

6G4SOCIETY

Towards a Sustainable and Socially Accepted 6G for Society

CO-AUTHORED BY

Monique Calisti, Martel Innovate

Katrina Petersen, Public Safety Communication Europe

Margot Bezzi, CyberEthics Lab.

Lucas Pereira Carwile, CyberEthics Lab.

Flavia Maragno, Digital4Planet

Sophie Staheyeff, Digital4Planet

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1. INTRODUCTION

As we stand at the onset of 6G development, it is crucial to ensure that 6G helps address outstanding societal and environmental challenges and concerns, while ensuring all citizens, communities, organisations, and public authorities recognise 6G as supporting societal values and sustainable outcomes. This is an essential aspect of digitalisation, aiming to empower all citizens and protect our planet, which is becoming enshrined in many different organisational visions around future connectivity initiatives. For example, the 6G Smart Networks and Services Industry Association (6G-IA) vision places sustainability at the forefront, emphasising three key areas for the 2030 communication networks: (1) societal, economic, and environmental values, as highlighted by the UN Sustainable Development Goals and the European Green Deal; (2) strategic autonomy and technological sovereignty reflecting European values; and (3) a human-centred approach to innovation that balances corporate and social values¹. The [European Smart Networks and Services Joint Undertaking](#) (SNS JU), a partnership jointly led by the EC and the 6G-IA, allows the pooling of EU and industry resources into Smart Networks and Services and actively contributes to this vision and to setting up the green and digital transition.

Within the context of the SNS JU, the [6G4Society](#) Coordination and Support Action in collaboration with the [FIDAL](#) and [BroadEU.Net](#) projects, organised a special session at the European Conference on Networks and Communications and 6G Summit 2024 (EuCNC & 6G Summit 2024) entitled “Towards a Sustainable and Socially Accepted 6G for Society”. The session’s goal was to foster a discussion about approaching the new generation of connectivity more holistically and with social, economic and environmental sustainability at the forefront. As 6G is in its initial development phase, this offers a unique opportunity to address challenges overlooked during 5G development and rethink business models in ways that place sustainability on an equal footing with profit.

The Special Session at the EuCNC & 6G Summit 2024 aimed at 1) engaging SNS JU projects/stakeholders to actively participate in the conversation about societal and sustainability main challenges and priorities; 2) presenting the work and activities of relevance undertaken by the three projects organising the session; 3) gathering input and feedback from the participants on the perception of 6G related to the topics of environmental sustainability, social acceptance, Key Value Indicators (KVI) definition, etc.; 4) aligning on major relevant efforts at R&I, policy, regulatory levels. This gave the opportunity to invite on stage several representatives of the project, but also prominent experts such as Ilias Iakovidis (European Commission), Chiara Mazzone (SNS JU Office) and Marja Matinmikko-Blue (University of Oulu).

Emphasising societal and sustainability values, discussions during the session included how Key Value Indicators (KVI) can complement traditional Key Performance Indicators (KPI) to guide 6G technology design, development, and adoption. The session also highlighted how focusing on social considerations can and should constructively impact technological and regulatory decision-making. The overall idea was to create a greater awareness of how intertwined social, environmental, and economic aspects of 6G innovation are, and how crucial it is that SNS JU projects join forces to ensure a human-centric and sustainable evolution of next-generation networks.

Before reporting on the main outcomes of the EuCNC & 6G Summit 2024 session, this short paper will first present the main pillars on which 6G4Society’s work is based: the approach

¹ 6G IA SNVC-SG. 2022. *What societal values will 6G address?* <https://5g-ppp.eu/wp-content/uploads/2022/05/What-societal-values-will-6G-address-White-Paper-v1.0-final.pdf>

based on the three dimensions of sustainability, the role played by Key Value Indicators (KVIs), the issues of acceptance and acceptability and the related contribution of public engagement.

2. SOCIETAL, ENVIRONMENTAL, AND ECONOMIC VALUE-BASED APPROACH

Integrating societal, environmental, and economic perspectives into 6G development involves aligning the goals and values of these domains, including how they are articulated in policy, with the planning, design, and implementation of 6G technologies. This multidisciplinary approach requires collaboration among researchers, policymakers, industry experts, and community representatives to ensure technology development aligns with broader societal goals and values. It also necessitates new design approaches that consider the appropriate contextual elements driving how a value is understood, to ensure all involved share an understanding of the value and related outcomes.

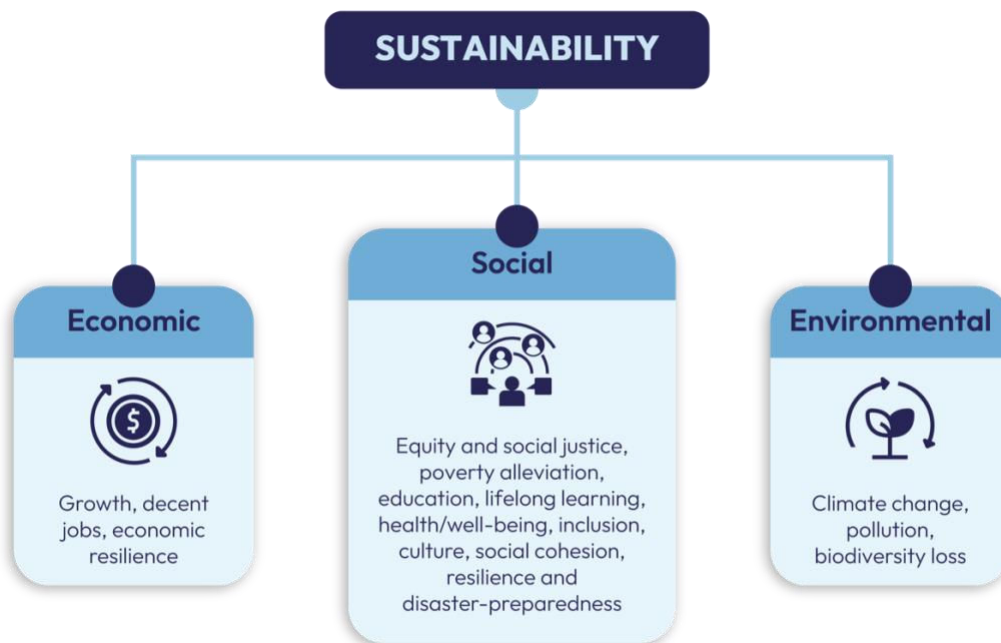


Figure 1 - The three dimensions of sustainability

From a societal perspective, this includes understanding how technology will impact different socio-economic groups, addressing issues of equity, diversity, justice, and inclusion, and ensuring that the benefits of technology, from improved community participation to better access to city services, are accessible to all. Additionally, considering societal values such as privacy, security, trust, safety, and cultural preservation is essential to building trust and acceptance of new technologies within communities.

A green digital transition, which Europe aims to achieve, should be at its core about using digital infrastructures and solutions to support sustainability, particularly in the social and environmental dimensions, as it has historically focused primarily on the economic one. This transition also involves minimising the ecological footprint of technology by reducing energy and resource consumption, minimising waste generation, improving reusability, and understanding how to mitigate negative environmental impacts. One aspect to bear in mind is that the energy usage in, for example, a laboratory is not comparable to the amount used by citizens for everyday activities, and these therefore require different policy approaches and

solutions. This includes incorporating principles of eco-design, life cycle assessment, and renewable energy use into the development process of 6G and similar technologies to promote environmental sustainability.

Technological development should also be economically viable and contribute to economic growth and prosperity. This involves assessing the cost-effectiveness of new technologies for diverse populations and geographic environments, identifying potential for spurring local or regional economic growth and equity, and ensuring that investments in technology generate positive returns for both businesses and society. Considering economic factors such as job creation, income distribution, and market competitiveness is crucial for fostering innovation and sustainable economic development. And, importantly, it involves rethinking traditional economic growth models that often come at the expense of the environment or the prospects of the most vulnerable in society.

3. KEY VALUE INDICATORS (KVIS)

KVIs are one tool that can support achieving the above needs and challenges. They serve as indicators of societal values that future technology, particularly 6G-enabled services and solutions, can enable or impact. By understanding the context within which technologies operate, KVIs provide insights into human-related values such as environmental, societal, and economic sustainability, privacy, trust, digital inclusion, personal health and safety, and protection from harm. They also have the potential to bring to the foreground the bigger picture that makes innovation possible, from the full lifecycle of a product or service to the various outcomes experienced by different groups or objectives within society. KVIs are informed by a framework of ‘societal readiness,’ which examines the readiness of technologies for integration into society rather than society’s readiness for new technology. This model assesses a technology’s practicality, effectiveness, ability to foster innovation in real-world contexts, and capacity to facilitate systemic societal changes for the better.

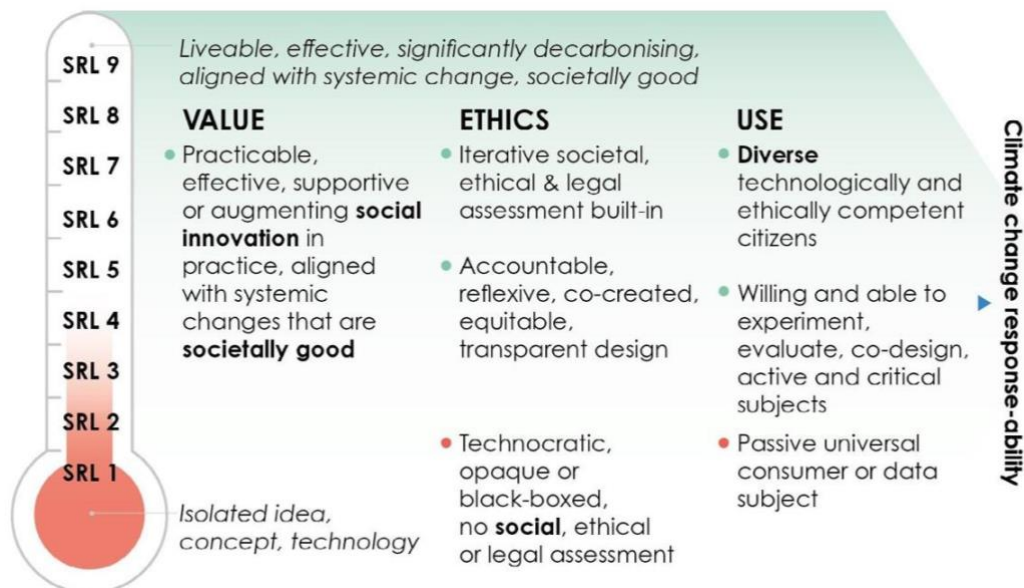


Figure 2 - Societal readiness levels²

² Büscher, Monika & Cronshaw, Cronan. (2022). NERC-the-little-book-of-SOCIETAL-READINESS.

6G4Society is initiating a series of activities to improve how KVs work within projects to uphold societal values. Simultaneously, the project is exploring the potential of KSI (Key Sustainability Indicators) to improve the approaches taken within projects towards sustainability, focusing uniquely on the compound nature of sustainability across environment, economies, and society. These activities include mapping the current landscape of KVs being used in the SNS JU projects, examining the diversity across definitions and approaches for assessing different values, and identifying good practices in associating values together. Workshops and webinars with the projects are being planned that will bring together those working on similar themes with external experts and vertical representatives that can ground project approaches with how these values are understood and experienced by stakeholders. They also consist of working with the projects to identify the challenges they face in assessing, prioritising, and selecting values they should engage. In parallel, 6G4Society seeks to understand the limits of KVs and where they are most effective. The aim is to produce a supporting framework for working with KVs and KSIs that can drive future work in this area and inspire deeper engagement in the projects.

4. DIFFERENCE BETWEEN ACCEPTANCE AND ACCEPTABILITY

The EU recognises the importance of aligning technological advancements with societal values and needs, as evidenced by frameworks like Ethical, Legal, and Social Aspects (ELSA) and Responsible Research and Innovation (RRI). The EU's commitment is reflected in the promotion of social acceptance studies across various 5G and 6G Research & Innovation projects, such as 5G-SOLUTIONS, HYACINTH (renewable energy), and 6G4Society. Social acceptance, which reflects how technology is embraced or tolerated by stakeholders, is important for the sustainable implementation of new technologies, directly influencing their success and societal impact. Without it, even promising technologies can face adoption barriers, as seen with hydrogen and fuel cell technologies or genetically modified organisms (GMOs).

While social acceptance describes the current state of societal response, acceptability is a forward-looking concept considering whether a technology should be accepted based on ethical, moral, and social implications. The distinction between these concepts is critical for 6G technology, as understanding both existing attitudes and potential future integration can shape the development process, ensuring that 6G aligns with current and future societal values, expectations, and ethical standards. Such a comprehensive approach is essential for the successful and responsible deployment of this transformative technology.

Importantly, acceptance and acceptability do not always correlate directly. A technology might have a wide acceptance despite low ethical acceptability, or vice versa. Addressing both dimensions is crucial when assessing 6G's potential impact. Considering both factors can help ensure that 6G is not only technologically advanced but also ethically sound and socially embraced, maximising its positive contribution to society. Stakeholders can thus work towards creating innovations that truly benefit and are welcomed by society at large.

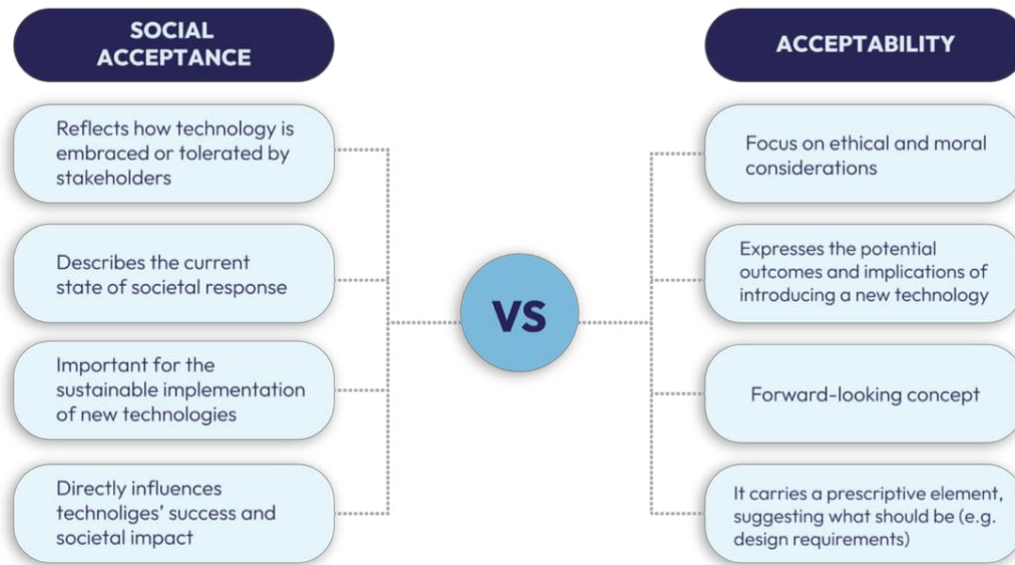


Figure 3 - social acceptance and acceptability: a comparison

Building on the distinction between acceptance and acceptability, 6G4Society is developing a comprehensive Social Acceptance Framework tailored to 6G technologies. This framework integrates four key dimensions: Social Disruptiveness, which assesses potential changes; Value Impact, evaluating alignment with social values; User Experience (UX), focusing on user interactions and satisfaction; and Trust, examining confidence in the technology and its providers. The framework aims to provide a structured approach for assessing both the current acceptance and future acceptability of 6G technologies. Through this dual focus, 6G4Society seeks to inform responsible innovation practices, guide policy recommendations, and ultimately contribute to the development of 6G technologies that are technologically advanced as well as socially beneficial. As a conceptual model, this framework offers other projects a comprehensive tool for evaluating the societal implications of 6G innovations.

5. THE IMPORTANCE OF PUBLIC ENGAGEMENT IN ENSURING SUSTAINABLE AND ACCEPTED 6G DEVELOPMENT

The controversy surrounding 5G deployment in Europe highlighted the risks of a top-down approach, where economic and technological priorities overshadowed local concerns. Communities felt their voices were ignored, leading to resistance and mistrust towards 5G. To avoid repeating these issues with 6G development, policymakers, industry leaders, and citizens must work together, drawing on more inclusive and transparent methods. These include actively involving the public in discussions, addressing their concerns, and incorporating their feedback into decision-making processes. Public engagement is therefore a pillar of the work to ensure that 6G technology benefits society in a sustainable and socially accepted way. Building on this, one important element of the 6G4Society's project is to gather data from citizens on their perception of and experience with 5G, as well as their wants, needs and fears regarding 6G, through a dedicated [online survey](#). The results of the questionnaire will be analysed and will inform several project outcomes, such as the Social Acceptance Model and a set of informational materials aimed at the public.

Building trust and understanding requires open dialogue and evidence-based communication. By engaging with the public and demonstrating a commitment to addressing their concerns, stakeholders can foster acceptability and support for 6G. One of the aims of involving the public

early-on is that social issues are then transparently and inclusively addressed, learning from the lessons learnt from 5G deployment. The roll-out of 5G faced significant public concerns around health risks, privacy, and environmental impacts, which were not always adequately communicated or mitigated. Addressing these concerns from the start in the 6G rollout can help build trust and acceptance. For instance, 6G is expected to bring hyper-connectivity with enhanced speed, reliability, and ultra-low latency, enabling advancements like immersive virtual experiences, real-time remote healthcare, and precision agriculture. These are features beyond the capabilities of 5G or existing networks, which will transform how we live, work, and engage with the world. However, transparency about the potential drawbacks is equally important. For instance, the energy demands of 6G could be significantly higher, raising questions about sustainability. Furthermore, rebound effects—such as increased data consumption or more intensive use of technology—could counterbalance the benefits if not managed responsibly. Transparent communication and targeted engagement help bridge the gap between technological advancements and societal expectations. This approach not only aligns 6G development with public values but also promotes responsible deployment, ensuring that the technology advances in ways that are beneficial for both people and the environment.

6. EUCNC & 6G SUMMIT SESSION: HIGHLIGHTS AND KEY TAKEAWAYS

As anticipated, the Towards a Sustainable and Socially Accepted 6G for Society session featured experts discussing how crucial is the integration of inclusivity, acceptance, and sustainability into the design and development of 6G. Discussions explored how KVIs can measure the success of these integration, fostering a holistic approach to 6G development. Presenting the [6G4Society Citizen Survey](#) also gave the opportunity to discuss how public engagement is essential to create a better understanding and promote improved acceptance of 6G and its benefits as relevant.

The panel discussion highlighted several key takeaways:

- The green and digital transition requires an integrated approach that harmonises environmental, social, and economic sustainability;
- Understanding the difference between acceptance and acceptability is important for advancing social acceptance of emerging technologies;
- Public engagement is vital to ensure inclusive decision-making processes that reflect the needs of the population;
- Embedding proactive sustainability-by-design in 6G development aligns technological advancements with sustainable goals, with the research community playing a critical role in advancing meaningful innovations;
- KVIs have the potential to guide sustainability projects and initiatives, enhancing accountability and transparency, particularly if done in ways that include stakeholder perspectives and shift use cases to put values at the centre;
- With a focus on sustainability, values, and acceptance, the SNS JU and its funded projects can inform and shape policies driving meaningful change in the 6G landscape.

7. CONCLUSION

As the 6G era unfolds, embracing a societal value-driven approach and integrating KVIs can ensure that 6G networks meet performance benchmarks while positively contributing to society, economies, and the environment. The EuCNC & 6G Summit 2024 was a pivotal platform for sharing knowledge, fostering innovation, and collaboratively working towards a sustainable, inclusive, and technologically advanced 6G future. The insights gained from this session will be integrated into the ongoing work of 6G4Society, continuing the effort to build a 6G network designed for society. The discussions highlighted the potential of 6G to shape a better world by embedding sustainability and societal values into its core design principles, presenting an opportunity to model other areas of innovation and drive forward a new era of sustainability.

It is vital to ensure that SNS efforts address the most pressing societal and environmental challenges, aligning technological advancements with the urgent need for sustainability and equity. A green 6G must become a fundamental pillar of our connected future, designed to not only reduce the environmental footprint of digital technologies but also to promote social inclusion, equity, and economic prosperity for all. By integrating eco-design principles, renewable energy usage, and life cycle assessments, 6G can actively contribute to achieving the EU's ambitious climate goals as outlined in the European Green Deal. Additionally, by focusing on KVIs, the SNS JU can ensure that societal, environmental, and economic values remain at the heart of 6G development, fostering a human-centred innovation process that balances corporate success with the wellbeing of society at large.

Moreover, public engagement and inclusive decision-making are critical to building the trust and social acceptance needed for successful 6G deployment. This means listening to diverse voices, understanding local concerns, and ensuring that 6G benefits are distributed equitably, particularly to underrepresented and vulnerable groups. By embedding sustainability and societal values into the core design of 6G, we can create networks that are not only technologically advanced but also ethically sound, transparent, and accountable. The future of 6G offers a unique opportunity to rethink business models, technological development, and economic frameworks in a way that prioritises sustainability alongside innovation. In this way, 6G can be an instrumental tool for driving both societal progress and environmental stewardship, shaping a better world for future generations.

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info@6g4society.eu



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