently no dedicated EU-level funding mechanism to support the preparation and promotion of European technical contributions in global standards fora. Moreover, no formal framework exists for democratic oversight or stakeholder consultation, leaving citizens and civil society with limited visibility or influence in decisions that will fundamentally shape their digital environment.		
Emerging Need	Guarantee that values of privacy, transparency, and democratic governance are embedded in global 6G technical standards; maintain single global 6G standard while preventing authoritarian influence; coordinate European technical contributions to maximise influence in standards development and prevent marginalization.		
Risk TSR4 - Foreign government access to European 6G infrastructure and data			
The integration of foreign-controlled components in 6G networks creates pathways for foreign government access to European communications, potentially bypassing legal protections. 6G's AI-driven architecture and software-defined infrastructure enable remote configuration changes, data collection, and network control that could be exploited for espionage, economic intelligence gathering, or infrastructure disruption.			
Risk Type	**Societal:** erosion of trust in communications infrastructure.	**Human**: individuals' communications and personal data vulnerable to foreign surveillance.	**Governance**: foreign authorities could access European data outside legal frameworks.
Gap	Current EU frameworks including the 5G Security Toolbox and NIS2 Directive provide risk mitigation recommendations but lack comprehensive protections against foreign government access through technical means. No dedicated EU-wide mechanisms exist to systematically monitor and prevent unauthorised foreign access to European telecommunications infrastructure.		
Emerging Need	Prevent unauthorised foreign government access to European 6G networks and data; ensure European legal frameworks take precedence over foreign legal obligations in telecommunications infrastructure; maintain citizen trust through transparent and accountable security measures.		
Risk TSR5 - Fragmentation undermining European strategic coherence			
Differences in national approaches to 6G security, vendor restrictions, spectrum allocation, and investment support create vulnerabilities that foreign actors can exploit while undermining European strategic coherence. Inconsistent implementation of EU frameworks including the 5G Security Toolbox and varying national approaches to Chinese vendor restrictions create a patchwork of protections that weakens overall European security.			
Risk Type	**Policy coherence**: fragmented approaches reduce effectiveness of European sovereignty measures.	**Economic**: regulatory uncertainty increases compliance costs and delays deployment.	**Governance**: foreign actors can exploit differences between Member States to circumvent restrictions.

Gap	While EU frameworks provide common objectives, implementation varies significantly across Member States. The 5G Security Toolbox has been implemented inconsistently, with some Member States failing to restrict high-risk vendors. No binding coordination mechanism ensures coherent European approaches to 6G sovereignty challenges. Enforcement capabilities vary dramatically between national regulators, creating compliance gaps.
Emerging Need	Ensure coherent European approach to 6G sovereignty across all Member States; eliminate vulnerabilities created by regulatory fragmentation; coordinate enforcement and compliance capabilities.

9 CONCLUSIONS

This policy-oriented analysis has examined how the development of 6G can be guided towards greater **social acceptance and sustainability**, the two main drivers behind the mandate and work of 6G4Society, by addressing both governance-related shortcomings in research and innovation practices, and the risks posed to key societal values along the current technological trajectory.

Next-generation technologies such as 6G illustrate the promise, the opportunity and the complexity of a true sustainability transition. With its ultra-fast and reliable connectivity, 6G is expected to become the backbone of industrial automation and smart sectors, supporting real-time data flows across factories, transport, healthcare, and beyond. Crucially, if 6G is conceived from the outset with sustainability in mind, its contribution can extend far beyond its own energy profile: it can act as a powerful enabler of net-zero and circular-economy pathways and support capabilities across all three pillars of sustainability: economic, social, and environmental.

It is in this context that **6G4Society's contribution becomes relevant**. In line with the original call for proposals, 6G4Society set out to explore the social dimensions of the 6G technological environment, with **two central aims**: to better identify challenges and opportunities for integrating **sustainability within technology design** (notably through KVIs), and to deepen the understanding of the dynamics **underpinning social acceptance**.

In this policy-oriented analysis, **social acceptance** is not understood as a simple outcome of deployment, user uptake, or market diffusion, but as a **dynamic process** that unfolds once technologies enter everyday life and interact with social practices, expectations, and lived experiences. **Acceptance both reflects and reveals the values that matter to individuals and communities**. Technologies that visibly embody values such as privacy, autonomy, fairness, or inclusion are more likely to be perceived as legitimate and desirable. Conversely, public controversies and resistance signal where values are perceived as neglected or violated, offering critical insights into societal priorities and emerging tensions. From this perspective, **sustainability** itself, when framed and communicated as a core value rather than as a constraint, can **become a facilitator of acceptance and a source of legitimacy**.

At earlier stages of technological development, however, the notion of **social acceptability** becomes particularly salient. In contexts where technologies are still emerging and operate at low levels of maturity, discussions on acceptability (i.e., compliance with societal values, ethical principles, and normative expectations) are more influential than assessments of acceptance. Acceptability defines the conditions under which a technology ought to be pursued, shaped, or reconsidered before it becomes embedded in society. Value-based design practices play a crucial role in this regard, enabling values to guide choices, priorities, and trade-offs from the outset. This is especially relevant when **sustainability is treated not merely as an outcome to be measured ex post, but as a fundamental requirement** and guiding value to be embedded into technological design.

Sustainability in its broadest sense—encompassing economic, social, and environmental dimensions—**has emerged as a critical global imperative demanding coordinated action from industry, policymakers, and civil society**. While the United Nations' 2030 Agenda called for "bold and transformative steps" to put humanity on a sustainable and resilient path, and although business commitments to environmental goals are increasingly visible, progress to date has been modest and often formalistic, or compliance-oriented. In many cases, sustainability measures have been appended to existing processes without addressing the fundamental transformations required. Achieving sustainability in a holistic, integrated, and

cross-sectoral manner requires rethinking entire value chains and production paradigms, rather than relying on incremental, ex-post, or mitigation-driven fixes.

Moving beyond purely theoretical analysis, 6G4Society combined desk research with participatory observations within the SNS community, combining insights coming from surveys and interviews to experts, project advisors and policymakers, and from a citizen survey. This allowed to advance understanding of the **following findings**:

- the taken-for-granted assumptions currently driving strategic choices and orienting innovation trajectory paths;
- the dependencies and relationships among the concepts of social impact, sustainability, social acceptance, and broader social values;
- the extent to which current 6G development practices consider societal needs and priorities, ethical concerns, and sustainability objectives;
- the ways in which traditional R&I processes may conflict with ambitions for sustainability and inclusion, and the gaps that remain to be addressed
- the practices that could better support sustainability as a core value across the value chain;
- the trends linked to human values and rights under transformative tension, including the longer-term societal implications of emerging technological trajectories.

Building on these findings, and to support the transition toward sustainable and socially accepted 6G technologies more closely aligned with societal expectations, this policy-oriented analysis organises the project's findings along **two main concerns**: (1) the methodological, cultural, practical, and governance aspects of R&I within the SNS-JU community; and (2) the specific values or rights that risk being insufficiently addressed, inconsistently considered, or entirely overlooked in the current trajectory of 6G development. The **lowest common denominator between the two levels is the centrality of an approach centred on *values***.

A first overarching conclusion, primarily related to **Concern 1**, is the need to move beyond a conception of innovation and competitiveness driven predominantly by technological advancement. The EU ambition for a socially accepted and sustainable 6G cannot be met through technical excellence alone. It demands a profound **cultural and methodological shift in the way research, innovation, and governance are conceived and enacted within the industrial sector** and across the SNS-JU ecosystem. The findings reveal structural limitations in how societal needs, priorities, values, and long-term impacts are explored and interpreted, showing a persistent technology-centric logic that risks to narrow the futures that 6G may shape and overestimating—or taking for granted—the benefits associated with hyperconnectivity.

Within this framework, environmental and social sustainability are indeed articulated as primary goals; yet at some point in the innovation culture, they become secondary to other considerations, losing coherence with a holistic conception of sustainability and increasingly resembling compliance-driven obligations. **Environmental sustainability** is still frequently framed as a trade-off or a burden to be managed, rather than as a strategic asset defining technological priorities and limits. At the same time, the contribution of technology to social sustainability is often overestimated, with insufficient attention paid to broader societal risks and long-term implications. This underscores the need to strengthen capacities for anticipating and contextualising social impacts. For example, further research topics might address how social values and rights are translated, reshaped, or reinforced within immersive communication environments; and how physical and virtual experiences blend across the real and the imaginary, influencing individual well-being as well as social sustainability.

To unlock the transformative potential of 6G, policy and governance instruments must steer a decisive **shift toward value-driven, anticipatory, and inclusive forms of innovation**.

Values should be treated not as abstract aspirations, but as actionable drivers shaping design choices, research priorities, and strategic orientations from the earliest stages of development.

This calls for cultivating the skills and mechanisms necessary to systematically identify societal implications, integrate diverse perspectives, and broaden understanding of what social and environmental sustainability entail within the specific context of future network technologies. It also requires shifting from a trade-off culture to one of **co-optimisation**, including dedicated support structures encompassing clearer programme requirements, targeted guidance for practitioners, strengthened interdisciplinary collaboration, and sustained engagement with stakeholders beyond the traditional telecommunications domain. Only by **embedding such approaches structurally—across work programmes, project operations, and governance practices**—the evolution of 6G can align with societal priorities, fundamental rights, and planetary boundaries.

With regard to **Concern 2**, the analysis shows how shortcomings in governance practices identified by Concern 1 may translate into **concrete risks for societal values and fundamental rights**. Risks related to data control, surveillance, human oversight, unequal access, procedural justice, and dependency on external actors point to the need for a more proactive and value-oriented approach to policy and regulation. These risks are not abstract: 6G's specific technical trajectory gives them concrete form. With respect to **privacy**, Integrated Sensing and Communication (ISAC), AI-native network management, and ambient intelligence architectures create conditions for continuous data collection that extends far beyond traditional telecommunications, challenging existing consent models and accountability structures. With respect to **inclusion**, 6G's deep integration with essential services means that connectivity gaps translate directly into exclusion from healthcare, education, employment, and civic participation; making inclusion not merely about access, but about distributive and procedural justice in how infrastructure decisions are made and benefits distributed. With respect to **technological sovereignty**, Europe's near-total dependence on external suppliers for advanced semiconductors and AI capabilities, combined with 6G's role as the operational backbone for critical infrastructure, creates vulnerabilities where foreign control could enable coercion, surveillance, or disruption of essential services. Addressing these risks requires moving beyond fragmented or reactive measures, and towards coordinated strategies that align legal frameworks, policy instruments, and research and innovation practices with societal priorities.

In summary, **the path toward a socially accepted and sustainable 6G is not only a technical or procedural endeavour, but fundamentally a governance challenge**. It requires redefining the role of digital infrastructures in society, expanding the set of actors who participate in shaping them, and elevating **sustainability** and **social desirability** as core, non-negotiable principles of innovation. This brings to a second conclusion: **embedding values such as (but not only) privacy, inclusion, and technological sovereignty** into the core of 6G development is not only an ethical imperative, but a prerequisite for ensuring legitimacy, trust, and long-term sustainability.

The four policy briefs developed over the course of the project, based on two years of analysis, converge on a **key overarching conclusion**: several challenges identified by the different stakeholders (i.e., citizens, experts, the SNS-JU community, policy makers, and external project advisors) fall at the intersection of regulatory, organisational, and cultural dimensions. In many cases, existing **legal and policy frameworks, as well as research programmes only partially address emerging risks, while other issues (such as participation deficits, value trade-offs, or long-term societal impacts) remain insufficiently covered or lie outside formal regulatory remits.**

Translating these gaps into actionable recommendations, as outlined in the four policy briefs, represents therefore a pathway to inform targeted policy options and to influence

future development efforts, notably through the integration of acceptance and acceptability concepts, grounded in societal values, into future research programmes.

This contributes to framing **social acceptance and sustainability as evolving and collective processes**, **supporting Europe's ambition to lead the development of next-generation connectivity that is not only technologically advanced, but also ethically grounded, socially legitimate, and ecologically responsible**, **through continuous dialogue, reflexive governance, and the capacity to align technological innovation with the European societal values**.

APPENDIX I - POLICY BRIEF ON VALUES AND IMPACT: THE PATH TO ACCEPTANCE AND SUSTAINABILITY

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TOWARDS A SOCIALLY ACCEPTED AND SUSTAINABLE 6G

Policy Brief on Values and Impact: the path to Acceptance and Sustainability

1. Highlights

The 6G4Society initiative has focused specifically on investigating the social dimensions of the 6G technology environment, addressing the central question of how 6G development can be guided to ensure meaningful social and environmental contributions. In particular, it examined the way 6G development interacts with societal needs, ethical considerations, and sustainability objectives. Evidence gathered through literature reviews, exploratory surveys within the SNS-JU project community, interviews with experts and policy makers, and direct engagement within 6G-IA and SNS-JU working groups highlights both a strong commitment and willingness to integrate values, and a range of cultural and practical challenges rooted in existing economic models, innovation practices, and governance structures.

Against this backdrop, this policy brief elaborates on this central question: ***How does a limited integration of social dimensions during innovation narrow the institutional and operational framing of sustainability, and to what extent does this hinder the achievement of a truly holistic sustainability?*** Risks identified relate to values alignment, awareness about societal implications, and overall approach to sustainability.

Six main recommendation are proposed: 1. Make social desirability a transformative driver within the technological process; 2. Support activities and capacities to manage the complex relationship between values and technology, so that relevant social values are meaningfully integrated in the innovation process; 3. Promote mechanisms to proactively anticipate, assess, and guide the broader societal impacts of future network technologies; 4. Investigate further ethical and societal issues arising from immersive communication environments from an ethical and sociological point of view; 5. Overcome the trade-off logic, supporting the transition towards sustainability as an integral value and strategic driver within innovation processes; 6. Ensure a comprehensive interpretation of environmental and social sustainability in research and innovation processes.

2. Context of the Issue

The 5G Infrastructure Association described 6G as “one of the basic foundations of human societies of the future.” [69], underscoring the pervasive and profound societal impact 6G is expected to trigger. The magnitude of this transformative potential is matched by significant commitments as to its role and mission in society. As elaborated in both institutional and industrial strategic documents, 6G is envisioned as a transformative technology whose ambition extends beyond technological advancement and performance metrics. 6G is considered for its potential to enable a wide range of critical services across multiple sectors, and in particular, to **enable sustainability**, as it can support major polluting sectors—such as transport, agriculture, and construction—in reducing their environmental footprint.

A major conceptual shift accompanies these goals, represented by the expressed ambition of incorporating value-oriented objectives in the design paradigm as of the onset, representing **intangible yet fundamental human and societal needs**. This evolution is explicitly elaborated in the strategic orientations of the SNS-JU, which positions future smart networks and services in support of European policy priorities, including the Green Deal, and of a sustainable and secure internet [70]. Further, the European Sustainability lighthouse project Sustain-6G concretely collects this commitment [5], with the mission of exploring 6G sustainability in a holistic way across the three environmental, economic, and social pillars. Altogether these developments signal a profound **cultural shift**, conceiving the advancement of next-generation connectivity as inseparable from the responsibility to foster societal well-being, protect fundamental rights, and support long-term planetary health.

It is within the space between the pervasive transformative potential attributed to 6G, and the desire to build a system based on social and ethics values, that the reflections of this policy brief develop. **Triangulating the concepts of values, impact and sustainability**, 6G4Society has explored and critically interpreted the work conducted within the SNS-JU and 6G-IA ecosystem, analyzing how the transformative contribution of 6G in society, as well as final objective of holistic sustainability, are being interpreted and addressed in R&I projects.

Gaps at the **governance and practical levels** emerged as well as **cultural and methodological barriers** and **challenges** that remain to be addressed to effectively translate high-level commitments and principles into the concrete day-to-day implementation of innovation processes. In particular, through the lenses of the Responsible Research and Innovation framework [13], innovation processes appear still falling short of the principles of reflexivity, anticipation, responsiveness, inclusion and participation, which are foundational to achieve the above-mentioned goals. This process demand awareness, openness to challenge assumptions, and ultimately dedicated guidance and capacity-building.

The first issue relates to the dimension of *values*, to how it influences both high-level strategic orientations and the practice of technology development. Dealing with values is inherently complex because values—whether at the individual, corporate, or institutional level—are often implicit and rarely acknowledged in a deliberate or conscious way. This difficulty translates into biases and limitations in how the strategic level and the implementation level reflect social values.

Strategic orientations guiding R&I tend to be shaped by the priorities, values, and viewpoints of limited stakeholders—primarily the industrial sector and technical communities. Overall, the decisions orienting future development tend to be grounded on what technology can achieve, rather than on what society may genuinely and deeply need. Considerations such as technological feasibility or market potential frequently prevail over broader cultural, and social implications; also, the persistence of a paradigm treating hyperconnectivity as an unquestioned and intrinsic value introduces inherent biases in the foundational elements guiding technological objectives. The result is that **current research and innovation (R&I) practices risk projecting a narrow-scoped vision of possible futures** to be designed and pursued, by overlooking the diversity of societal perspectives and aspirations. This translates into missed opportunities for a more disruptive and inclusive explorations of how human and societal development might evolve.

At the level of **technology implementation**, value related considerations raise significant challenges. Despite innovation actors being increasingly expected to define and manage the value dimension within technology development processes, evidence from 6G4Society confirms that many technical experts still lack the multidisciplinary expertise that is needed to navigate the complex interplay between values and technology and to recognize how cultural values shape innovation, especially at low TRL levels. This competence gap, combined with challenges in identifying and engaging relevant stakeholders early on, results in **value-related**

considerations being addressed predominantly at later TRL stages, and with a **partial and/or biased reflection of social values** in the innovation process**.** The potential for value-based design at the earliest stages of technology development, when flexibility is greatest, is therefore constrained, together with the possibility of truly steering technological development toward ethics, values, and social good considerations in technology design.

The second issue where the risk of narrow scoping of the future emerges, is in the way ***impact*** is described and addressed within the current technical R&I culture. What became evident is the tendency to act on the **assumption of a beneficial effect** of technology as concerns its impact on society, with **limited awareness of the potential negative and unintended social implications** that technologies may generate beyond their intended or sector-specific impacts. As a result, a number of social impacts — related to the creation of broader value for society or linked to the transformative impact of the digital world on individuals — are often not sufficiently taken into consideration and reflected in the R&I design or assessment processes. This affects – and compromises – in turn: the definition and calculation of costs and benefits – pains and gains; the capacity of identifying in due time social values or rights that are either at risk, or that require a new recognition and protection; the breath and scope of KVIs and their capacity to capture longer-term impacts, beyond the project lifetime. Overall, these aspects may overestimate the benefits associated to hyperconnectivity (e.g. overlooking the importance of equally taking care of *disconnection*) and can compromise the **capacity of comprehensively scoping and addressing the social sustainability dimension**.

Immersive communication environment has been especially recognised as an environment liable of profoundly **reshaping society and human experience, calling for a more responsible, anticipatory, and reflexive approach to innovation**, in line with the European Commission strategy on Web 4.0 and Virtual Worlds (the “metaverse”) [28]. Important and specific dimensions have been identified in the context of 6G4Society work, through the lenses of social theory and media studies, highlighting needs and opportunities for further ethical and social research. These dimensions include: the reconfigured relationship between body, space, and environment; the blurred boundaries between reality and imagination in the virtual world; the relationship between physical and virtual social space; the perpetration of stereotypes in the virtual world; the role of mediation in immersive communication environments.

The third and last dimension analysed regards *sustainability* – as a value and as a set of practices – and the way it is addressed within the industrial R&I culture. Overall, sustainability continues often to be framed as a **trade-off**, or as a secondary or external consideration, rather than being integrated as a core priority. It remains frequently associated with notions of **constraint**, **burden**, or **renunciation**, and is often perceived as standing in **tension** with objectives such as competitiveness, performance, and profitability. In most business contexts, sustainability **has not yet evolved into a genuine guiding principle** and still fails to contribute to shaping innovation strategic objectives in a transformative way, informing the design and development of products or business models, and ultimately stimulating a real paradigm shift. This partly derives from sustainability not being widely recognised as a **source of business value in terms of market positioning**, **reputation**, or product and service offerings. This scenario points to two important aspects: on a practical side, sustainability risks to remains **peripheral** to industrial research and innovation agendas, core business models, and decision-making processes, resulting in only a **superficial and compliance-oriented** exercise, failing to evolve into a genuine driving force and source of business value. On a cultural side, this scenario embodies a disconnect from the fundamental values that should underpin responsible and future-oriented development, reflecting the **persistence of a deeply rooted cultural and value framework still oriented towards different priorities.**

Final considerations regard the way in which the concept of **social and environmental sustainability is interpreted** in the context of R&I innovation agendas and practice. Some nuances and aspects that are constitutive of the concepts are currently not taken into account and not reflected into R&I processes. This perceived lack of relevance may derive from: **a low priority attributed** to these topics within programmatic research priorities (work programmes); a **difficulty in meaningful interpreting** these sustainability dimensions and research in the contexts of innovation priorities, targets and operations; **missing specialist competences** to properly address these aspects**.**

A proper understanding of these aspects is important to avoid negative social and environmental rebound effects from the digital transformation. Also, in the specific context of the SNS-JU, the community has manifested the willingness to transitioning from a trade-off logic and approach, towards ***co-optimisation*** approach [71], as a way to guarantee **a more holistic alignment** between technological advancements and broader sustainability objectives. The capacity to devise concrete co-optimisation strategies, however, remains a critical challenge. Appropriate support mechanisms are needed to support industry in this effort, to avoid treating conflicting variables as competing interests, and to ensure that a performance-oriented culture does not overshadow broader sustainability considerations. This need was first raised here [71] and then reaffirmed in occasion of EuCNC.

In conclusion, a key insight drawn from these analyses is the dominance of certain perspectives in addressing concepts such as impact, need exploration, and key values — often resulting in partial, technology-centric interpretations that can obscure broader societal considerations. Considered these issues, 6G4Sociey underscores how any such limitations – on capturing social needs, understanding societal impact, incorporating values in the innovation process – may **relapse on the way sustainability is scoped and enabled, ultimately hampering the possibility to realise sustainability in a holistic way.**

3. Policy Recommendations

3.1. R1 – Make social desirability a transformative driver within the technological process

Research priorities must be able to integrate and embrace social desirability as a driver and as a criterion informing choices. This entails openness to capture different, alternative visions and priorities as to the desired lifestyle for the future of our society, even in discontinuity with taken for granted and dominant positions. This requires a cultural shift and a redefinition of the role of technology in society, to overcome the current technology driven paradigm, with the awareness that decision at each design phase can shape future societies. Research and innovation orientations, technological priorities, use-case prioritisation, and approaches to problem-solving shall be shaped around different assumptions, questioning on the one hand the need for certain innovations, and understanding – on the other hand – the orientation and priorities of society. This implies the opportunity of consciously selecting and prioritising specific human principles and visions for the future, independently from immediate or technology driven market opportunities.

Social desirability can be actioned in R&I at different levels through outlining specific requirements at the level of funding mechanisms. Main dimensions of change relate to the approaches used to define or identify social needs, to define social acceptance, to cure the relationship with the stakeholder system, including the way to manage conflicting situations.

The perspective of who has a legitimate stake in technological innovation shall be extended beyond the community of business, technical and industrial specialists and beyond final users, including those groups or communities that may be indirectly or negatively

impacted – or which perceive themselves as negatively impacted. The objects of exploration should include needs, priorities, driving values, or potential tensions.

Social acceptance shall not be conceived as a goal to achieve, but as an ongoing process to explore and critically examining whether the value envisioned by industry aligns with actual social needs, identifying potential gaps between technology-driven objectives, underlying assumptions on societal priorities, and the perspectives of underrepresented groups. This, not to dismiss business objectives, but to widen their perspective and conception in terms of social value creation. This would ensure a comprehensive exploration and elicitation of societal needs across social groups, and relative important social values.

Such turns are essential to promote a **critical examination and elicitation of what social values and assumptions** are being promoted and reinforced, or challenged, through current innovation trajectories, getting to shape orientations, pathways, and decisions. Recommended policy options are the following:

- **Overturn the approach to social acceptance, from goal to exploration,** widening its scope of investigation, targeting a wider range of stakeholders (beyond final users) and the socio-economic contexts beyond the scenario of use – e.g., the socio-political, community or market level.
- **Support the creation of a new culture of stakeholder engagement in the telecom sector**. This could be done on the lines of the quadruple helix model – aimed not only at a comprehensive needs exploration but also to challenge driving assumptions.
- **Tune towards conflicting or divergent voices, embracing controversies as a way to elicit and explore diverging social values and social needs.**

3.2. R2 – Support activities and capacities to manage the complex relationship between values and technology, so that relevant social values are meaningfully integrated in the innovation process.

Practical and structured guidance shall be provided to practitioners, to support the identification and articulation of values across the innovation process, understanding when and how they emerge, and in which ways they exert influence and become available for assessment. Guidance and capacity building shall focus on three main levels in which values influence and relate to the technology work: 1) **Elicitation of values** as guiding (and often implicit) principles defining purpose and orienting strategic or technical decisions; 2) **Integration of values** into design and development processes as of the earliest stages; 3) **Translation of key values into KVIs**, providing clear rationales, methodological steps, and examples to help teams navigate different options.

These capacities, aimed at promoting responsiveness to societal priorities, find applications into innovation processes under the form of different activities. These activities may scope from the capacity of mapping different perspectives across stakeholders, to that of translating and embedding insights into technology design decisions, evaluation criteria, or project objectives. Further elaboration on the complex interplay between values and technology, and on how values act throughout the research and innovation process, is provided in two dedicated 6G4Society Insight Reports, [72] and [9]. Recommended policy options are the following:

- **Promote the presence of specific competences in R&I activities aimed at addressing or integrating social values or ethical issues** – notably from social sciences and cultural studies – to provide and deliver practical guidance to practitioners to identify, manage or integrate values throughout the innovation process.
- **Supporting a specific Coordination and Support Actions (CSAs) to provide cross-cutting support and expert service to the SNS JU community** (also to low

TRL projects) on the ways values and technology intersect. Outputs could take the form of guidelines and practical toolkits, including methodological approaches, templates and reflection prompts, and case examples to facilitate systematic engagement with values in technology R&I.

3.3. R3 – Promote mechanisms to proactively anticipate, assess, and guide the broader societal impacts of future network technologies

A new way of approaching and understanding ICTs impact is needed in the industrial culture, which complements the study of more immediate and intended social impacts with a broader comprehension of the transformative effect that technology triggers on several fundamental aspects of human experience and social organization. Assessing 6G's potential impact (and implications) at the societal level requires awareness on the complex set of dynamics ignited at the cultural, social and individual levels (cognitive, psychological, identity-related, relational, mental health aspects). These levels can be problematised, explored and anticipated (although not predicted or assessed), and shall be addressed as of the earliest stages of the R&I process. This requires leveraging on complementary knowledge, competences and methodologies, in particular from the social sciences realm.

A number of anticipatory approaches help bridging the gap to capture the broader, systemic, and long-term transformations that technologies trigger in society, by revealing potential second-order effects and societal dynamics that conventional methods do not capture. These are, for example: Constructive Technology Assessment (CTA), Value Sensitive Design (VSD), Socio-Technical Integration Research (STIR), scenario building, foresight and backcasting exercises, Technology Foresight Assessment (TFA). In the operations of the SNS JU ecosystem such methods would help complementing existing innovation practices, by expanding innovation targets from technical feasibility and performance, towards a more substantial pursue of social desirability, long-term societal relevance and ethical soundness. Recommended policy options are the following:

- **Make the integration of social science competences a requirement in topics where future and emerging technologies are studied**, in order to integrate as of the onset an anticipatory perspective and therefore capture aspects liable of complex and possibly controversial societal implications. The importance of a multidisciplinary contribution could be made more explicit in future SNS JU Work programmes, where the involvement of SSH experts could be established as a necessary and structural condition for projects addressing social and sustainability dimensions.
- **Promote tools and methods for the anticipatory exploration of possible broader societal implications of technology.** This integration could be directly operationalised within specific technical topics, or through dedicated CSAs, aimed at devising targeted methodological guidance, training, and support for anticipatory reflection at different TRL stages.

3.4. R4 – Investigate further ethical and societal issues related to immersive communication environments

Three research paths are here proposed for further exploration. Further explanations and elaboration on the relevance of these topics, together with academic references, can be found in chapter 3 of 6G4Society D1.1 [1], and in [73].

Immersive communication as new communication mode: Immersive communication is considered by some communication sciences and media theory scholars a new communication paradigm [17], for the extent to which it is expected to impact on communication categories that participate to the generation of meaning - space, time, human body presence, non-verbal communication. The investigation of relevant and constitutive

dimensions of this new communication and media paradigm from the social dimension and media theories point of view is suggested. This shall include the study of how the capabilities and influences of "mediation" changes within the processes of meaning creation, while evolving towards increasingly naturalised" and immanent forms. Risks such as emotional manipulation, bodily surveillance, or dependency on immersive environments shall become object of reflection, while reflecting on which values should be safeguarded —autonomy, authenticity, inclusivity, well-being—as immersive communication and XR become central to cultural production and experiences.

Narratives, stereotypes and values reinforced by games: The gaming experience evolved lately from pure entertainment, into platforms for socialisation, learning, and identity-building. This raises relevant questions as concerns the development of contents in the gaming industry, as through gaming experiences different values may be transferred and reinforced in society. Currently, games contents often develop in contexts of competition, violence, or war, reinforcing values –and experiences– such as dominance, conquest, and rivalry. In addition, games tend to reflect stereotyped representations of female characters. Research shall be supported to investigate the role of gaming experiences in the context of social sustainability and of social values reinforcement. The focus could relate on critically assessing how social stereotypes risk of being reinforced (e.g. gender or minorities representations) and how, conversely, games could be designed to foster positive values such as exploration, cooperation, diversity, equity or inclusion. Also, research could focus on the influence of gaming in the shaping of self and social identity; or on emulation risks connected to virtual experiences constituted by violence or aggression.

The relationship between physical, virtual, real, and imaginary spaces: The immersive potential of XR technology generates vivid experiences and real emotions, transforming the relationship and type of interaction between physical, virtual and imaginary space. The ethical implications are profound: while immersion can enrich creativity, learning, and cultural expression, excessive engagement risks to entail detachment from the physical world, and to weaken the ability to distinguish mediated from unmediated experience, potentially leading to confusion or disconnection from one's physical surroundings and social relationships. Further research shall be done on how physical and virtual experiences are articulated across real and imaginary, affecting not only individual well-being but also social sustainability.

Recommended policy options are the following:

- **Foster multidisciplinary research on the ethical and societal implications of immersive communication and XR environments**, with the mandatory contribution of SSH disciplines (e.g. social sciences, communication sciences and media studies, cognitive sciences, psychology) in the above-described specific topics.

3.5. R5 – Overcome the trade-off logic, supporting the transition towards sustainability as an integral value and strategic driver within innovation processes

There is a need to overcome the trade-off culture and to foster a culture where sustainability is not felt as a burden or external constraint, but as an integral, strategic asset, a way of living and working, a principle that naturally guides how activities, products, and systems are designed, produced, and managed. Actions at different levels are needed:

Assigning to sustainability a higher priority in research and innovation programmes, making it less negotiable. In the same way that security, safety, and quality are treated and socially perceived as essential dimensions of performance and value, and not perceived as limiting constraints, so sustainability shall be assigned a higher priority, as an element strengthening long-term resilience and eco-systemic well-being. This is especially crucial as concerns enabling aspects for circular economy.

Creating positive narratives and evidences, tailored for the telecom sector, on how sustainability and ethical responsibility can become integral part of businesses and create tangible value. Virtuous examples from project-level experimentations, or beyond, shall be gathered. The aim is showing how embracing environmental sustainability goals and transforming operation modalities. Example shall cover different stages of the value chain, from design and infrastructure choices, to service provision and end-of-life management, with special attention to options and experimentations on innovative viable business models.

Investigating both economic and cultural barriers to explore: the cultural grounding behind the persisting perception of sustainability as an obligation and burden, rather than opportunity and an intrinsic value; international cooperation strategies, opportunities and competitive challenges related to the integration of sustainability in competitiveness and investments outside the EU; customer acceptance and market adoption dynamics related to sustainability-centred value; this includes leveraging on the growing awareness of the public, and on the potential of marketing to promote sustainability as a competitive, intrinsic value.

Setting up a support and guidance mechanism to accompany industry in the transition. Guidance and steering are needed by industry from policy makers to navigate choices and options within a context aiming at *holistic co-optimisation*. Dialogue, orientation and governance is required as concerns: setting conditions for use (e.g. applying the principle of frugality to avoid unnecessary bandwidth usage); establishing thresholds and limits (e.g. of carbon emissions, or EMF); prioritising achievements and targets; establishing rules for what the technology can and cannot be used for; distinguish between what constitutes a legitimate trade off – expression of specific contextualities – and what represents the perdurance of traditional priorities and values (performance, profitability) at the expenses of other interests (e.g. environment, ecosystem, biodiversity, etc.).

Recommended policy options are the following:

- **Integrate in R&I work programmes precise requirements, to support a transition towards circular value chains as of technologies conception phase**. Specific requirements shall be set to explore the design of products (as of the earliest stages) also in view of their end-of-life management. Accent shall be put on exploring long-lasting, repairable, and modular designs, assessing any impact on performance or reliability. Equally, the exploration of business models not based on selling products, but on product as a service, shall be promoted where relevant.
- **Support the cultural transformation, building different narratives and evidences** tailored for the telecom sector, based on experimentations and experiences from projects, giving evidence on how sustainability and ethical responsibility can become integral part of businesses and create tangible value, showing how to adapt operation modalities and assumptions at different stages of the telecom value chain, or creating innovative viable business models (e.g. adaptable user experience; “product-as-a-service” principle). This objective could be supported by a CSA.
- **Create a guidance mechanism, or a stable institution-industry dialogue**, to steer and navigate choices and options within a context aiming at *holistic* ***co-optimisation***, beyond a trade-off culture.

3.6. R6 – Ensure a comprehensive and contextual interpretation of environmental and social sustainability in research and innovation processes.

There is a clear need to clarify and contextualise what environmental and social sustainability mean in the context of future network technologies. Not only specific nuances, aspects and objectives shall be better defined, but also the way such aspects relate, directly or indirectly, to the work of SNS-JU projects, including low TRL ones, shall be illustrated,

through concrete examples and contextual explanations. This would make it possible to draw a thread, linking technical operations to long-term, systemic social impacts.

Aspects relevant to correctly scope the concept of social sustainability, and currently not fully addressed are: *mental and physical health and wellbeing; cultural heritage; cultural identity and diversity; sense of belonging; feeling of being safe in a community, and of being part of a community; community prosperity; intergenerational justice; equity in the way assets, resources and benefits are distributed; societal resilience; social cohesion; participation and empowerment; autonomy; freedom; dignity; right to disconnect or not to be connected; landscape preservation; quietness and unspoiled nature.*

Aspects relevant to correctly scope the concept of environmental sustainability, appearing a less addressed within the activities of SNS-JU projects are: *greenhouse gas (GHG) emissions; electromagnetic field (EMF) exposure; circularity; impact on biodiversity*; *landscape preservation; quietness and unspoiled nature.*

As concerns **social sustainability**, the visions, narratives and approaches proposed by industry on future social scenarios or to address social challenges shall be analysed through social sciences competences, to highlight ethical or social issues requiring attention for their potential wider societal implications (also for works at low-TRL or on enabling technologies). As concerns **environmental sustainability**, there is a need to explore, verify and demonstrate how and to which extent (under which respects and focus) aspects currently left behind (e.g. GHG, circularity, biodiversity) are possibly relatable to technology-focused, low TRL work, in view of value-based design considerations. Specific competences shall be required to address such areas (GHG, circularity, biodiversity). Recommended policy options are the following:

- **Support multidisciplinary actions aimed at better defining and contextualising environmental and social sustainability aspects in the SNS-JU realm**, clarifying focus, meaning, relevance and links between the sustainability dimensions listed above – currently less covered – and specific areas of action of SNS JU operations.
- **Promote a dedicated CSA** to work cross-cuttingly with SNS-JU projects, with the aim of operationalise the work above (mapping the relevance of environmental and social sustainability topics against SNS-JU projects areas of intervention)
- **Integrate requirements into R&I work programmes to consult or involve specialists** in environmental sustainability areas that are currently underrepresented, particularly circularity, GHG emissions, and biodiversity. This should be done with the aim of exploring the extent to which these areas are relevant and addressable already in the earliest phases of technology exploration and development, ensuring thus sustainability by design.
- **Integrate the *Right to Disconnect* into the reflection on 6G policy and regulatory frameworks**, alongside existing inclusion objectives. This may include considering the incorporation of disconnect/pause-by-design mechanisms within 6G device architectures, as well as aligning technological design with workplace regulations that protect individuals from constant availability. The role of disconnection shall be recognised as a necessary counterpart to hyperconnectivity, rather than its negation. Embedding safeguards can help ensure that increased connectivity enhances wellbeing and productivity, rather than contributing to stress, burnout, disconnection from reality and social ties, and long-term social harm.

4. Evidence and analysis

The project's findings at the basis of these policy briefs are based on the analysis of multiple sources and the triangulation of quantitative (surveys), qualitative (interviews and workshops), and desk-research methods. Sources have been analysed through the analytical lens of

Responsible Research and Innovation (RRI) and Science and Technology Studies, and comprise scientific literature, participatory workshops, surveys and interviews with R&I practitioners from SNS JU projects, a citizen survey, consultations with policymakers and experts on topics such as social acceptance, 6G, green ICT, smart cities, and sustainability.

Other key sources to understand approaches and methods applied by industry in matters of social needs, social values, social acceptance and KVIs, have been: a **survey** to explore the SNS-JU projects' community [10]; the direct engagement within the **SNS JU community working groups** (e.g. SNS-JU Sustainability Task Force); the constructive face-to-face exchanges and collaborative work conducted for two **EuCNC** events; the active participation in technology-focused SNS-JU projects. Combined, these sources and methods offer a complementary view across diverse stakeholders of how societal values and needs are currently represented and operationalised in 6G research and innovation. Here a synthesis of the main findings.

The way social and societal impact of ICTs are generally conceived and approached is important to the cause of sustainability. It emerged how the **impact of ICTs** is rarely addressed beyond the description direct and intended effects of technologies, and is mostly viewed as inherently positive. A particularly interesting context where social implications should be further and more broadly investigated – and with anticipatory approach – is that of **immersive communication.** In this context, the relationship between human, technologies, media and the environment will be subverted, calling for specific reflections. The identification of sensitive ethics and sociological aspects in immersive communication is rooted on interpretative categories and knowledge proper of social theory and media studies, and especially on the notion that communication environments not only determine how contents are produced and conveyed, but they also structure the way audiences perceive and interact with these contents, influencing the relational affordances of society. We have further explained these aspects in chapter 3 of 6G4Society project D1.1 [1].

A narrow awareness and vision on possible societal implications may undermine the substance of *sustainability* actions – **compromising especially the social sustainability** dimension. This narrow framing of impact reflects a more general issue pertaining the **perspective** used to define innovation outlooks and targets.

The analysis of project documents and the collection of expert views through interviews and direct interactions in EuCNC, confirmed a general framework already well elaborated upon by the RRI theory. Innovation **paths appear still shaped by a narrow set of actors and values**, with limited importance attributed to the point of view of non-specialists in defining the trajectories of future technologies, and ultimately, of the future of humanity. This leads to reproducing a vision of the future that reflects **assumptions, visions and priorities** proper of industrial actors. In this cultural and value context, technology tends to be considered as the solution to most of the problems (**techno-solutionism**), universal connectivity is mostly framed as **inherently beneficial**, and **societal progress** tends to be treated as a by-product of technological advancement. Innovation is frequently associated with technological advancement, with the concept of innovation mostly associated to that of technological advancement. Such a vision of the role of technology in society relapses also in the way **social acceptance** is conceived: acceptance is mostly treated as a goal to be achieved, typically through persuading people of the benefits of technology, and reflecting a traditional "**technology push**" model – where companies create demand rather than respond to real societal needs.

Considering that innovation choices shape the boundaries and affordances of future human civilisation, the dominance of a partial perspective raises concerns about the ability to genuinely **capture the diverse needs of society** and to remain responsive to its evolving needs and values.

Shifting from a more strategic level, to the practical and operational one, the work of 6G4Society across SNS-JU projects, combined with insights collected at EuCNC 2025, highlighted that **values represent a terrain of both ambition and challenges for technology projects' practitioners**. Teams have shown difficulty in translating the value dimension into practical management (e.g. understanding what constitutes a social value, which values to identify, where to look for them, how to derive them), with some using user experience as a more accessible – though not appropriate – proxy for societal values. Regarding KVIs, most projects reported significant difficulties engaging with this concept, especially in low-TRL, technology-focused environments. More broadly, regardless of the TRL level, **KVIs are still not being used as a guiding tool for design.**

Finally, **insights regarding sustainability** are derived from active contributions to the analytical work conducted within the SNS-JU Sustainability Task Force, complemented by interviews with national and European policymakers. These findings are further enriched by direct and participatory observations gained through involvement in project consortia activities. A key analytical perspective relates to **how the discourse on environmental and social sustainability is framed**.

Environmental sustainability is mostly framed around the **need to mitigate negative effects**, leading to treat the relation between economic and environmental sustainability as a continuous **trade-off**. Social sustainability, instead, is often framed around a **generic positive assumption** that technologies can solve social problems. This, combined with a still low awareness on the societal implications of ICTs, may lead to overlook important nuances and categories of values, relevant to define social sustainability in the context of future networks and connectivity.

5. Sources

This policy brief synthetises findings from 6G4Society Deliverables D1.1 [1], and D1.3 [74]. In addition, this work draws from activities and outputs realised under WP2 and WP3, and in particular, 6G4Society SNS Survey Report 2024–2025 [10], based on two survey rounds conducted across the SNS JU project community; 6G4Society Insight Report #1 [72]; 6G4Society Insight Report #2 [9].

6. Contact details

For further information, contact CyberSocial Lab. at eu-projects@cybersoclab.com or visit www.6g4society.eu. Project deliverables are publicly available through the 6G4Society Zenodo repository at https://zenodo.org/communities/6g4society.

APPENDIX II - POLICY BRIEF ON SAFEGUARDING PRIVACY IN 6G

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TOWARDS A SOCIALLY ACCEPTED AND SUSTAINABLE 6G

Policy Brief on Safeguarding Privacy in 6G

1. Highlights

Europe's transition toward sixth-generation (6G) mobile network will significantly intensify data collection, as billions of connected humans, devices and digital twins generate continuous and often invisible streams of personal and behavioural information. Citizens already identify privacy as their primary concern for future connectivity, expressing deep concern about surveillance, loss of control, and opaque AI-driven decision-making. Project findings confirm that existing EU privacy and data-protection frameworks, while robust, were not designed for 6G's hyper-connected, distributed and globally interdependent architecture, leaving gaps in user control, profiling governance, accountability, and cross-border safeguards.

Evidence gathered through citizen surveys, expert and policy makers interviews, and Smart Networks and Services Joint Undertaking (SNS JU) project analysis points to five priority risks: erosion of user agency, foreign access to EU data, discriminatory or opaque AI decisions, unclear responsibility across multi-vendor networks, structural tensions among stakeholders with diverging privacy interests, sensing and geolocalisation, privacy and security. These insights underscore that the success of 6G will depend not only on technological progress but on embedding European values such as privacy, fairness, accountability, and sovereignty into its governance and design.

Against this backdrop, this policy brief examines the central question: ***How can Europe safeguard privacy and fundamental rights as 6G networks become more data-intensive, AI-native, decentralised, and reliant on global supply chains?*** It proposes six main recommendations: 1. Restore user control over 6G data processing; 2. Protect EU data sovereignty from cross-border and foreign access risks; 3. Regulate AI-driven profiling and automated decisions; 4. Clarify accountability across complex 6G ecosystems; 5. Reconcile conflicting privacy interests within the value chain; 6. Modernise legal rules for location data; 7. Enforce privacy, data protection and security literacy; 8. Reinforce targeted research and coordinated policy support.

2. Context of the Issue

As 6G will bring together humans with massive instances of IoT, robots, and digital twins, enabling continuous environmental sensing and a dense web of vendors and service providers, all multiplying the personal and behavioural data that can be collected, often automatically and invisibly, policy makers and privacy authorities should be prepared. Although the EU has a robust framework for privacy and data protection including, inter alia, the GDPR, the ePrivacy Directive, the Data Act, and the Cyber Resilience Act, gaps remain. This brief supports policymakers in the implementation of the GDPR, the AI Act, and the EU's wider digital governance agenda (including the Digital Decade targets) by identifying where additional guidance, safeguards, or governance mechanisms will be needed to ensure privacy-preserving and socially acceptable 6G deployment.

Co-funded by the European Union

In this context, the technical architecture of 6G reshapes data flows and responsibilities introducing a series of specific risks.

As defined by the EDPS highlights in blog [30], 5G/6G create environments of continuous, invisible data collection, reducing meaningful consent and control. Such pervasive and invisible data flows risk **eroding personal autonomy**, as individuals **lose track of who** holds their information and for what purpose. Existing models of **consent and control are unlikely to remain effective** when data circulates across countless devices and providers. Current mechanisms for exercising GDPR rights in telecom systems are **fragmented, inconsistent, and difficult to use**. Without transparent and accessible tools that allow people to understand and manage their data, both **individual agency and accountability** will be undermined.

In addition, individuals may find it harder than ever to understand **who processes their data**, especially when parts of the value chain operate **outside the EU**, raising concerns over **data sovereignty** and the exposure of EU citizens' information to foreign jurisdictions. Although the GDPR mechanisms for international data transfers, as well as the EDPB recent guidelines [35] on the requirements for recognising judgments or decisions from third country on personal data transfers, **enforcement of those mechanisms** remains difficult. Moreover, although examples like the joint commitment outlined in [36] to promote trusted technologies that protect national security and individual privacy, and to advance global standards through open, transparent, and consensus-based processes supported by international cooperation, **a sector-specific arrangement** (such as an adequacy decision tailored to telecom data exchange) has yet to be established.

In some cases, 6G networks bring fundamentally new privacy challenges rather than simply extending those of 5G, and existing **policies were not designed with 6G**'s highly distributed architecture or its pervasive sensing capabilities in mind. For example, although 6G will be AI-native, enabling networks to make autonomous, real-time decisions about users and resources, and raising concerns about automated processing and bias, enforcement of GDPR provisions such as Article 22 on **profiling** and **automated decision-making remains uneven in the telecoms sector**. More fundamentally, as 6G networks become AI-native and increasingly rely on zero-touch automation, compliance with the EU AI Act requires **rethinking human oversight as an architectural safeguard embedded by design**, rather than as real-time human intervention. According to [37], automated decision-making and profiling may pose risks to individuals' rights and freedoms, including the possibility of unfair or discriminatory effects and reduced transparency, which can make it difficult for individuals to understand the reasoning behind such decisions and to exercise their GDPR rights. Likewise, current rules provide limited clarity on **how profiling restrictions apply** to large-scale telecom analytics or algorithmic network management, where users might be prioritised or deprioritised without their knowledge.

Moreover, integrated sensing and communication will allow **centimetre-level positioning** and **passive environmental monitoring**, creating the possibility of continuous ambient **surveillance**.

Insights from recent project activities highlight several shortcomings in the current policy landscape. There is **no sector-specific regulation tailored to next-generation telecommunications**, and the overlapping frameworks that do exist often **lack coherence**. This fragmentation increases **accountability challenges**, particularly when multiple vendors handle different components of the same data flow. ENISA guidelines [39] [40] stress the need for supplier risk assessments and clear governance. As outlined [41], there is a concrete risk of unclear responsibility for privacy compliance (who is the controller, who must respond to breaches, etc.). Furthermore, **competing interests** in the 6G value chain (from operators seeking to monetise data, to advertisers demanding greater access, to governments seeking data for law-enforcement purposes) risk creating structural imbalances that undermine fairness

and digital autonomy. Furthermore, while ENISA [42] underlines the importance of a common approach to telecom security for the Digital Single Market, different 6G stakeholders might have conflicting goals. **Competing interests** in the 6G value chain (from operators seeking to monetise data, to advertisers demanding greater access, to governments seeking data for law-enforcement purposes) risk creating structural imbalances that undermine fairness and digital autonomy.

3. Policy Recommendations

3.1. R1 – Restore user control over 6G data processing

Ensuring that individuals can meaningfully control their personal data in 6G environments is fundamental to maintaining trust in next-generation connectivity. Strengthening **user-centric mechanisms** across the ecosystem would prevent situations in which people lose control over their information or cannot effectively exercise their rights, addressing the structural imbalances created by pervasive sensing and fragmented data flows. Enhancing transparency and accessible rights-management tools also aligns 6G with EU principles of fairness, autonomy and accountability, ensuring that individuals understand how their data is handled and can act on that understanding without disproportionate effort. At the same time, clear and **harmonised standards providing requirements for user controls** would provide legal and operational certainty to telecom operators and service providers, allowing them to implement consistent, compliant interfaces for access, consent and redress throughout complex multi-vendor infrastructures. Together, these measures shape a 6G ecosystem that preserves user agency and upholds the EU's commitment to rights-preserving digital innovation. Recommended policy options are the following:

- Create **EU-mandated personal data spaces** for telecom/6G data. **Standardise** interoperable tools allowing users to aggregate and manage permissions for all their 6G-related data.
- Improve GDPR enforcement in telecom contexts introducing **mandatory data controller labelling** for IoT and 6G devices. Mandate physical or digital labels identifying the controller and offering **simple opt-out mechanisms**, e.g., through codes of conduct.
- Support **collective redress mechanisms** for telecom data rights. **Empower consumer organisations** to exercise rights on behalf of groups of users.
- Conduct an EU-wide public **education campaign** on 6G data practices. Provide **transparency** on what data networks collect and how users can manage settings.

3.2. R2 – Protect EU data sovereignty from cross-border and foreign access risks

Strengthening robust safeguards for cross-border data transfers in 6G prevents the **exposure of EU citizens' data** to foreign surveillance regimes, reducing the risk that sensitive information may be accessed or exploited under legal systems that do not meet EU standards. At the same time, it supports **European strategic autonomy** and reinforces core **sovereignty** principles, ensuring that the EU sets the conditions under which personal and operational data may circulate. Recommended policy options are the following:

- Negotiate **telecom-specific international data-exchange agreements**. Embed privacy protections, redress, and auditability in digital partnerships and trade agreements.
- Create **telecom-specific Standard Contractual Clauses** (SCCs). European Telecommunications Network Operators should draft SCC addenda for typical 6G data flows.

- Restrict **high-risk vendors** in data-rich network segments. Build on the 5G Toolbox [38] approach of excluding suppliers subject to foreign interference laws.
- Keep **EU data in the EU whenever possible**, and when not**,** apply **encryption** and legal **safeguards** when data must transit outside the EU.

3.3. R3 – Regulate AI-driven profiling and automated decisions

As 6G networks become AI-native, relying on autonomous optimisation, large-scale behavioural analytics and zero-touch network and service management, **the governance of AI-driven profiling and automated decisions becomes an immediate regulatory and compliance challenge**. In this context, AI systems embedded in 6G infrastructures are not merely consumer-facing applications, but core components of critical digital infrastructure, with direct implications for fundamental rights, fairness, accountability and public trust. Strengthening the regulation of profiling and automated decision-making is therefore essential to **prevent discriminatory network behaviour, opaque prioritisation practices, and unchallengeable outcomes affecting users and non-users** alike. These risks extend beyond individual consumer profiling to systemic effects arising from automated resource allocation, mobility prediction, quality-of-service differentiation and behavioural inference performed at network level. At the same time, the deployment of AI-native, zero-touch network management creates a **structural tension with existing legal requirements** particularly for human oversight. Under the EU AI Act, many AI systems used in 6G network management are likely to fall within high-risk categories (Annex III), triggering binding obligations, including the requirement for effective human oversight (Article 14). However, real-time human intervention in sub-millisecond network operations is technically infeasible and incompatible with network performance guarantees. Recommended policy options are the following:

- Issue **EDPB and AI Act-aligned guidelines** on telecom AI-driven profiling and automated decision-making. Clarify lawful bases, limits, and expectations for profiling via network-derived behavioural patterns.
- Define **sector-specific rules** e.g.**,** prohibiting sensitive inferences on health, religion, political views from telecom-derived data.
- Explicitly recognise **AI-driven 6G network management systems as high-risk AI where applicable**. Provide guidance on how **Annex III and Article 14 on human oversight** of the AI Act apply to AI-native, zero-touch infrastructures.
- Promote **oversight-by-design approaches** as the primary means of complying with human oversight obligations in real-time 6G environments. Include architectural safeguards, predefined policy constraints, monitoring mechanisms and validated fallback modes, rather than real-time human intervention.
- Support **regulatory sandboxes and standardisation efforts** enabling telecom operators, regulators and standards bodies to test and validate compliant oversight architectures for AI-native network management before large-scale deployment.

3.4. R4 – Clarify accountability across complex 6G ecosystems

As 6G networks evolve into highly distributed, multi-vendor ecosystems, reinforcing governance structures becomes essential to maintain trust and legal clarity. Enhancing role assignments, contractual obligations, and oversight mechanisms would **strengthen accountability in data-rich multi-vendor 6G systems**, ensuring that each actor's responsibilities are clearly defined, consistent, and enforceable. Such measures also help **reduce disputes and improve breach handling**, enabling faster coordination, clearer escalation paths, and more effective remediation when incidents occur. By clarifying who is responsible for which processing operations, they **increase users' ability to identify the parties accountable for their data**, supporting meaningful rights exercise in complex infrastructures. At the same time, harmonised accountability models and transparent role delineation would **enable regulators to audit complex infrastructures effectively**,

equipping supervisory authorities with the tools needed to assess compliance across interdependent supply chains. Together, these steps are crucial to securing a trustworthy and rights-preserving 6G ecosystem. Recommended policy options are the following:

- Develop **standard contractual frameworks or approved codes of conduct** for 6G data-processing chains. Define **sector-wide templates** for controller–processor responsibilities, breach notifications and data subject request handling.
- Publish **6G processing scenario catalogues** (via e.g., EDPB opinions). Identify **pre-approved models** clarifying role assignments in typical 6G contexts.
- Create a **GDPR Art. 42 certification scheme** for 6G service providers. Requires transparency on roles, vendor oversight, and cooperation mechanisms.

3.5. R5 – Reconcile conflicting privacy interests within the value chain

In a 6G landscape where commercial incentives, state security interests, and user rights increasingly collide, **coordinated governance** is essential to safeguard fundamental values. A balanced and coherent policy approach is needed to avoid privacy being systematically overshadowed by commercial or state interests, ensuring that economic or security objectives do not undermine individual autonomy or trust. Strengthening **harmonisation** across Member States on how national security exceptions are applied would reinforce **EU cohesion, reducing fragmentation** and ensuring that privacy protections remain consistent even in sensitive contexts. At the same time, clearer rules and oversight mechanisms can promote legitimate data uses while preventing exploitative or rights-eroding practices, enabling innovation without enabling misuse. By embedding these principles into the regulatory and operational framework for next-generation networks, policymakers can facilitate the socially acceptable deployment of 6G, ensuring that the technology evolves in ways that command public confidence and reflect European democratic values. Recommended policy options are the following:

- **Harmonise EU rules** on public authority access to telecom data. Ensure consistent safeguards and minimisation principles.
- Use **trade and procurement policy** to mitigate conflicting foreign laws. Require vendors to disclose foreign government access obligations or to avoid suppliers subject to such laws.
- Create a permanent **multi-stakeholder 6G ethics and governance forum** coordinated for instance by the EC or ENISA that bring together telecoms, civil society, regulators, and law enforcement to shape guidelines (e.g., prohibiting social scoring or pervasive tracking).

3.6. R6 – Modernise legal rules for location data

6G networks introduce Integrated Sensing and Communication (ISAC), so that 6G networks will natively combine communication with environmental sensing capabilities, enabling centimetre-level positioning accuracy and passive objective detection. This means networks can continuously monitor physical spaces and user movements with unprecedented precision, potentially enabling invasive profiling and ambient surveillance even of non-subscribers. The ePrivacy Directive governs location data, but it was drafted before such precision was possible. Current regulations do not adequately limit the collection, retention, or secondary use of fine-grained geolocation data. Recommended policy options are the following:

- Strengthen **location-privacy rules** to reflect increased precision and potential intrusiveness. This should ensure that regulatory safeguards keep pace with the far more granular sensing capabilities expected in 6G.
- Provide **clear DPA guidance** specifying that any secondary use of 6G location data must meet strict legal requirements, including necessity, proportionality, and user

consent. Such guidance would give operators and service providers unambiguous expectations and reduce inconsistent interpretations across jurisdictions.
- Limit **access to 6G location data**, requiring case-by-case judicial authorisation and independent oversight for real-time tracking. This would help prevent disproportionate surveillance practices and reinforce democratic accountability.

3.7. R7 – Enforce privacy, data protection and security literacy

A limited public understanding of how 5G and 6G systems process personal data creates a silent yet systemic ethical risk. The opacity of these infrastructures weakens informed consent and public trust as they increasingly permeate everyday life through IoT, AI, and edge computing. Developers also tend to conflate privacy, data protection, and security, reducing ethical and legal questions to technical fixes and enabling systems that may be secure but still infringe fundamental rights. No dedicated ethics framework exists for 5G/6G, while public communication remains fragmented and overly technical. As a result, citizens lack accessible information and meaningful avenues to participate in data governance and policy design. Recommended policy options are the following:

- Require 6G operators to activate all standardised **security features** under the European Electronic Communications Code (EECC); **prohibit use or sale of exploitative tools** except for authorised bodies.
- Ensure **democratic access** to information on 6G and promote critical thinking through digital and data-literacy initiatives.
- Foster **university-level education and training programmes** to give developers a clear, shared understanding of the distinct yet complementary roles of privacy, data protection, and security.
- Establish an **Ethics Framework for 6G** to guide responsible innovation, driven by values, and rights-based deployment.
- Adopt **KVIs** to assess the wider sustainability and societal impacts of 5G/6G technologies.
- Promote **accountability and trustworthiness** among all actors in the 5G/6G ecosystem.
- Improve **communication of 6G benefits and risks** to ensure informed public engagement.

3.8. R8 – Reinforce targeted research and coordinated policy support

In conclusion, targeted research and coordinated policy support are needed to address the full set of challenges identified across the five priority risk areas. The next EU research framework should therefore include **dedicated CSA calls** designed to equip policymakers, regulators, data protection authorities, and standards bodies with the evidence, guidance, and operational frameworks required to act on these recommendations. These CSA should promote the following activities:

- **Conduct interdisciplinary legal and social-science deep research** on user control, algorithmic decision-making, profiling restrictions, cross-border transfers, sovereignty implications in 6G environments, and ultra-precise localization tracking.
- **Identify specific accountability gaps** caused by multi-vendor distributed infrastructures, opaque data flows, and automated network management.
- **Deep EU guidance for telecom-specific interpretations** of GDPR provisions (e.g., Article 22) and security standards, profiling limits, and responsibilities in shared data processing scenarios, defining **KVIs** to assess the wider sustainability and societal impacts of 6G technologies on privacy and data protection.

- **Produce policy blueprints** for sector-specific rules tailored to next-generation connectivity, supporting coherent regulation and enforceable responsibilities across the 6G value chain.
- **Define a code of conduct, an Ethics framework for 6G and a certification scheme** for 6G service providers as well as **training programs** for university-level education.
- Providing **clear, accessible information on 6G impacts** through public outreach, education, and transparent reporting.

4. Evidence and analysis

The project's findings are based on a triangulation of quantitative (surveys), qualitative (interviews and workshops), and desk-research methods, ensuring robustness and alignment between citizen, expert, and institutional viewpoints. Survey responses reflect the perceptions of participants rather than the full EU population, while evidence from SNS JU projects represents early-stage research rather than deployed infrastructures. Nevertheless, the extensive combination of scientific literature, citizen surveys, participatory workshops, interviews with industry practitioners and experts in acceptance, 6G, green ICT, smart cities and sustainability, as well as consultations with policymakers and engagement within the SNS JU community, provides complementary academic, civic, and institutional perspectives on how societal values are currently represented and operationalised in 6G research and innovation, and where alignment with EU frameworks such as the GDPR and the AI Act may require further action.

Across these activities, **privacy consistently emerged as the value most at risk** in the 6G context. Survey data indicate that 47% of citizens view privacy and data protection as their top concern for future connectivity, highlighting anxieties about **pervasive sensing, surveillance, and opaque uses of personal data**. Workshop participants echoed these concerns, emphasising the need for transparency, meaningful consent, and limits on AI-driven decision-making. SNS JU projects further substantiated these trends, with over 70% identifying privacy as a priority, particularly in relation to **sensing technologies, data ownership, and the use of network data for AI training**. Expert interviews confirmed a broader shift from traditional privacy concerns to deeper anxieties about **surveillance architectures, algorithmic control, and the erosion of digital autonomy**. These findings closely correspond to the **priority risks** outlined above.

5. Sources

This policy brief synthetises findings from 6G4Society Deliverables D1.1 [1], and D1.3 [74], as well as WP2 and WP3 outputs on stakeholder engagement and liaison with the SNS JU community. It draws on EU legal frameworks including GDPR, ePrivacy, Data Act, AI Act, Cyber Resilience Act, European Electronic Communications Code (EECC), as well as EU policies, strategies, guidelines and recommendations including Digital Decade 2030 (by DG CNECT), Cybersecurity of 5G networks (by EC), WP29 and EDPB guidelines and opinions, EU Toolbox for 5G Security and other ENISA reports.

6. Contact details

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APPENDIX III - POLICY BRIEF ON ENSURING INCLUSION-BY-DESIGN FOR 6G

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TOWARDS A SOCIALLY ACCEPTED AND SUSTAINABLE 6G

Policy Brief on Ensuring Inclusion-by-Design for 6G

1. Highlights

Inclusion is a core European value and precondition for the legitimacy of sixth-generation (6G) mobile network deployment. As digital connectivity increasingly mediates healthcare, education, work, and civic participation, access and use now determine who can exercise democratic rights and access essential services. 6G's deeper integration with critical infrastructure will amplify these dynamics unless inclusion is embedded from the outset. Findings from the 6G4Society project show 45 percent of surveyed citizens identified inclusion and access as top priorities for future digital development, linking connectivity to social justice and quality of life [2]. Without proactive measures, next-generation networks risk reproducing and amplifying current patterns of exclusion, concentrating opportunity among already advantaged populations while deepening the marginalisation of vulnerable groups.

Project key findings confirm that persistent gaps in current connectivity generations threaten to be replicated or worsened in 6G deployment. Rural and peripheral territories remain underserved, affordability provisions are uneven, and skills gaps persist among older adults, jobseekers, low-income households. Accessibility standards are only partially implemented, while citizens reported limited participation in infrastructure decisions. Evidence gathered through citizen surveys, expert interviews, and Smart Networks and Services Joint Undertaking (SNS JU) project analysis reveals that inclusion remains a widely articulated public expectation but an underdeveloped dimension of current research and deployment practice [2] [3] [4]. These insights underscore that the success of 6G will depend not only on technical performance but on embedding European values such as fairness, cohesion, and democratic legitimacy into its governance and design [75].

This policy brief examines: ***How can Europe ensure that 6G deployment serves all citizens rather than reproducing existing patterns of digital exclusion?*** It proposes six main recommendations: 1. Guarantee equitable infrastructure access and affordability; 2. Build sustainable local digital-skills ecosystems; 3. Implement outcome-focused monitoring and intervention; 4. Embed accessibility-by-design across 6G systems and services; 5. Strengthen participatory governance and procedural justice; 6. Reinforce targeted research and coordinated policy support.

2. Context of the Issue

As Europe prepares for 6G, inclusion has become a strategic test of fairness and cohesion. Connectivity is no longer a purely technical or commercial matter but the infrastructure through which individuals participate in modern life. In this context, exclusion from high-quality networks increasingly means exclusion from essential services and democratic processes.

European policy frameworks already acknowledge these challenges. The **Digital Decade Policy Programme** [54] sets binding targets for gigabit connectivity and digital skills by 2030;

the **Gigabit Infrastructure Act** accelerates deployment [56]; the **European Electronic Communications Code** provides for universal service and affordability [57]; and the **Digital Education Action Plan**, the **European Accessibility Act**, and the **Web Accessibility Directive** outline pathways for skills and accessibility [76]. Yet implementation remains uneven. Rural regions continue to experience coverage and quality deficits, affordability mechanisms such as social tariffs vary widely, skills initiatives are fragmented. Current accessibility provisions address existing technologies; as 6G introduces new interaction modalities, these standards will need to evolve accordingly to ensure inclusive design from the outset. Monitoring remains focused on infrastructure deployment rather than on whether connectivity produces tangible benefits.

6G4Society engagement activities indicate **inclusion is among the highest public priorities** for 6G. Surveys and workshops reveal citizens associate connectivity with equality of opportunity and rural community viability. Many expressed frustrations at infrastructure decisions made without consultation and at what they perceive as an urban bias in technological investment. Expert interviews with researchers and project leaders reinforced these concerns, highlighting the neglect of distributive justice (who benefits versus who bears burdens) and procedural justice (whether affected communities have a genuine voice) [3].

Understanding these dynamics requires moving beyond an oversimplified notion of a “digital divide” as merely connected versus unconnected. Two decades of research shows digital inequality unfolds across multiple layers. Even among connected users, differences in skills, literacy, and confidence determine how effectively they benefit, while those with greater social and economic resources consistently derive larger gains. Scholars including such as Jan Van Dijk, Eszter Hargittai, Ellen Helsper, and Mark Warschauer, reveal that inclusion depends on reinforcing conditions: access, skills, and outcomes must advance together [43], [77], [44], [45], [46].

Within 6G4Society, **inclusion is therefore understood as the set of conditions that enable all individuals and communities to participate meaningfully in digital life**. It encompasses the capability to use technologies safely and autonomously, achievement of equitable outcomes across life domains, universal accessibility regardless of ability, and the exercise of voice in decisions shaping digital infrastructures. Inclusion, in this sense, is not a technical endpoint but a governance principle essential to 6G legitimacy.

The transition to 6G will magnify consequences of inaction. Early deployments will likely concentrate in profitable urban corridors and industrial zones, while AI-native architectures and advanced interfaces will demand higher digital literacy. Unless policy treats inclusion as a guiding criterion from the outset, Europe risks a two-speed digital society where some enjoy high-performance connectivity while others remain confined to outdated infrastructure and limited opportunity.

3. Policy Recommendations

Aligning 6G deployment with Europe’s social model requires policy action across six mutually reinforcing dimensions: infrastructure access and affordability, sustainable digital skills ecosystems, outcome-focused monitoring and intervention, accessibility by design, and participatory governance.

3.1. R1 – Guarantee equitable infrastructure access and affordability

Universal access to high-quality 6G infrastructure at affordable prices is fundamental to preventing reproduction of existing digital divides. Without binding deployment obligations and affordability safeguards, 6G rollout will concentrate in profitable urban areas, leaving rural and peripheral communities with outdated infrastructure. Strengthening access and affordability

mechanisms prevents geographic location or economic status from determining who benefits from next-generation connectivity. Clear, **harmonised requirements** for universal service and **social tariffs** provide legal and operational certainty to telecom operators while fulfilling social obligations.

Policy options:

- Attach **binding rural deployment obligations to spectrum awards**, requiring operators to meet specific deployment milestones with quality-of-service standards in underserved areas.
- Establish **transparent public reporting mechanisms** allowing citizens and local authorities to track infrastructure deployment progress and quality metrics.
- Create a **harmonised European affordability framework** setting common principles for social tariffs and device access schemes across Member States.
- Ensure vulnerable households can obtain **fixed and mobile broadband at sustainable prices** through standardised affordability mechanisms.
- Use Union-level funding instruments (Recovery and Resilience Facility, Connecting Europe Facility) to support **affordability programmes and backhaul infrastructure** in market-failure areas.

3.2. R2 – Build sustainable local digital-skills ecosystems

Addressing persistent digital skills gaps requires moving beyond fragmented, short-term training toward sustainable community-based learning ecosystems. As 6G introduces AI-native architectures and advanced interfaces, **higher digital literacy** will be essential for meaningful participation. Without structured, locally embedded skills initiatives, existing inequalities will widen, leaving older adults, jobseekers, low-income households, and vulnerable groups unable to benefit. Building sustainable skills ecosystems ensures all citizens can use 6G technologies safely, autonomously, and effectively, transforming infrastructure access into genuine capability.

Policy options:

- Develop **community-based digital skills** learning networks offering modular training and recognised micro-credentials across Member States.
- Build on the Digital Education Action Plan with **stronger operational support and dedicated EU co-funding** for local skills initiatives.
- Integrate **digital-skills assistance routinely** into employment and social services, providing tailored support based on individual needs and contexts.
- Design **public digital platforms** for usability by people with basic competencies, reducing barriers to accessing essential services.
- Establish **common indicators** tracking progress in digital skills by age, income, education, and disability, enabling comparison and improvement across the Union.

3.3. R3 – Implement outcome-focused monitoring and intervention

Shifting from infrastructure-centric to outcome-focused monitoring is essential to ensure 6G deployment produces **tangible improvements in citizens' lives**. Current frameworks emphasise network coverage and speeds but rarely assess whether connectivity translates into real improvements in employment, education, health, and civic participation. Without outcome-focused indicators, policymakers lack evidence to identify persistent inequalities or evaluate intervention effectiveness. Strengthening outcome monitoring reveals which groups and regions benefit from 6G and which remain excluded, enablingope targeted interventions addressing root causes.

Policy options:

- Include **outcome-focused indicators** in the Digital Decade framework assessing whether connectivity translates into real improvements in employment, education, health, and civic participation.
- Disaggregate data by region and social group, **reporting publicly** each year to enable tracking of persistent inequalities.
- Require **social-impact assessments** to accompany major 6G deployments, evaluating how benefits and burdens are distributed across different populations.
- Create a **shared data infrastructure for digital-outcome research** helping identify persistent inequalities and inform targeted interventions.
- Support **longitudinal studies** tracking how different population groups use and benefit from 6G over time.

3.4. R4 – Embed accessibility-by-design across 6G systems and services

Ensuring 6G technologies are accessible to persons with disabilities and older adults from earliest development stages is both a legal obligation and social imperative. Current accessibility provisions designed for existing technologies **require updating to address interaction modalities** 6G may introduce. Without accessibility by design, next-generation networks will reproduce and amplify existing barriers, preventing millions of Europeans from accessing essential services. Strengthening accessibility requirements ensures 6G serves all citizens regardless of ability. Clear regulatory expectations, co-design requirements, and periodic audits provide legal certainty while ensuring accountability.

Policy options:

- Extend implementation of the European Accessibility Act, Web Accessibility Directive, and harmonised standard EN 301 549 to cover emerging 6G-related applications, from network management and evidence of **co-design with organisations representing persons with disabilities** and older adults in research projects, public procurement, and regulatory approvals.
- Conduct **periodic accessibility audits** by regulators with public reporting and mandatory remediation of identified gaps.
- Create **dedicated innovation sandboxes** for assistive technologies using 6G capabilities (real-time captioning, haptic feedback, AI-based personalisation) to accelerate inclusive innovation.
- Mainstream **accessibility best practices** across the sector through knowledge sharing and technical guidance.

3.5. R5 – Strengthen participatory governance and procedural justice

Ensuring affected communities have meaningful voice in infrastructure decisions is fundamental to democratic legitimacy and social acceptance of 6G deployment. Current consultation processes often occur too late to influence design, use inadequate formats, or fail to reach marginalised populations. Without **genuine participatory governance**, 6G rollout will be perceived as imposed from above, eroding public trust. The Aarhus Convention establishes the right to public participation in environmental decision-making, applicable to telecommunications infrastructure given its environmental and territorial implications. Strengthening participatory mechanisms ensures infrastructure decisions reflect local needs, values, and concerns.

Policy options:

- Develop **EU and national guidance on public consultation** for telecommunications infrastructure setting minimum standards for early information, accessible documentation, realistic response times, and transparent consideration of public input.
- Create **open digital portals where citizens can access** deployment plans, site proposals, and related assessments, submit comments, and follow how feedback is addressed.
- Provide **technical and financial support to rural and peripheral communities to participate** effectively in infrastructure decisions.
- Establish community-benefit arrangements ensuring that hosting infrastructure translates into **tangible local opportunities** (improved connectivity, literacy programmes, digital-service hubs).
- Require demonstration of **genuine engagement with affected communities as condition** for planning approvals and spectrum awards.

3.6. R6 – Reinforce targeted research and coordinated policy support

Targeted research and coordinated policy support are needed to address the full set of challenges identified. The next EU research framework should include a dedicated **CSA call** to equip policymakers, regulators, data protection authorities, and standards bodies with evidence, guidance, and operational frameworks required to act on these recommendations. This CSA should promote:

Policy Options:

- Consolidate **evidence and benchmarks on inclusion gaps**; develop **operational guidance** for a 6G inclusion governance model.
- Coordinate **cross-institutional collaboration** between regulators, data-protection authorities, standards bodies, and local administrations, ensuring coherent policy action across the Union.
- Facilitate **participatory methodologies and co-design practices** with citizens, vulnerable groups, and local communities, strengthening procedural justice in 6G-related decision-making.
- Build shared data infrastructure and analytical tools enabling disaggregated monitoring of 6G inclusion outcomes, **supporting regulators and policymakers** with timely, high-quality evidence.

4. Evidence and analysis

Project findings are based on triangulation of quantitative (surveys), qualitative (interviews and workshops), and desk-research methods, ensuring robustness and alignment between citizen, expert, and institutional viewpoints. Survey responses reflect participant perceptions rather than the full EU population, while evidence from SNS JU projects represents early-stage research rather than deployed infrastructures. Nevertheless, the extensive combination of scientific literature, citizen surveys, participatory workshops, interviews with practitioners and experts in acceptance, 6G, green ICT, smart cities and sustainability, consultations with policymakers, and engagement within the SNS JU community provides complementary academic, civic, and institutional perspectives on how societal values are currently represented and operationalised in 6G research and innovation.

Citizen surveys showed 45% of respondents viewed **inclusion and access as key priorities for future connectivity**. Participants highlighted persistent **coverage gaps**, particularly in rural and natural-park areas, and expressed concern that advanced mobile generations benefit urban centres while neglecting those in precarious conditions. Workshops linked connectivity directly to social **justice, equality of opportunity, and community sustainability**.

Expert interviews emphasised the importance of **distributive and procedural justice**, noting that **stakeholder engagement** in technological development often occurs too late to influence design. Consultations with research and innovation projects confirmed that while many acknowledge inclusion as relevant, **few operationalise it** beyond basic access metrics.

The evidence converges on a clear conclusion: inclusion remains a widely articulated public expectation but an **underdeveloped dimension** of current research and deployment practice. Treating it as a **governance principle**, integrating access, skills, equitable outcomes, accessibility, and participation from earliest development stages, is essential to ensuring 6G delivers on Europe's commitment to fairness, cohesion, and democratic legitimacy.

5. Sources

This policy brief synthetises findings from 6G4Society Deliverables D1.1 [1], and D1.3 [16], as well as related outputs under WP2 and WP3. It draws on EU policy frameworks including the Digital Decade Policy Programme, the Gigabit Infrastructure Act, the European Electronic Communications Code, the Digital Education Action Plan, the European Accessibility Act, the Web Accessibility Directive, and the Aarhus Convention on public participation in environmental matters.

6. Contact details

For further information, contact CyberSocial Lab. at eu-projects@cybersoclab.com or visit www.6g4society.eu. Project deliverables are publicly available through the 6G4Society Zenodo repository at https://zenodo.org/communities/6g4society.

APPENDIX IV - POLICY BRIEF ON SECURING EUROPE'S TECHNOLOGICAL SOVEREIGNTY IN 6G

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TOWARDS A SOCIALLY ACCEPTED AND SUSTAINABLE 6G

Policy Brief on Securing Europe's Technological Sovereignty in 6G

1. Highlights

Europe's technological sovereignty in sixth-generation (6G) mobile network is at risk. Current analysis shows that Europe still produces only around 10% of the world's semiconductors and remains highly dependent on imports for many critical digital technologies [78], while leading-edge chips are manufactured entirely outside European borders [79], [80]. The global telecommunications equipment market is dominated by a small number of large suppliers – especially Huawei, Ericsson, and Nokia - creating oligopoly conditions that limit European strategic choices and increase vulnerability to supply-chain disruptions [81].

While citizen surveys revealed concerns about Europe's competitive position, network reliability, and dependence on external actors, expert consultations with Smart Networks and Services Joint Undertaking (SNS JU) projects confirmed six critical vulnerabilities requiring policy intervention: supply chain dependencies in critical components, fragmentation of global standards processes, risks of foreign government access to European infrastructure, integration with critical sectors creating cascading failure risks, regulatory fragmentation across Member States, and insufficient European capacity for independent technical assessment.

These findings underscore that 6G's success depends not only on technological performance but on ensuring Europe can design, deploy, and govern networks in line with its democratic values while maintaining security and economic competitiveness. Against this backdrop, this brief proposes examines the following question: ***How can Europe develop technological sovereignty for 6G that strengthens security, embeds European values, and maintains global interoperability without resorting to technological isolation?*** It proposes six priority recommendations: 1. Strengthen supply chain resilience through targeted investment in European capacity for semiconductors, software, and manufacturing equipment while maintaining cooperation with trusted partners; 2. Build European governance capacity for independent 6G technical assessment, reducing dependence on vendor expertise for critical security and sovereignty decisions; 3. Coordinate European positions in global standards bodies to embed privacy, transparency, and democratic governance principles in technical specifications from the outset; 4. Enhance protections against foreign government access and interference through strengthened security frameworks adapted for AI-native, cloud-based 6G architectures; 5. Harmonise Member State approaches to vendor security, spectrum allocation, and deployment requirements, eliminating vulnerabilities created by regulatory fragmentation; 6. Develop specialised expertise for 6G governance through training programs, research support, and capacity building enabling effective democratic oversight.

2. Context of the Issue

The debate on technological sovereignty has intensified following the COVID-19 pandemic, supply chain disruptions, and rising geopolitical tensions that exposed **Europe's deep dependencies on foreign technologies** for connectivity, cloud services, and

semiconductors. In response, the European Union updated its Industrial Strategy and embraced the concept of "**open strategic autonomy**", seeking to reduce critical dependencies while remaining engaged in global cooperation, maintaining interoperability, and supporting standards-based development [82].

Unlike previous mobile generations that primarily served communications, 6G is being designed as **AI-native infrastructure deeply integrated with critical sectors** including energy, transportation, healthcare, and financial systems. This integration creates novel **vulnerabilities** where foreign control over components or data flows could enable economic coercion, espionage, or disruption of essential services.

Europe has established instruments [79] including the EU Chips Act, the 5G Security Toolbox [83], the NIS2 Directive [84], and STEP to address sovereignty concerns [85]. However, **significant gaps** remain: comprehensive supply chain mapping for 6G components, sufficient regulatory expertise to govern AI-native networks, coordinated European strategy in global standards bodies, frameworks addressing foreign interference in cloud-based architectures, harmonised Member State security approaches, and integrated critical infrastructure resilience mechanisms.

Analysis within 6G4Society reveals that while citizens rarely used "technological sovereignty" terminology, they expressed **concerns about Europe's competitive position, dependence on external actors, network reliability, and regulatory lag**. Expert consultations with SNS JU projects confirmed these concerns operationally: **geopolitical competition** risks fragmenting 6G into incompatible regional standards, with governance models embedded in technical specifications shaping how rights and security are distributed [3]. Experts emphasised that sovereignty means retaining **capacity to embed European values** (e.g., transparency, privacy, democratic governance) in 6G design while balancing innovation needs with regulatory safeguards [3].

Within this context, technological sovereignty for 6G encompasses Europe's capacity to make **autonomous, democratically accountable decisions** about 6G development and governance while remaining interoperable and globally engaged. It operates across **industrial capacity** (semiconductors, software, equipment, security autonomy (preventing foreign control, maintaining verification capability), and **value integration** (embedding European commitments to rights, privacy, transparency in technical design). This aligns with the EU's "open strategic autonomy" approach, distinguishing European sovereignty from close, nationalist strategies that risk fragmentation and isolation [82].

3. Policy Recommendations

Aligning 6G with Europe's vision of technological sovereignty requires coordinated action across six interconnected areas, from supply chain resilience to specialised governance expertise.

3.1. R1 – Strengthen 6G supply chain resilience and critical industrial capacity

Europe's reliance on non-European suppliers for advanced semiconductors, manufacturing equipment, and key software components creates vulnerabilities to supply disruptions, geopolitical tensions, and strategic dependencies that could compromise autonomous decision-making. While the EU Chips Act [86] and IPCEI mechanisms [87] address strategic dependencies in semiconductors and microelectronics generally, and mapping exercises have identified 137 products in sensitive ecosystems with high external dependencies [88], these efforts have not yet been extended to the specific requirements of 6G networks. The telecommunications sector requires **dedicated supply chain resilience frameworks** that address 6G-specific components including RF equipment, AI accelerators for network

intelligence, and software-defined networking infrastructure. Building European capabilities while maintaining cooperation with **trusted partners** enables strategic autonomy without technological isolation.

Recommended policy options:

- To mitigate the risk of heavy dependence on external suppliers, adopt **a coordinated 6G governance framework**, aligning Member State policies and fostering a diverse industrial ecosystem that **links innovation with sovereignty**.
- Regulation should clarify accountability and liability across complex, multi-vendor systems, supported by **independent certification and transparent reporting**.
- Foster public **trust enforcing** clear responsibility, openness, and citizen engagement, to ensure that connectivity remains a public good, not a private monopoly.
- Embed **cooperation with democratic partners and empower communities** through transparency and inclusion, so that Europe can turn technological autonomy into a form of shared governance, achieving resilience not through isolation, but through fairness, openness, and collective trust in its digital future.

3.2. R2 – Build independent European governance capacity for 6G oversight

The complexity of AI-native, software-defined 6G networks will significantly exceed current regulatory expertise in most Member States. Existing EU bodies do provide important foundations: ENISA offers extensive technical guidance through the EU 5G Toolbox [38], 5G Threat Landscape [89] [39], 3GPP security guidance for regulators [90], and 5G Security Controls Matrix [91] while BEREC facilitates regulatory coordination and knowledge exchange through its 5G Radar [92] and associated reports [93]. The NIS Cooperation Group has established strategic cybersecurity coordination for 5G networks through the EU coordinated Risk Assessment and 5G Toolbox [31].

However, all these frameworks remain focused primarily on 5G, not the architectural transformations introduced by 6G, including native AI integration, distributed network intelligence, quantum-resistant cryptography, and software-defined 6G architectures. European institutions – regulators, data-protection authorities, and security agencies – currently lack specialised training in these areas, a gap confirmed by ENISA's cybersecurity skills reports and European Cybersecurity Skills framework [94] [95]. This emerging capacity deficit risks undermining democratic oversight and increasing reliance on the very entities being regulated as 6G deployment approaches.

Recommended policy options:

- Develop a coordinated governance ecosystem for 6G that **combines expertise, oversight, and innovation**.
- Establish a governance hub to **train regulators and policymakers** in the technical, security, and sovereignty dimensions of next-generation networks.
- Create an **independent assessment capability** to analyse system vulnerabilities through research and public-private partnerships.
- Launch a governance innovation programme to **design democratic oversight models** suited to AI-driven, software-defined infrastructures.
- Support these efforts through **a knowledge-sharing and expertise-exchange platform** linking national authorities and European institutions, ensuring consistent understanding, accountability, and resilience across the 6G policy landscape.

3.3. R3 – Lead in global 6G standards development to embed European values

While European companies are key participants in 3GPP, ITU, and ETSI standards processes [96], the EU still lacks a 6G-specific strategy for systematically translating its legal and ethical requirements into coordinated positions in these fora. The 2022 EU Strategy on Standardisation outlines a values-based approach and calls for stronger coordination, but it measures remain general and not tailored to 6G technical specifications [97]. Existing initiatives such as the EU Standardisation Booster provide project-level support, yet there is no dedicated long-term mechanism to sustain European expert leadership in 6G standardisation [98]. Civil-society organisations also note that current system provides limited venues for public-interest oversight, calling for more democratic governance of standardisation [99]. As major global actors explore separate 6G standards pathways, this lack of sustained support and oversight increases the risk that European legal and ethical requirements will not be fully reflected in future technical architectures [96].

Recommend policy options:

- Establish a **standards leadership initiative with dedicated support for regional experts** to take leading roles in global 6G standards development.
- Create a **values-based standards framework** requiring that positions in international technical negotiations include human rights, privacy, and ethical impact assessments to ensure technology aligns with democratic principles.
- Implement a **reference implementation programme offering open-source** versions of proposed standards to demonstrate technical feasibility, encourage global uptake, and provide non-proprietary alternatives that foster openness and interoperability.

3.4. R4 – Enhance protections against foreign government access and interference

Existing frameworks including the 5G Security Toolbox and NIS2 Directive already provide common approaches to vendor risk assessment and cybersecurity obligations for 5G networks and other essential services [100] [84]. However, they were conceived for current generations of networks and do not yet systematically address the specific threat model of AI-native, cloud-based 6G architectures – including large-scale virtualisation, pervasive remote-management functions and more complex software supply chains. The EU's coordinated 5G risk assessment and subsequent toolbox already highlight non-technical vulnerabilities, such as dependencies on suppliers subject to third-country laws and possible foreign interference through those suppliers. In parallel, European case law and guidance on international data transfers, notably *Schrems II* and the EDPB's Guidelines on Article 48 GDPR, emphasise the systemic risk of foreign government access to data via extra-territorial legal orders [101], [35]. As 6G would become tightly integrated with critical infrastructures in sectors such as energy, transport, healthcare and finance, these combined technical and legal exposure points could enable not only surveillance, but also disruption of essential services if not proactively mitigated.

Recommend policy options:

- Reinforce the 5G Security Toolbox and NIS2 Directive implementation by explicitly **addressing foreign technical exploitation risks, including** supply chain vulnerabilities, covert data channels, or software backdoors, within a coordinated 6G security framework. Building on existing provisions on supplier risk Toolbox and third-country influence, these measures should be translated into clear, verifiable safeguards and certification schemes applicable across Member States.
- To guarantee coherence and oversight, the EU should strengthen ENISA's mandate under **the Cybersecurity Act,** or establish a joint coordination mechanism with **BEREC** and national authorities to manage certification, intelligence-sharing, and

audits related to cybersecurity, foreign interference, and technological sovereignty in 6G networks.

3.5. R5 – Harmonise Member State approaches to 6G security and deployment

Despite common EU objectives, Member State implementation of the 5G Security Toolbox remains uneven. While a majority of countries are applying or preparing restrictions on high-risk vendors, others have not yet taken equivalent steps, and security aspects are still not addressed in a fully concerted manner across the Union [102], [103]. This fragmentation may create vulnerabilities that malicious actors can exploit, increases compliance costs for operators working across borders, and weakens overall European security. Differences in national approaches to spectrum assignment, vendor restrictions, and security obligations similarly undermine the coherence required for effective technological sovereignty in 6G [102].

Recommended policy options:

- Strengthen technological sovereignty in 6G by transforming existing coordination into a **binding, coherent framework**. Building on current EU programmes, Member States should align decisions on security, vendors, and spectrum through a **formal consultation mechanism**.
- Evolve the 5G Security Toolbox into a **unified 6G security and resilience framework** with common vendor assessments and restrictions. Regulatory capacity should be reinforced, ensuring all authorities can **enforce standards**.
- Clear **accountability rules and a shared monitoring system** under the Digital Decade framework would prevent fragmentation and safeguard collective European resilience

3.6. R6 – Reinforce targeted research and coordinated policy support

Addressing technological sovereignty challenges requires both dedicated researches to develop evidence-based frameworks and systematic capacity building to enable implementation. Without coordinated support, European regulators and policymakers risk dependence on external expertise for critical decisions. The next EU research framework should include a dedicated CSA call equipping policymakers, regulators, and standards bodies with the evidence and operational capacity needed to act on these recommendations.

Recommended policy options:

- Conduct **interdisciplinary research** on supply chain resilience, standards governance, security frameworks, and accountability in AI-native 6G architectures.
- Develop **EU guidance for telecommunications-specific** security certification, vendor assessment methodologies, and standards participation strategies.
- Produce **policy blueprints for sector-specific rules**, including codes of conduct and certification schemes for 6G service providers.
- Establish a European **6G governance hub** providing specialised training for regulators, policymakers, and data protection authorities.
- Strengthen EU's ability to independently **assess 6G technologies**, develop **governance expertise** and facilitate **structured knowledge exchange** with regulatory authorities.

4. Evidence and analysis

The project's findings are based on a triangulation of quantitative (surveys), qualitative (interviews and workshops), and desk-research methods, ensuring robustness and alignment between citizen, expert, and institutional viewpoints. Survey responses reflect the perceptions

of participants rather than the full EU population, while evidence from SNS JU projects represents early-stage research rather than deployed infrastructures. Nevertheless, the extensive combination of scientific literature, citizen surveys, participatory workshops, interviews with industry practitioners and experts in acceptance, 6G, green ICT, smart cities and sustainability, as well as consultations with policymakers and engagement within the SNS JU community, provides complementary academic, civic, and institutional perspectives demonstrating where current frameworks require strengthening to align 6G development with European sovereignty objectives.

Desk research examined EU policy documents on industrial strategy, open strategic autonomy, cybersecurity, and digital regulation, tracing how European policy **thinking evolved from viewing telecommunications primarily as market competition to treating digital infrastructure as strategic assets** with direct implications for security, democracy, and economic resilience. Analysis of the EU Chips Act, 5G Security Toolbox, NIS2 Directive, and related frameworks revealed the gaps identified in this brief.

Empirical engagement complemented this analysis. Citizen surveys revealed **concerns about Europe's competitive position in digital infrastructure, dependence on external actors, network reliability, and regulatory capacity** to keep pace with technological change. While citizens rarely used "technological sovereignty" terminology, their concerns about dependence, control, and lagging regulation reflect its underlying themes. Expert interviews with representatives from SNS JU projects confirmed these concerns operationally, highlighting **vulnerability** from reliance on foreign semiconductor and equipment suppliers, **concentration of critical software** and cloud services, **accountability gaps** in multi-vendor networks, and **geopolitical dimensions of standards development** where diverging regional strategies risk **non-interoperable systems** embedding **different governance models**.

These findings align with broader European analyses documenting **high import dependence** for critical digital technologies and uneven implementation of security frameworks across Member States. Together, the desk research, citizen engagement, and expert consultations yield a consistent conclusion: technological sovereignty is not simply industrial policy but a **practical prerequisite for ensuring 6G infrastructures can be governed in line with European law and values**.

5. Sources

This policy brief synthetises findings from 6G4Society Deliverables D1.1 [1], and D1.3 [74], as well as WP2 and WP3 outputs on stakeholder engagement and liaison with the SNS JU community. It is framed within the wider EU policy context defined by the Updated Industrial Strategy (2021), the concept of open strategic autonomy, the EU Chips Act, the Digital Decade Policy Programme, the ENISA 5G Security Toolbox, the NIS2 Directive, the Cybersecurity Act, Important Projects of Common European Interest (IPCEI), and the Strategic Technologies for Europe Platform (STEP).

6. Contact details

For further information, contact CyberSocial Lab. at eu-projects@cybersoclab.com or visit www.6g4society.eu. Project deliverables are publicly available through the 6G4Society Zenodo repository at https://zenodo.org/communities/6g4society.

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