

White Paper 

6G KVIs

SNS Projects Target
Values and Survey Results
2026

EXECUTIVE SUMMARY

The Test, Measurement, and Validation (TMV) Working Group (WG) of the Smart Networks and Services Joint Undertaking (SNS JU) continues to advance the development of methodologies for assessing the societal, environmental, economic, and human-centric impact of future 6G networks through the concept of Key Values and KVIs. Building upon the foundational work of the 6G-IA TMV and Societal Needs and Value Creation (SNVC) Sub-Group, this updated white paper consolidates the latest research results, methodologies, validation approaches, and target values emerging from SNS JU projects. Its objective is to provide a structured and evidence-based overview of how Key Values (KVs) and KVIs are currently defined, operationalised, measured, and validated across multiple 6G research domains, while supporting the transition towards sustainable, trustworthy, resilient, and value-driven 6G ecosystems.

The white paper analyses all twelve Key Value families originally defined within the 6G-IA framework, covering Environmental Sustainability, Societal Sustainability, Economic Sustainability & Innovation, Democracy, Cultural Connection, Knowledge, Privacy & Confidentiality, Simplified Life, Digital Inclusion, Personal Freedom, Personal Health & Protection from Harm, and Trust. While the categorisation of Key Values remains unchanged, the presentation of the findings has been streamlined by grouping families with fewer updates into consolidated sections, thereby improving readability without altering the underlying methodology. The analysis confirms that Environmental Sustainability, Societal Sustainability, Economic Sustainability & Innovation, Simplified Life, and Personal Health & Protection from Harm continue to account for the majority of KVI-related activities, reflecting the priorities of SNS JU projects and their alignment with European policy objectives.

A key finding of the study is the growing maturity of KVI operationalisation across SNS JU projects. Increasingly, projects are moving beyond conceptual discussions and are providing concrete KVI definitions, measurable target values, validation methodologies, and explicit mappings between traditional technical Key Performance Indicators (KPIs) and value-oriented outcomes. Quantitative approaches are emerging in areas such as energy efficiency, security, privacy, reliability, orchestration efficiency, Quality of Experience (QoE), and resilience, while qualitative and mixed-method approaches are being developed for more complex societal and human-centric values. This evolution demonstrates a clear shift from technology-centric evaluation towards holistic assessment frameworks capable of capturing the broader impact of 6G systems on society, industry, and the environment.

The analysis also highlights the increasing adoption of integrated KPI–KVI assessment methodologies. SNS JU projects are progressively recognising that societal and economic impact does not arise solely from network performance but from the interaction between technical capabilities, organisational processes, user experiences, and contextual deployment environments. As a result, several projects are establishing explicit causal relationships between network performance indicators and higher-level value outcomes, enabling a more comprehensive understanding of how technological innovations contribute to sustainability, trustworthiness, digital inclusion, economic growth, and human well-being.

At the same time, the white paper acknowledges that KVI research remains an emerging field. The results showcase that significant heterogeneity persists across projects regarding definitions, measurement approaches, validation methodologies, and target values. This diversity reflects both the complexity of translating abstract societal values into measurable indicators and the highly heterogeneous nature of 6G applications across different vertical sectors. While such flexibility enables domain-specific innovation, it also limits direct comparability between projects and highlights the need for greater methodological convergence, harmonised benchmark metrics, and common validation frameworks.

Another important conclusion concerns the central role of AI/ML, distributed intelligence, and edge-cloud continuum architectures as key enablers of future KVs. Technologies such as AI-assisted orchestration,

privacy-enhancing technologies, secure-by-design frameworks, federated intelligence, and autonomous management mechanisms are increasingly used to support sustainability, trustworthiness, resilience, efficiency, and human-centric service delivery. However, these technologies simultaneously introduce new challenges related to fairness, explainability, governance, accountability, bias mitigation, and societal trust. Consequently, KVIs emerge as essential instruments for monitoring not only technical performance but also the long-term societal impact and responsible adoption of these advanced technologies.

Overall, the findings confirm that KVIs are becoming a fundamental component of the 6G validation ecosystem and an essential mechanism for guiding future network development, experimentation, standardisation, and policymaking. Significant progress has been achieved across SNS JU projects in defining and operationalising value-oriented assessment frameworks; however, further research is required to harmonise definitions, establish common validation methodologies, develop benchmark target values, and validate KVI frameworks at scale under realistic operational conditions. The SNS JU and the TMV Working Group are uniquely positioned to coordinate these efforts, facilitate methodological convergence, and ensure that future 6G networks are evaluated not only by their technical performance but also by their contribution to sustainability, societal well-being, economic prosperity, trustworthiness, and European strategic objectives.

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1. INTRODUCTION

The Smart Networks and Services Joint Undertaking (SNS JU), through its Test, Measurement, and Validation (TMV) Working Group (WG), is actively advancing the adoption of Key Value Families and Key Value Indicators (KVIS) as a foundational mechanism for assessing B5G/6G networks through the lens of sustainability and societal impact. Building on the legacy of the 5G paradigm and the current upgraded readiness levels, as well as on the continuity of the evolution from 5G to 6G, the SNS JU coordinate research efforts towards strengthening EU's digital sovereignty and provides a unified European framework spanning the full lifecycle of 6G systems, from early research and experimentation to large-scale deployment.

While technical KPIs remain indispensable for assessing network performance, they are insufficient to capture the broader environmental, societal, economic, and trust-related impacts expected from 6G systems. In the absence of a shared Key Value – oriented assessment framework, SNS projects have historically applied heterogeneous definitions, validation methods, and impact narratives, limiting cross-project comparability and policy alignment. This gap motivates the systematic development and consolidation of KVIS as a complementary assessment dimension for 6G.

Within this context, the TMV WG plays a central role in fostering collaboration among SNS projects, promoting common methodologies, and ensuring consistency in testing, measurement, and validation practices. While these activities have traditionally focused on KPIs, the transition toward 6G introduces a broader perspective, where performance evaluation is complemented by value-driven assessment through KVIS in order to capture the human and broader social benefits in the 6G era. This whitepaper represents a critical step in that journey, serving both as a reference point for current progress and as a foundation for future standardisation and impact-driven innovation in the 6G era.

More specifically, since the early stages of 6G, SNS JU – in joint efforts driven by the 6G-IA and the European Commission – has promoted a forward-looking vision in which technological progress is intrinsically linked to environmental, socioeconomic, and well-governed value creation towards resilience. Within this shared vision, KVIS have emerged as critical enablers for the measurement and evaluation of how 6G innovations contribute to broader sustainability objectives, extending beyond the technical performance advancements – posing a central paradigm defined in ITU-R IMT-2030 framework. To this end, and as KPIs remain essential for quantifying system performance and enabling comparability across technologies, KVIS introduce a complementary dimension that aims to capture the real-world impact of 6G systems on society and the economic ecosystems, with respect to environmental protection and in full alignment with human and pan-anthropocentric values and societal priorities.

Throughout the advancements of both qualitative and quantitative KVIS, EU aims to ensure that future networks and services are designed not only for performance upscaling, but also for achieving excellence through value-driven outcomes, delivering tangible benefits across multiple verticals, based on their unique characteristics. Overall, the SNS Work Programme 2025 and beyond reinforces this direction, placing strong emphasis on the operationalisation, validation, and scalability of KVIS, while maintaining methodological alignment with established KPI frameworks. These efforts are closely aligned with the strategic orientations of Horizon Europe for 2025–2027—namely the Green Transition, Digital Transition, and a more resilient, competitive, inclusive, and democratic Europe.

In particular, KVIS play a central role in supporting key Sustainable Development Goals (SDGs), notably SDGs 3, 8, 9, 11, and 13, under the dual perspective of “Sustainable 6G” and “6G for sustainability”. Through this approach, SNS JU is shaping a measurement paradigm where KVs are systematically linked to technological enablers and performance indicators, enabling the quantification of real-world impact across diverse domains.

Within this evolving ecosystem, the SNS TMV WG continues to act as a cornerstone for the development and harmonisation of methodologies for testing, monitoring, and validation across projects. Leveraging best practices from past activities, the WG promotes the formalisation, validation, and reusability of both KPI and KVI frameworks, ensuring methodological consistency across SNS JU projects. In this context, KVIs are positioned as the logical extension of KPI-based evaluation, requiring robust measurement methodologies, well-established definitions, comparable results reproducible validation procedures and interoperable frameworks.

Under this scope, the present whitepaper, representing the second iteration of the TMV WG work on KVIs, consolidates insights from multiple SNS projects and provides a structured analysis of how KVIs are defined, implemented, and evaluated in practice. It also reflects the ongoing effort to bridge existing gaps between high-level value concepts and measurable indicators; a challenge similarly encountered in the early stages of standardisation. The findings seem to confirm that KVIs are transitioning from conceptual constructs to operational tools for impact assessment, although their maturity remains uneven across domains and use cases.

More specifically, the reported results from the 6G early-stage experimentation within SNS JU projects demonstrates that, KVIs require iterative refinement, validation through trials and pilots, and alignment with standardisation bodies to upscale readiness and maturity. This highlights the importance of developing harmonised definitions, establishing measurable target values, and ensuring that KVI methodologies are scalable and comparable across different technological and application contexts.

Looking forward, the development of KVIs is inherently iterative and evolutionary, requiring continuous refinement, given that as methodologies mature and validation frameworks become more robust, KVIs are expected to become core instruments for guiding 6G system design, policy alignment, and regulatory frameworks. This second whitepaper represents a critical step in that journey, serving both as a reference point for current progress and as a foundation for future standardisation and impact-driven innovation in the 6G era.

The remainder of this paper is structured as follows:

- Sections 1 and 2 provide the high-level introduction of the present whitepaper and the objectives and motivation for its release, respectively.
- Section 3 provides an analysis of the collected material by Key Value, utilizing the 12 Key Vales as defined in [7], along with aggregate insights on 6G networks' performance and capabilities.
- Section 4 entails an overview of the insights and the common research ground across the definitions and the relevant frameworks of the KVIs, as collected and analysed by the SNS JU projects taking into account the results of a dedicated questionnaire that has collected knowledge and experience gained by the SNS JU projects overtime. This section aims to contribute to the formation of a common KVIs Measurement and Evaluation Framework.
- Section 5 reports the main lessons learned from this white paper's approach to the 6G Key Values and KVIs, building upon the measurement frameworks and provide the insights retrieved from the available data.
- Finally, Section 6 concludes this white paper with the core concluding remarks.
- Detailed KVI tables per family category can be found in Section 7, Annex I.

2. OBJECTIVES & MOTIVATION

2.1. MOTIVATION

The evolution toward 6G is not only characterised by unprecedented technological ambitions, but also by a fundamental shift in how societal and ESG-linked aspects are defined and measured. While KPIs – such as – data rate, throughput, latency, reliability, capacity etc - are at a mature stage both in terms of deployment, emerging KVs and KVIs aim to introduce a broader and more holistic perspective, enabling the evaluation of how technological advancements translate into tangible benefits for society, economy, and environment in all aspects of KVs. This transition focuses on the recognition of the critical role and the unique contribution of the future networks and systems on the value they generate and the real impact.

As part of this continuous process TMV focuses on the engagement of SNS JU projects in the definition and reporting of KPIs and, increasingly, KVIs. To this end, the projects were invited to provide detailed information on the KVIs, including target values, contextual information related to use cases and trials, and methodological considerations. This collaborative effort has been met with strong participation, resulting a unique set of data and insights that underpin the analysis presented in this whitepaper. Moreover, the diversity of projects, leads to a wide range of KVIs lessons learned, in areas where the lessons learned and the conclusions converge, while the divergences indicate the areas for further exploration and the need for focus of the 6G research.

Specifically, KVs align closely with global policy frameworks, most notably the UN SDGs, reinforcing the role of 6G as a key enabler of a sustainable, inclusive, and resilient digital society. At the same time, KVIs enable a more comprehensive understanding of the long-term impact of 6G systems, supporting evidence-based policymaking and strategic investment decisions. This alignment also ensures that European 6G research remains consistent with international priorities and contributes meaningfully to global sustainability agendas. In this context, SNS JU TMV WG extends its scope to include the development of robust KVI methodologies, ensuring that value-driven assessment becomes an integral part of the 6G evaluation framework. In practical terms, the work of the TMV WG spans multiple dimensions of the ecosystem, including the design and implementation of comprehensive testing frameworks, the mapping of KVs and KVIs, the collection of requirements, specifications, experimental environments, target and realized outcomes, as well as the challenges and limitations, to assure that value indicators are also assessed in a coherent and integrated manner. Furthermore, the WG develops and promotes testing methodologies and procedures that enable reproducibility, comparability, and scalability across different projects and use cases. This is particularly important in the context of KVIs, where the diversity of application domains and societal impacts introduces additional complexity in measurement and validation.

Against this background, this white paper responds to the need for a structured, evidence-based overview of how KVIs are currently defined, measured, and applied across SNS JU projects, building on earlier work and extending it with empirical insights from ongoing research activities.

A central motivation of this white paper is therefore to identify and analyse the most commonly adopted approaches to KVI definition, measurement, and validation across SNS JU projects. While projects address diverse use cases and vertical domains, early evidence suggests emerging patterns and shared practices in how KVIs are formulated and operationalised. By systematically identifying these convergent approaches, the white paper aims to establish a common starting point for the development of a more coherent and reusable KVI framework, utilising all existing experience and knowledge created within SNS Working Groups, as the SNS Sustainability Working Group, the Societal Needs and Value Creation Sub-Group, and SNS JU ongoing projects.

This diversity, while limiting the direct comparability of results, provides valuable insights into the emerging capabilities and expectations of 6G networks, architectures and systems. It highlights the need for flexible yet structured evaluation frameworks that can accommodate heterogeneity while enabling meaningful analysis. Finally, by establishing links and mapping between KPIs and KVIS, the TMV WG has the ambition to contribute to the progress towards an integrated evaluation paradigm in which technical performance is systematically connected to value creation and potentially the impact measurement.

2.2 OBJECTIVES OF THE WHITE PAPER

The present whitepaper builds on these contributions by providing a consolidated view of KVI developments. It documents the definitions, target values, and contextual applications of KPIs, while also analysing the emerging methodologies for KVI assessment and validation, not only capturing the current state of the art, but also identifies key gaps and opportunities for future research. offers guidance to future projects, enabling them to build upon existing methodologies, leverage accumulated expertise, and contribute to the ongoing refinement of KPI and KVI frameworks. The main objectives of this white paper are to:

- Consolidate the current state of practice on Key Value Indicators across (selected set of) SNS JU projects, building on the definitions and Key Value families introduced in earlier work.
- Analyse and compare how KVIS are defined, validated, and operationalised across projects, use cases, and vertical domains.
- Assess the maturity of KVIS, including the availability of validation methods, qualitative and quantitative evidence, and indicative target values.
- Identify convergence, gaps, and challenges in KVI measurement and evaluation, with particular attention to harmonisation needs across projects.
- Provide evidence-based insights to support future SNS research activities, Test, Measurement, and Validation (TMV) Working Group discussions, and interactions with standardisation and policy initiatives.
- Identify convergent and commonly adopted approaches to KVI definition, measurement, and validation across SNS JU projects, as a basis for future framework development.

2.3 SCOPE AND INTENDED USE

This white paper is intended as a **survey, consolidation, and analytical reference** for the SNS JU ecosystem. It does not define mandatory KVIS, prescribe certification criteria, or establish binding benchmarks. Instead, it documents and analyses current approaches adopted by SNS projects, highlighting both common patterns and project-specific innovations.

The results presented in this document are expected to support:

- alignment and knowledge exchange among SNS JU projects,
- methodological discussions within the TMV Working Group,
- the evolution of KVI frameworks toward greater consistency and operational readiness,

and informed dialogue with standardisation bodies and policy stakeholders on value-driven assessment of 6G networks.

3. KVIS DEFINITIONS, TARGET VALUES & MEASUREMENT INSIGHTS AMONG SNS JU PROJECTS PER FAMILY

The current Section is dedicated to the analysis of the methodological foundations and analytical approaches provided by the SNS JU projects on the KV families, and the tailored KVIs definitions. The structure of the Section and the sub-sections is mainly consistent with widely adopted practices and aligned with the previous iteration of the whitepaper.

Overall, all SNS JU initiatives that responded to the questionnaire follow the structured development approach. More analytically, for each section the same structure was implied in order to keep consistency and alignment among the KV families, as well as the structure of the previous whitepaper on KVIs. The KVI classification is organised around the defined KV families which represent the broader societal and environmental dimensions. The total number of families The analysis focuses on identifying commonalities, methodological gaps, and emerging best practices, as well as on assessing the maturity of KVIs across projects. Particular attention is given to the relationships between KVIs and underlying KPIs, recognising that value outcomes often emerge through complex interactions between technical performance, user behaviour, and contextual factors.

The structural logic includes three parts for each KV family:

- (a) brief analysis of the main projects individual and comparable results for each of the KV families. Emphasis is given on the definitions and the progressive advances toward validation through trials and experimentation.
- (b) an aggregate table which includes the name of the KVIs and the definition used for the scenarios and/or use cases, continues with the identification of key enablers and vertical implications within the context of the project. and
- (c) an aggregate table per project and KVI, along with the validation approach used within the context of the project, the target values as identified in the earlier stages and initial testing cycles, as well as the final measurement for the results, as long as the results are finalised.

The approach used is fully compliant with the scope of the whitepaper, since envisions the compliance with a continuous comparable and a properly harmonised framework, while highlighting the need for both well-defined technical requirements, with respect to the reflection of the need, toward the shape of commonly agreed definitions of the societal, environmental, and economic value outcomes that 6G systems are expected to deliver. As such, the scope of each project, the diversity of use cases, and the specific deployment scenarios significantly influence both the qualitative interpretation and the quantitative assessment of KVIs.

3.1. ENVIRONMENTAL SUSTAINABILITY FAMILY [KV#1]

Environmental Sustainability constitutes one of the most critical KV families on the 6G transition roadmap, reflecting the broader shift toward a holistic, human-centric, and value-oriented assessment of future communication systems and networks. In line with the SNS JU vision and the IMT-2030 Framework, this KV family is intrinsically linked to climate policy, regulatory compliance, ecological responsibility, and the long-term sustainability of 6G-enabled services. Within the 6G context, environmental KVIs are evaluated across two complementary dimensions: the direct ecological impact of the network itself, encompassing energy consumption, materials use, emissions, and waste from infrastructure and devices; and the enabling impact of 6G connectivity on vertical applications that conserve natural resources or displace carbon-intensive processes. The SNS KVI Working Group treats environmental sustainability as a multi-dimensional value aligned with the EU Green Deal, the UN Sustainable Development Goals, and EU sectoral frameworks including the Water Framework Directive, the Biodiversity Strategy 2030, and the Common Agricultural Policy.

Across the SNS JU projects, a strong conceptual alignment is observed in the framing of environmental sustainability, while significant variations exist in scope, measurement methodologies, and target values, owing to diverse use cases, vertical domains, and technological maturity levels. A comparative analysis of the projects highlights three dominant approaches. The first, adopted by the majority of projects, prioritises network-internal energy efficiency expressed through measurable and enforceable technical metrics. FLECON-6G exemplifies this approach with aggressive targets of energy savings exceeding 90% versus 5G, validated through ETSI-aligned energy-per-bit calculations, while ETHER reports comparable gains across delay-tolerant IoT, vertical handover, and resource-allocation use cases. BeGREEN further operationalises this paradigm at the radio layer through ISAC, RIS, and AI-driven RU on/off schemes, with similar approaches adopted by 6G-DALI, 6G-EWOC, ACROSS, Eco-eNET, 6G-BRICKS, and iSEE-6G. The second approach centres on materials and lifecycle assessment, with 6G-SANDBOX as the principal exemplar: three KVIs covering energy footprint, materials usage, and environmentally neutral lifecycle, validated through expert review and LCA-style desk analysis aligned with ISO 14040/14044, ITU-T L.1410, and ETSI EN 303 470. The third approach, exemplified by 6G-PATH and ENVELOPE, extends environmental KVIs into vertical-domain ecological outcomes, evaluating 6G value through observable benefits in agriculture, healthcare, smart cities, mobility, and education. SUNRISE-6G occupies a complementary position by locating environmental value in travel substitution through federated metaverse, validated through user surveys.

The interrelationships between technical KPIs and environmental KVIs are most fully articulated by 6G-PATH, which traces explicit causal chains from network performance to ecological outcome. Video resolution, jitter, and uplink data-rate KPIs are identified as the technical preconditions for water conservation through accurate hydric-stress and phenology detection, with soil-moisture accuracy directly enabling precision irrigation. Edge-computing KPIs drive energy efficiency by displacing energy-intensive cloud transmission, while ultra-low-latency and high-throughput KPIs enable optimised AGV routing in smart-city logistics. Other projects articulate analogous chains at the network layer: BeGREEN links sensing-accuracy KPIs to energy savings through unused-cell switching enabled by ISAC and RIS, ACROSS connects energy savings and scalability measurements to its sustainability KVI through energy-aware orchestration, and FLECON-6G ties communication and service KPIs to its energy-efficiency target. The dominant pattern across the portfolio is that environmental KVIs are enabled indirectly through KPIs supporting precision sensing, route optimisation, and edge processing; the chain becomes most direct where measurement accuracy determines resource-targeting precision, exemplified by analytics accuracy reducing unused-dressing waste in 6G-PATH's healthcare use case. Moreover, 6G-INTENSE and ADROIT6G place stronger emphasis on system-wide sustainability, integrating dimensions such as lifecycle

awareness, resource consumption, carbon neutrality, and sustainable digital infrastructures. At the same time, 6G-VERSUS combines network efficiency with renewable.

The current results highlight a key distinction across projects: while many prioritise measurable network-layer efficiency through quantitative simulation and laboratory testing, others emphasise vertical-domain outcomes through trial-based stakeholder evaluation. The two paradigms are mutually reinforcing, as network-layer measurement establishes the technical preconditions for ecological outcomes, while vertical-domain measurement validates whether those preconditions translate into observable environmental benefit. This analysis verifies that environmental sustainability is treated as fundamental for the long-term acceptance of 6G networks across the SNS JU portfolio. While significant progress has been made in defining KVIs and validation methodologies, a number of challenges remain: the harmonisation of measurement methods and target structures across projects, broader adoption of established environmental SDOs, integration of LCA-aligned lifecycle perspectives, and longitudinal validation for outcomes such as soil health, biodiversity, and water-quality protection that exceed short trial windows. The future of 6G is inextricably linked with the delivery of energy-efficient, resource-conscious, and ecologically responsible network and application services.

6G-PATH currently provides the SNS portfolio with its earliest validation of vertical environmental KVIs. The strongest quantitative evidence emerges from precision agriculture, where a farming use case achieved a 42% reduction in water use against a 10% target, with stakeholder agreement above 85% across surveys, focus groups, and interviews. Energy efficiency was validated in the FARM and CITIES verticals through high collapsed agreement and consistently positive Likert means, while waste reduction was best evidenced in a healthcare use case where wound-analytics accuracy enabled by 3D hydrogel patches reduced packaging and unused-dressing waste. Phase 1 also drove methodological refinement of the KVI framework itself: education use cases were extended with energy-efficiency and waste-reduction KVIs following gap analysis, and water-quality protection was elevated from a use-case-specific to a standard KVI. Phase 2 priorities include longitudinal soil-health and biodiversity baselines, standardised carbon-accounting methodology aligned with LCA frameworks, and systematic air-quality measurement against EU standards.

3.2. SOCIETAL SUSTAINABILITY FAMILY [KV#2]

Social Sustainability constitutes one of the foundational KV families on the 6G transition roadmap, reflecting the imperative to evaluate next-generation networks not only through technical performance but also through their contribution to human wellbeing, equity, and social cohesion. In line with the SNS JU vision and the IMT-2030 Framework, this KV family is intrinsically linked to wider societal acceptance, digital inclusion, public service resilience, and the long-term sustainability of 6G-enabled services. Within the 6G context, social KVIs address outcomes that affect people directly: physical and emotional safety, quality of life, access to essential services, social participation, digital skills, and trust in the systems that mediate everyday life. The SNS KVI Working Group treats social sustainability as a multi-dimensional value aligned with the European Pillar of Social Rights, the Digital Decade 2030 targets, and the relevant UN Sustainable Development Goals (SDG 3 Health, SDG 4 Education, SDG 10 Reduced Inequalities, SDG 11 Sustainable Cities).

A comparative analysis of the SNS JU projects' contributions reveals strong conceptual alignment in the framing of social sustainability alongside significant methodological diversity in scope, measurement approach, and target structure. Two complementary paradigms are observed across the portfolio. The first treats social value as an extension of network performance, where improved coverage, lower latency, and higher reliability translate into safer and more accessible services. BeGREEN exemplifies this approach by linking ISAC, RIS, and relay-assisted coverage extension to service availability and digital inclusion, while

iSEE-6G defines a composite KVI on resilient public services enabled by integrated UAV corridors and 6G coordination, anchored to reliability, latency, localisation accuracy, and service continuity. The second paradigm, exemplified most fully by 6G-PATH, locates social value in vertical-domain end-user experience across deployment contexts, evaluated through trial-based stakeholder surveys, focus groups, and interviews. 6G-PATH defines thirteen KVIs across five thematic clusters: health, safety, and emergency response; digital inclusion, accessibility, and reduction of the digital divide; quality of life and social participation; trust, community engagement, and user satisfaction; and digital skills, technology adoption, and food security. SUNRISE-6G occupies a complementary position by addressing user safety through avoidance of risky travels in federated metaverse environments, validated through perception-based questionnaires with high user-agreement targets - an approach that mirrors the user-centric methodology adopted by some Privacy and Trust projects.

The relationships between network KPIs and social KVIs are most fully developed in 6G-PATH, where reliability, availability, latency, and packet loss are identified as foundational enablers of public health and safety across all use cases. The clearest causal chain operates in emergency response: sub-2-second fall-event detection latency in the healthcare vertical directly determines response speed, while sub-20 ms end-to-end latency and high downlink throughput in PPDR contexts enable real-time situational awareness. Coverage KPIs (RSRP, RSRQ), bandwidth, and session uptime constitute the structural enablers of digital inclusion, equity of access, and reduced digital divide; when rural or remote areas achieve the same KPI thresholds as urban areas, the technical precondition for divide reduction is satisfied. Network latency, session uptime, and XR-duration KPIs further determine the consistency of digital training experiences in education use cases, with one such case providing clear empirical evidence of bidirectionality, where degradation of video and audio KPIs corresponded to a sharp drop in satisfaction and reliability scores. iSEE-6G anchors its societal KVI to reliability, latency, localisation accuracy, sensing accuracy, coverage, and service continuity, while BeGREEN connects coverage and energy KPIs to service availability through ISAC, RIS, and relay technologies. The strongest social KPI-to-KVI chains across the portfolio are those where ultra-low latency or high reliability is non-negotiable; the weakest are those mediated by non-technical factors such as governance, transparency, and community trust.

The current results highlight a key distinction across projects: while some treat social sustainability as a derivative of measurable network performance, others approach it as a vertical-domain outcome dependent on stakeholder experience and contextual fit. A distinctive property of social KVIs identified through Phase 1 is their bidirectionality: where network performance falls below user expectations or legacy-system baselines, the corresponding social KVI is actively undermined rather than merely failing to improve, with implications for trust, adoption, and perceived safety. This analysis confirms that social sustainability, alongside privacy and trust, constitutes a fundamental dimension of societal acceptance of 6G networks. While progress has been made in defining KVIs and validation methodologies, several challenges remain: the harmonisation of social-impact instruments aligned with frameworks such as WHO quality-of-life measures and Digital Decade 2030 KPIs, broader project participation in social-pillar assessment, integration of bidirectional measurement to capture both positive and negative outcomes, and longitudinal tracking of social-participation, equity, and skills outcomes. The future of 6G is inextricably linked with the delivery of inclusive, equitable, and trustworthy digital experiences across diverse user populations and deployment contexts.

6G-PATH currently provides the SNS portfolio with its earliest validation of social sustainability KVIs. The strongest evidence emerges from healthcare, where a fall-detection use case achieved sub-2-second alert latency alongside the highest user-agreement levels recorded for emergency response and quality-of-life dimensions in its use case. Education evidence is similarly robust: a rural Romanian XR deployment reported strong agreement that immersive learning improves digital skills and inclusiveness, while another education use case recorded the highest inclusion score in its vertical. Smart-city logistics reached unanimous agreement on technology adoption and workplace safety improvement through AGV

deployment. A PPDR use case produced an instructive contrasting result, with the majority of respondents reporting low satisfaction owing to legacy TETRA/TETRAPOL performance superiority, providing the empirical basis for the bidirectional measurement principle. Phase 1 also led to elevation of food-security contribution from a farming-specific to a standard KVI following gap analysis. Phase 2 priorities include a standardised quality-of-life instrument across verticals, longitudinal social-participation tracking, a structured comparison protocol between 6G and legacy systems for PPDR contexts, and a systematic equity-of-access assessment across all use cases.

3.3. ECONOMICAL SUSTAINABILITY & INNOVATION FAMILY [KV#3]

The evaluation of 6G wireless technology represents a transformative shift not only in technical performance, but also in how 6G technologies create and sustain economic value. Among all the SNS JU-funded projects, economic sustainability has been one of the fundamental and original dimensions of sustainability assessment methodologies. It is considered a mandatory requirement to ensure the economic sustainability of next-generation wireless technology, given its significant investment and long-term societal impact. Alongside other KV families, “economic sustainability and innovation” emphasises the commitment to designing and applying next-generation wireless technology and networks that are financially viable, cost-efficient, and long-term value-generating.

The economic sustainability and innovation family and the related KVIs, in most of the SNS JU projects have evolved beyond traditional approaches and methodologies, which emphasise networks and systems cost-efficiency and their productivity contributions. To this direction, the expectation on emerging 6G technologies have been augmented, with modern requirements expanding to the delivery and improvement or expansion of new innovative revenue streams, in comparison to the existing ones, the creation new business models and value propositions, contributing to the development of value chains, while at a macro level 6G is expected to drive future economic growth and competitiveness, as compensation for the substantial investments currently required and the high CAPEX.

More specifically, the development of novel KVIs is considered essential, ensuring 6G technologies can be deployed also at a large scale, without compromising economic sustainability, while also maintaining the benefits of innovations. To this end, the ongoing SNS JU projects have identified some mutual and distinct sets of KVIs to evaluate the economic sustainability and innovation of 6G technologies. The most widely adopted economic sustainability KVI is the reduction of Capital Expenditure (CAPEX), exemplified by projects such as SUNRISE-6G, 6G SANDBOX, ETHER, BeGREEN, and ENVELOPE. Furthermore, many 6G projects also target the reduction of operational costs (OPEX) for everyday activities in respective verticals. Specifically in the SUNRISE-6G project, technical improvements, such as low-latency, scalable, and self-healing capabilities, are enabled by 6G.

In addition, SUNRISE-6G, 6G-PATH, ENVELOPE, iSEE-6G, and BeGREEN projects employed increased productivity and efficiency as an economic-sustainability KVI. Exclusively in the 6G-PATH project, KVIs such as profit and revenue improvements and new revenue opportunities are identified, each related to a couple of use cases. The 6G BRICKS and FLECON-6G projects adopted open collaboration as an economic sustainability KVI, enabling knowledge sharing and collaborative methods across projects. Business value creation and supply chain expansions enabled by 6G technologies are measured in the 6G-BRICKS, FLECON-6G, and PREDICT-6G projects. The broader impacts of 6G technologies in shaping a competitive and resilient economy are evaluated using the economic growth KVI across the 6G-BRICKS, FLECON-6G,

ACROSS, and PREDICT-6G projects. The respective KVI identification for each project rationalises the use-case context and the diverse stakeholder groups' impacts through their unique 6G technologies applications.

The validation methods used by projects ranged from a survey questionnaire to focus group discussions to interviews. The SUNRISE-6G, ETHER, FLECON-6G, and ENVELOPE projects have listed target values for the identified KVIs for economic sustainability and innovation, while other projects are still in progress. Among identified target values, SUNRISE-6G is expected to improve its productivity by more than 20%, Eco-eNET and ENVELOPE projects predict that CAPEX and OPEX costs will be less than the set baseline, ETHER project plans for 90% reduction of CAPEX and OPEX with the implementation of terrestrial deployment, and FLECON-6G project predicts a 30% increase in revenue streams and enhanced value chain through engaging more than 500 stakeholders. According to results from the SUNRISE-6G project, more than 80% of users believe CAPEX and OPEX reductions are achievable through advanced 6G technologies. Similarly, more than 80% of users agreed that the SUNRISE-6G project can achieve more than 20% increase in productivity compared to 5G baselines.

3.4. PRIVACY & CONFIDENTIALITY AND TRUST FAMILIES [KV#7 & KV#12]

Privacy & Confidentiality and Trust constitute two of the most critical KV families on the 6G transition roadmap, reflecting the need for a fundamental shift toward a holistic, human-centric, and value-oriented assessment of future communication systems and networks. In line with the SNS JU vision and the IMT-2030 Framework, these KV families are intrinsically linked to wider societal acceptance, regulatory compliance, digital sovereignty, and the long-term sustainability of 6G-enabled services. In these domains, KVIs' role aims to capture the perceived and experienced level of security, privacy, transparency, and trustworthiness of systems by the end-users, providers, and overall, the ecosystem's actors.

More specifically, Privacy & Confidentiality KVIs are completely aligned with the modern regulatory and standardization frameworks¹, while Trust KVIs extend these foundations by incorporating AI trustworthiness, system reliability, cross-domain consistency, and user perception. To this end, within the 6G context, both KV families are evaluated mainly for end-to-end applications and services, encompassing data generation, transmission, processing, storage, and decision-making, particularly in AI-native and distributed architectures (e.g., cloud-edge continuum, federated environments), across verticals. Across the SNS JU projects, which updated their inputs, a strong conceptual alignment is noticed in the definition of these KVIs. At the same time, significant variations exist in measurement methodologies, validation approaches, and target values due to diverse use cases, vertical domains, and technologies' maturity levels. A comparative analysis of the projects highlights both convergence trends and key differentiating approaches.

A deeper analysis showcases that Privacy & Confidentiality KVIs are typically expressed as measures of secure data handling, anonymization, confidentiality preservation, and timeliness of secure information exchange, while Trust KVIs emerge as composite indicators combining technical performance (e.g., security response), compliance (e.g., standards adherence), and subjective user perception (e.g., trust scores, acceptance of AI decisions). This evolution reflects the convergence of networking, cybersecurity, and AI, where value creation depends on both measurable system robustness and perceived trustworthiness.

¹ Such as GDPR, NIS2 Cybersecurity Framework, as well as SDOs definitions, methodologies and guidelines, for example ETSI specifications and ISO/IEC 27001.

The dominant approaches for all SNS JU projects (iTrust6G, ACROSS, FLECON-6G, and SUNRISE-6G), are (a) the tech-driven enforcement for operationalizing privacy through measurable and enforceable mechanisms and (b) user-centric evaluation with qualitative metrics. More specifically, iTrust6G exemplifies a highly quantitative and operational model, defining measurable KVIs such as threat intelligence sharing timeliness and vulnerability management speed, directly linking privacy to security efficiency through metrics (e.g., ≤ 5 minutes sharing delay, $\geq 40\%$ faster remediation), validated through system logs and automated monitoring. In contrast, SUNRISE-6G focuses on user perception, assessing privacy and trustworthiness through surveys in immersive environments, targeting over 90% user agreement, highlighting the importance of perceived privacy in human-centric applications. FLECON-6G emphasizes regulatory compliance and ethical AI, ensuring full data anonymization and GDPR alignment through privacy-preserving techniques and risk assessments, while ACROSS integrates privacy into AI-driven orchestration and GDPR-compliant data flows, though with more qualitative validation at early stages.

At the same time, SUNRISE-6G adopts a more user-centric and perception-based methodology, particularly within immersive metaverse environments. Similarly, the same approach is also utilised by ADROIT6G and 6G-BRICKS. Here, privacy and trustworthiness are evaluated through questionnaires and interviews, with a targeted percentage over of user agreement on ethical and privacy adherence. Projects such as ADROIT6G and 6G-INTENSE extend KVIs beyond technical sustainability toward trustworthy-AI dimensions, emphasizing accountability structures, privacy-aware AI/ML training, fairness validation through white-box testing, and trustworthiness demonstrated via PoCs. focusing on transparency, accountability, and trustworthy AI operation, while ADROIT6G explicitly connects these KVIs to core KPIs such as reliability, orchestration efficiency, latency, and QoE. Finally, 6G-VERSUS complements these approaches through stakeholder engagement, cultural acceptance, and trust in AI-assisted management systems. Using surveys, interviews, focus groups, and participatory observation, the project evaluates how users perceive and adopt 6G-enabled services, particularly in relation to AI-driven alert management and operational decision-making.

The current results highlight a key distinction across projects: while some prioritize technical enforcement and measurable compliance, others emphasize user experience and perceived privacy, particularly in human-centric applications. Finally, this analysis dedicated on Privacy & Confidentiality and Trust Key Value Families across SNS JU projects, seems to verify that both dimensions are considered as “fundamental” for the wider societal acceptance of 6G networks. Moreover, while great progress has been made in on the definitions and validation methodologies for the related KVIs, a series of significant challenges remain in the harmonization of the methodologies, the integration of AI-related metrics and indicators, and the gap-bridging between technical capabilities and user perceptions. Future of 6G is inextricably linked with the delivery secure, private, and trustworthy digital experiences for the end-to-end services and applications.

3.5. SIMPLIFIED LIFE FAMILY [KV#8]

Simplified Life composes a core Key Value family attracting the interest of many SNS JU projects, since it is directly linked to the capacity of B5G and 6G networks to reduce complexity in several life’s aspects, improve everyday usability, enable more seamless digital services, and transform advanced connectivity into practical benefits for all EU ecosystem’s individual stakeholders (citizens and communities, professionals and employees, operators etc). In the SNS JU KVI framework, Simplified Life is defined as the use of technology, innovation, and social systems to make daily life easier, more accessible and more resource-conscious, while supporting long-term environmental, social and economic well-being, covering areas such as better access to services, improved production processes, more efficient transport, flexible

work environments, and the reduction of cognitive and technical burdens for users interacting with advanced digital systems.

Within the 6G context, this KV is therefore not limited simply to convenience, but expresses the wider ambition that ubiquitous connectivity, AI-driven automation, intelligent resource allocation, network slicing, immersive communication and zero-touch systems should simplify human interaction with increasingly complex digital infrastructures. The previous 6G-IA/SNS JU white paper already highlighted the direct and indirect association with serious time saving through increased speed, scale efficiency, user satisfaction and emotional quality, accuracy and consistency and many other better life aspects.

The updated evidence depicts a strong connection between network performance and experiential, operational and societal value. This specific family seems to extend the KPIs achievements (throughput, latency, reliability or availability) into real-life experiences through easier, faster, more reliable, more trustworthy and useful services. To this end, the KPI-to-KVI pathway: technical performance enables service quality; service quality shapes perceived usefulness; and these perceptions determine adoption, satisfaction, confidence and quality-of-life outcomes. The central methodological lesson is that Simplified Life cannot be measured only through network counters or platform logs. It requires more advance hybrid or mixed validation methods, combining objective KPIs, with subjective evidence from questionnaires, usability assessments and pre- and post-deployment surveys.

At a project level, Across the SNS JU portfolio, Simplified Life results consistently show that value emerges when technical network performance is translated into seamless user experience, although projects differ in focus and measurement maturity. SUNRISE-6G emphasizes infrastructure-level simplification, demonstrating that continuity and stability—through >99% session continuity and <50 ms interruption—can hide complex multi-access NTN/TN orchestration from users, ensuring uninterrupted service across PLMNs. In contrast, 6G-PATH provides the most comprehensive user-centric validation, showing that Simplified Life is strongly dependent on KPI performance, particularly reliability and latency. Its results highlight variability across verticals: high satisfaction (100%) when KPIs are met (UC-CITIES-2), and strong rejection (74% negative) when reliability is insufficient (UC-CITIES-3), confirming that perceived simplicity collapses when technical performance degrades.

Comparatively, iTrust6G shifts the focus from end-user experience to operational simplification, quantifying how automation, explainability and trust reduce system complexity for operators. Its measurable targets—such as 40% workload reduction, 50% faster response and 99.999% availability—complement SUNRISE-6G's network-level continuity and 6G-PATH's experiential validation, showing that Simplified Life spans both user and operator domains. TrialsNet reinforces the experiential dimension, reporting consistently high acceptance levels (80–92%) and demonstrating that immersive quality is directly tied to throughput, audio-visual performance and interaction smoothness, supported by robust behavioural methodologies (Likert, PLS-SEM).

Furthermore, 6G-DALI introduces a distinct but complementary perspective, where simplification is achieved through semantic alignment between user intent and system outputs, reducing friction in data interaction with a 90% satisfaction target. Finally, ENVELOPE highlights that in safety-critical domains such as CCAM, Simplified Life depends less on interface ease and more on trust, reliability, certification readiness and predictable system behaviour.

Overall, the updated SNS JU evidence confirms that Simplified Life is one of the most integrative KVI families, because it absorbs multiple KPI domains into a human-centred impact layer, while touches upon the great majority of the other KV families. The most common technical enablers include low-latency connectivity, reliable service continuity, cloud-edge architectures, AI/ML automation, explainable dashboards, policy engines, secure orchestration, immersive XR interfaces, real-time data platforms, scalable sensor networks, teleoperation, digital twins and LLM-based intent processing. The most common validation approaches remain surveys, interviews, focus groups and field-trial questionnaires,

but the new project evidence shows growing maturity through the use of pre/post trust surveys, workload analysis, orchestration logs, usability testing, PLS-SEM, task completion measurement and KPI-linked interpretation. The most robust future methodology should therefore combine three layers: objective technical KPIs, service-level experience metrics and user-reported KVI outcomes.

Finally, the cross-comparison across SNS JU projects' results shows three converging dimensions of Simplified Life: (i) invisible network continuity, (ii) KPI-driven user experience, and (iii) automation and trust-enabled operational simplification. These results confirm that Simplified Life is not a single measurable outcome, but rather a multi-layered KVI family, where technical performance, system intelligence and contextual trust jointly determine perceived simplicity across different verticals. At the same time, the results also reveal important challenges. Target values are still unevenly defined, many indicators remain qualitative, and cross-project comparability and harmonisation is limited by different vertical contexts and validation designs, that could be more aligned. This alignment would lead from project-specific evidence toward a more coherent methodological assessment on 6G societal benefits for daily life providing measurable societal value.

3.6. PERSONAL HEALTH & PROTECTION FROM HARM [KV#11]

Personal Health and Protection from Harm is considered as one of the mostly socially impactful and fundamental KVs, given the tight relationship with the EU citizens health and the protection of human life. The KV is closely aligned with UN Sustainable Development Goals, such as SDG 3 and broader ESG priorities. Within the context of 6G networks, the KV reflects directly the modern capabilities to safeguard human life, guarantee life quality and well-being, providing effective risks mitigation, arising from both physical and cyber environments. Moreover, the present KV family extends the evaluation framework toward human-centric societal benefits, linking to the actual contribution of 6G tech capabilities with tangible health and life privileges, such as reduced accidents, PPDR services for improved emergency response, enhanced safety, and protection against harm.

More specifically, the family's KVIs are also well-defined and established with measurement approaches, utilising both qualitative and quantitative methodologies, validated across diverse verticals (healthcare, industrial sectors and manufacturing, public mobility, smart mobility etc). KVIs build upon standardized KPI frameworks, including those defined by 3GPP (e.g., TS 22.261 for latency, reliability, and availability), ITU-T resilience and trust architectures, and cybersecurity standards such as ISO/IEC 27001 and the NIS2 Cybersecurity Framework. The related KVIs seem inherently being multi-dimensional, combining technical performance metrics with human behaviour and relevant perceptions, as well as the relative resilience.

In the great majority of the projects, Personal Health and Protection from Harm KVIs are often expressed as improvements against baseline societal conditions, with the operationalisation of measurements collected using a consistent mix of experimental validation frameworks, simulations, experts' assessments, and user-centric evaluation processes. For once again, the multi-sided approaches reflect the inherent complexity of measuring human-centric outcomes, where direct quantification is complemented by proxy indicators and stakeholders' needs, occurring and an inward-to-outward process, rather than the opposite. Despite the fact, KVIs research progress shows strong conceptual alignment on the conceptual definitions, the implementation varies significantly across projects due to differences in several verticals and domains, using different technologies, and validated in diversified environments.

The project-level analysis shows that 6G-EWOC and iSEE6G illustrate how integrated sensing, communication, and edge computing enhance real-time situational awareness, enabling more accurate hazard detection and improved emergency response. These approaches rely on core KPIs—such as

sensing accuracy, latency, and communication performance—which are interpreted as enablers of KVis like reduced injuries and more effective interventions. In parallel, 6G-SANDBOX and 6G-BRICKS emphasize resilience through the uninterrupted service continuity, demonstrating that reliable and uninterrupted connectivity is fundamental for safety in crisis scenarios. Here, KVis are often derived indirectly from improvements in latency, availability, and network stability, validated through trials and simulations, showcasing the direct interdependence between KVis and KPIs. At the same time, iTrust6G, FLECON-6G, and ENVELOPE highlight more explicit and measurable dimensions of safety. iTrust6G focuses on cybersecurity as a key component of protection from harm, achieving significant reductions in incidents and near-continuous service availability through AI-driven mechanisms. FLECON-6G examines the role of robust AI integration and user trust in ensuring safe system behavior, while ENVELOPE provides the most tangible societal outcomes, including substantial reductions in accident rates, faster emergency response times, and improved user well-being. Overall, the projects demonstrate strong alignment in linking KPIs to higher-level KVis, while differing in the degree of quantification and validation maturity, reflecting the diversity of use cases and methodological approaches in 6G safety research.

Finally, the results verify that health- and safety-related KVis are strongly dependent on underlying KPIs but require contextual interpretation to capture real societal impact. While technological enablers show clear potential, differences in methodologies and validation approaches highlight the need for more harmonized frameworks for measuring human-centric outcomes in 6G.

3.7. OTHER FAMILIES [KV #4,5,6, 9 AND 10]

Finally, the last section of the present whitepaper provides the evidence produced by the SNS JU projects for the remaining Key Value families, such as **Democracy, Cultural Connection, Knowledge, Digital Inclusion, and Personal Freedom**. The grouping of these five families is not based on any methodological or conceptual approach, and in any case does not aim to undermine the importance of the families, given their nature and the fact constitute core pillars of modern societies. The reasoning for this is the emerging 6G evaluation paradigm, extending beyond traditional performance-centric KPIs toward a holistic assessment of societal impact, ethical alignment, and human-centric value creation. In the context of the evolution from 5G/B5G to 6G, these KVis are increasingly embedded within the broader sustainability and societal frameworks defined by international bodies such as ITU-R IMT-2030 and the European Union's digital and ethical policy landscape. Unlike conventional KPIs, which focus on measurable technical outputs such as throughput, latency, or reliability, KVis aim to capture the qualitative and quantitative impact of 6G systems on societal structures, user empowerment, inclusiveness, and trust. This transition reflects a fundamental shift in network design philosophy, where technological excellence must be aligned with democratic values, cultural diversity, knowledge generation, equitable access, and individual autonomy.

Within this context, the **Democracy family** is primarily concerned with fairness, inclusiveness, and the equitable distribution of technological benefits. SNS JU projects such as 6G-BRICKS and FLECON-6G demonstrate that democracy-oriented KVis are often expressed through the dual definition of fairness and neutrality of AI/ML-driven decision-making processes and equitable services facilitating underserved populations. In particular, the fairness concept is defined as the ability of AI/ML algorithms to perform decisions free from discrimination and biases, measured through qualitative methods, such as questionnaires. Moreover, FLECON-6G extends the Democracy KVI into regulatory compliance and policy alignment, ensuring that 6G systems adhere to evolving legal frameworks and promote network neutrality. These KVis are typically validated through engagement with policymakers, regulatory reporting, and compliance audits, with ambitious targets such as 100% adherence to legal and ethical standards, relying on user surveys and stakeholder feedback, while others integrate quantitative proxies,

such as compliance rates or inclusiveness indices derived from underlying KPIs. This KPIs-KVIs interrelationship emerges, where specific metrics, such as accessibility, coverage, and service reliability, serve as enablers for digital inclusion, equitable access, and democratic participation.

In addition, the **Cultural Connection** family gives emphasis on the localization and contextual adaptation of 6G services, to operationalise through the customization of security policies and access control mechanisms to reflect regional regulations, cultural norms, and societal expectations (iTrust6G). Mostly, the validation approach relies on policy audits, scenario-based testing, and compliance verification, with target values typically expressed as high levels of localization coverage (e.g., $\geq 90\%$) and full compliance with regional regulations.

Furthermore, from a tech perspective, Cultural Connection KVIs are enabled by advanced policy engines, AI-driven configuration frameworks, and flexible access control systems capable of dynamic adaptation. These capabilities highlight the importance of programmability and modularity in 6G architectures, allowing networks to accommodate diverse regulatory and cultural requirements without compromising performance. However, similar to the Democracy KVI family, the measurement of cultural connection remains challenging due to its inherently context-dependent nature. While compliance rates and localization metrics provide useful quantitative proxies, the broader impact on cultural inclusivity and user acceptance often requires qualitative assessment methods.

The Knowledge family represents a more mature and quantifiable concept, focusing on the generation, utilization, and exchange of knowledge enabled by 6G technologies. For once again, knowledge-related KVIs can be directly linked to measurable improvements in AI performance, threat detection capabilities, and situational awareness (as in iTrust6G and iSEE6G). For example, automated policy interpretation and learning are evaluated through improvements in AI model accuracy over time, with targets such as a $\geq 20\%$ increase in interpretation accuracy across training iterations. Similarly, forensic analysis and threat prediction KVIs are quantified through standard ICT metrics, such as true positive rates, prediction accuracy, and false positive reduction, often achieving targets of $\geq 85\%$ accuracy and significant improvements over baseline systems.

In addition to performance-oriented knowledge generation, SNS JU projects also emphasize the importance of knowledge sharing and ecosystem-wide capacity building. The “Extending Knowledge” KVI captures the extent to which knowledge assets—such as datasets, reports, and operational playbooks—are shared among stakeholders, with targets including the dissemination of multiple knowledge assets and high levels of stakeholder satisfaction. Validation methods in this domain combine quantitative tracking of shared resources with qualitative surveys assessing their usefulness and adoption. Furthermore, projects like iSEE6G expand the Knowledge KVI into the domain of environmental and contextual awareness, leveraging integrated sensing, mapping, and positioning technologies to generate actionable insights for applications such as traffic management, agriculture, and public safety.

The Digital Inclusion KVI family reflects the strategic importance of ensuring equitable access to 6G services across diverse populations and geographical regions. Digital inclusion encompasses multiple dimensions, including accessibility, coverage, affordability, and usability, all of which are critical for bridging the digital divide. Projects such as SUNRISE-6G, 6G-SANDBOX, iTrust6G, and ETHER provide a comprehensive view of how digital inclusion KVIs are defined and validated in practice. For instance, SUNRISE-6G evaluates accessibility through the ability of edge computing resources to support autonomous systems, while 6G-SANDBOX focuses on the availability and reliability of remotely accessible experimentation facilities. Coverage KVIs, on the other hand, are concerned with extending connectivity to underserved areas, including rural regions and areas with limited terrestrial infrastructure. Projects leveraging non-terrestrial networks (NTN), UAV relays, and integrated terrestrial-satellite architectures demonstrate that 6G can achieve near-equal service quality across diverse environments, with targets often defined in terms of parity with well-covered areas.

iTrust6G introduces the “Threat Mitigation Effectiveness” KVI, which ensures that all user categories benefit from consistent levels of protection, with targets such as 100% user group coverage and $\geq 90\%$ consistency in threat protection. Similarly, projects like ACROSS and FLECON-6G highlight the role of automation and inclusive service design in reducing barriers to access, particularly for marginalized communities and users with disabilities. The common set of KVIs for real-world validation, including 100% coverage or universal accessibility.

Finally, the Personal Freedom KVI family addresses the critical dimension of user autonomy, privacy, and control over data and security in 6G environments. Projects such as iTrust6G demonstrate that personal freedom can be operationalized through user-centric design principles, including transparent consent management, configurable privacy settings, and the ability to override automated decisions. This KVI is defined as the extent to which users can exercise control over their data and interactions within the network, ensuring that technological advancements do not compromise individual rights. The validation of personal freedom KVIs relies heavily on user-centric methodologies, including surveys assessing perceived autonomy, as well as quantitative metrics such as the usage rate of privacy settings and the frequency of user interventions. Target values are typically expressed in terms of high user satisfaction (e.g., $\geq 85\%$ reporting improved control) and widespread availability of configurable features.

In conclusion, the analysis of **Democracy, Cultural Connection, Knowledge, Digital Inclusion, and Personal Freedom KVIs** across SNS JU projects confirms that 6G research is progressively aligning technological innovation with societal values and human-centric outcomes. While there is a strong convergence toward standardized definitions and policy frameworks, significant variation remains in terms of KPI selection, target values, and validation methodologies. The two core aspects are notable also in these families.

Firstly, the interrelationship and strong dependence between KPIs and KVIs is particularly evident in all KV families, at least for dedicated KVIs. For example, improvements in data rates, latency, reliability and coverage, sensing accuracy, and other processing capabilities directly translate into social benefits. In addition, low latency and high reliability are essential for real-time privacy management and user interaction, while robust security KPIs underpin trust and personal freedom. However, the diversity of use cases and application domains leads to significant variation in KPI selection, the target values, and validation methodologies, underscoring the need for harmonized frameworks to ensure comparability and scalability.

Secondly, the variability of definitions and results reflect the diverse nature of use cases and the inherent complexity of measuring societal impact. Nevertheless, the integration of KVIs into the 6G evaluation framework represents a critical step toward ensuring that future networks not only deliver superior performance, but also contribute to a more inclusive, equitable, and trustworthy digital society. Future work should focus on the harmonization of KVs descriptions, KVIs definitions, measurement methodologies, and the systematic integration of qualitative and quantitative approaches to capture the full spectrum of 6G impact.

4. EMPIRICAL INSIGHTS FROM DEFINITIONS

The main lessons learned from the present research indicate the following lessons learned and highlight the empirical practices:

- Both KVs and KVIs are inherently multi-dimensional, leading to an inherent challenge of increased generalisation and complexity, leaving multiple degrees of freedom, toward strict definitions. The ambition of the KVIs to capture complex societal values (e.g., democracy, trust, privacy, fairness, etc.) for the measurement of long-term impact, social acceptance, and user perception, as well as inherently complex values, is both an ally and a foe. This leads to the wider utilisation of hybrid methodologies and composite indicators. The current research paper illustrates examples of KVIs defined as an aggregation of multiple other indicators (e.g., security performance + User Trust + AI Explainability Metrics), making the definition inherently composite.
- Across all projects there is a valid conceptual alignment, but operational definitions remain heterogeneous, given the idiosyncratic needs of several verticals. KVIs are highly context-dependent and driven by use cases and verticals, since definitions and validation methodologies depend highly on the application domains. While most projects align conceptually with existing frameworks and standards, the actual implementation, especially for real-world scenarios and large-scale pilots of KVIs, varies significantly. This characteristic entails the risk of fragmentation in definitions and a lack of comparability, although it provides more valid, robust, and realistic results, while ensuring their relevance. Overall, the results from several projects, Phase 1 and Phase 2, seem to converge to the conclusion that there is a significant variation between verticals and use cases, which is highly valuable for KVI learning.
- There is a strong interdependency between traditional KPIs and KVIs in the formation of the definitions and validation frameworks. The vast majority of quantitative KVIs are derived from or supported by KPIs (e.g., MTTD, MTTR → trust; latency/security → privacy or inclusiveness, or even democracy). This creates a layered structure where KVIs represent value abstraction over existing KPI measurements. This fact and lesson showcase the emerging need for the creation of explicit standardised mappings, for the interconnection of technological performance and advancements of 6G toward the achievement of long-term impact. The roadmap leads to the need for a well-established ontology for Key Values, KVIs, and the KVIs-KPIs nexus to avoid fragmentation, ambiguity, and limiting interoperability of results.
- KVIs evolve dynamically with system maturity and experimentation phases, while they are tightly coupled with AI-related concepts. Early-stage projects define KVIs qualitatively or conceptually, while more mature projects refine them into quantifiable indicators. This iterative evolution highlights that KVI definitions are not static but co-developed with technological progress. In addition, KVIs increasingly integrate AI trustworthiness dimensions such as fairness, explainability, transparency, robustness, and accountability. This indicates that future KVI definitions cannot be decoupled from AI system behavior and governance, especially in the field of automation of decision-making and systems' policies execution.
- Overall, in spite of the fact that KV families and KVIs provide a powerful lens for the assessment of the societal impact of future generations of networks. Although there is great diversity among the definitions, methodologies, technologies involved as enablers, as well as the validation approaches, this underscores the need for continued efforts toward harmonization, standardization, and integration. This diversity reflects the inherent complexity of translating abstract societal values into measurable indicators. The advancements in this field should focus on developing robust, scalable, and comparable methodologies for measuring human-centric outcomes, while ensuring

that technological advancements are consistently aligned with the overarching Key Values within the 6G era.

5. KVIS TARGET VALUES & MEASUREMENT INSIGHTS AMONG SNS PROJECTS

Given the irreversible evolution of the 6G advancements, even at the current early stage of maturity, the importance of the transition from traditional and well-established performance-centric evaluation, the research communities tend to expand their interest in value generation assessment models and frameworks. This shift elevates the importance of the KVs measured with KVis as a complementary and transformative framework that aligns technological advancements with human and societal priorities, as reflected in the UN Sustainable Development Goals (SDGs) and the broader EU Digital and Green transition agenda. This necessity appears as a sufficient way forward for estimating and documenting with new datasets the systemic impact of 6G on society, economy, environment, and human well-being.

The current analysis manages to highlight and reveal that measurement methodologies and the validation approaches remain one of the most significant challenges in the operationalization of KVis. Of course, part of these challenges is due to the broader definitions of the KVs and the KVis utilised by the projects. Despite the great progress in defining baseline KVis and their target values, there is still a space for the conceptualisation of harmonized approaches into the following three aspects:

- The close relationship between the KPIs and KVis is one of the straightforward results, since the well-matured KPIs and the benefits of next generations of networks are clear in terms of definitions and KVis descriptions. In spite of the establishment of specific dedicated causal relationships between KPIs and KVis, needs further exploration.
- Another major challenge arises in the field of interoperability and comparability assurance in both projects and real-world implications in real operational environments. Scaling KVI during the validation phases in the technology transfer procedure from pilot environments to large-scale deployments entails a series of mismatches, systemic gaps, and risks during the integration process. The large heterogeneity across implementations of the same technologies into different domains, operational environments, and contexts needs to be comparable for the generation of better metrics of Value and Impact. The last mile will definitely be the validation of long-term societal impact and beyond controlled trial environments.

In response to those challenges, emerging best practices point toward the adoption of multi-layer/hybrid evaluation architectures, where technical validation (e.g., network performance testing) is complemented by user-centric validation (e.g., satisfaction surveys, trust assessments) and system-level impact analysis (e.g., socio-economic or environmental modelling). This layered approach enhances robustness and provides a more holistic understanding of 6G's value creation potential.

More specifically, the early experience from both the first phase SNS JU projects, as well as results from experimentation and real-world-based PoCs, UCs, trials, etc., drawing primarily on 6G-PATH end-to-end results, as an SNS project with Phase 1 KVI results, offers some important methodological lessons:

- **KVI frameworks must explicitly incorporate multi-phase validation processes, where each phase serves a distinct methodological purpose.** In particular, Phase 1 emerges as a foundational validation layer, focusing predominantly on the calibration of evaluation methodologies, measurement instruments, and data collection processes. At this stage, projects - especially early-stage Trials and Pilots (T&Ps) - are not expected to deliver statistically mature or generalisable impact results. Instead, their contribution lies in testing the validity, reliability, and sensitivity of KVI

constructs, ensuring that subsequent phases can produce credible and reproducible evidence. This phased approach aligns closely with the progressive maturation logic of experimental research and highlights that methodological robustness must precede impact quantification.

- KVI frameworks explicitly incorporate a structured, iterative, and multi-phase validation process, starting with the identification of KVs, for KVis evaluation.** These KVs must then be systematically aligned with concrete UCs and trial scenarios, so that abstract value dimensions are contextualised within realistic operational environments. KVs and KVis are supported by KVEs, creating measurable or assessable proxies of value realisation that combine quantitative system-level evidence, often linked to KPIs, with qualitative stakeholder-driven indicators. Afterwards, the methodological approaches are often calibrated through the definition of KPI–KVI linkages, qualitative or quantitative measurement tools, and finally, the evaluation is subsequently executed to capture results on the perceived value and contextual impact. Finally, this multi-phase approach confirms that early-stage trials should not be expected to deliver fully generalisable impact evidence, but should primarily validate the robustness, sensitivity, and credibility of the KVI framework, ensuring that later phases can produce stronger, more comparable, and policy-relevant evidence on the actual value generated by 6G systems.
- Reliability as a fundamental condition and foundational enabler for value realisation.** Across multiple projects, and clearly from 6G-PATH, reliability consistently functions as a moderating variable that directly influences higher-level KVis such as user satisfaction, trust, adoption, and perceived utility. Moreover, seems to be more important as an enabler than speed or latency, as well as all other performance and value dimensions. When reliability thresholds – particularly in terms of availability, latency stability, and service continuity – are not achieved, the entire value chain is disrupted, effectively suppressing the emergence of positive outcomes across all other dimensions. This effect is especially pronounced in mission-critical domains such as mission-critical PPDR, where performance is implicitly benchmarked against highly trusted legacy systems. In such contexts, KVis cannot be meaningfully assessed in isolation from minimum performance guarantees, reinforcing the need to treat reliability as a baseline prerequisite rather than a standalone indicator. In addition, reliability seems to be
- Domain-dependent value realisation.** KVis are most strongly validated in scenarios where direct and observable benefits can be clearly measured. Real-world problems and human needs provide tangible and quantifiable outcomes, while in sectors such as education and healthcare, digital inclusion is directly linked to measurable access and service delivery enhancements. Strongest evidence emerges where direct resource optimisation is observable (water conservation in farming) or where digital inclusion is technically enabled (education, healthcare); environmental and social impacts are often indirect and context-dependent. In contrast, broader environmental and societal impacts—such as sustainability, cultural cohesion, or social well-being—tend to manifest indirectly and over longer time horizons, making them inherently more difficult to quantify within the lifecycle of individual projects. This highlights the need for context-aware evaluation strategies, where the selection and interpretation of KVis are tailored to the specific characteristics and impact pathways of each domain.
- In practice, value creation rarely follows a direct mapping from a tech performance to societal outcomes.** Instead, it seems to emerge through a more complex chain of interactions involving organisational processes, real operations, user behaviour and expectations mechanisms, and other contextual or idiosyncratic conditions. To this end, the generalised [Value] → [Enabler] → [Performance] → [Impact] logic is more meaningful than direct mapping, which supports a linear and one-to-one relationship between KPIs and KVis. Within this type of formulation, technical KPIs act as enablers rather than direct determinants of value, which seems conceptually more accurate. Such a perspective underscores the importance of integrating intermediate variables, including user

engagement, trust formation, and operational adaptation, into KVI frameworks. It also reinforces the need for interdisciplinary approaches that bridge engineering metrics with social science methodologies.

- A further methodological tension identified detects a **trade-off between indicator breadth and data quality**. While comprehensive KVI frameworks aim to capture the full spectrum of potential impacts, excessively broad or unprioritised KVIs could potentially lead to respondent fatigue, inconsistent data collection, and reduced statistical reliability. Empirical evidence suggests that more effective approaches rely on a coherent set of focused KVIs, which can be adapted to particular use cases. This structured prioritisation not only improves data quality but also enhances the interpretability and comparability of results.
- Finally, the issue of **comparability across projects and use cases emerges as a critical design challenge**. This result needs to trigger the open dialogue on the “**Comparability and Interoperability-by-Design**”. The current diversity of methodologies, questionnaires, and measurement instruments significantly limits the ability to perform cross-project analysis and benchmarking. To address this, comparability must be designed into KVI frameworks from the outset, rather than treated as a post hoc consideration. This requires the development of harmonised core evaluation instruments, such as standardised questionnaires and baseline metrics, complemented by modular extensions tailored to specific sectors. In addition, stronger methodological practices—such as triangulation of data sources and inclusion of diverse stakeholder groups—are necessary to ensure robustness and representativeness. Without such alignment, the scalability and policy relevance of KVIs will remain constrained.

At a human-centric level, in a series of cases, there are several useful results on the human response and acceptance, providing real-world evidence on the relationship between technological advancements and human behavior. For instance, in some cases, user satisfaction and strong trust improve when reliability, latency, and monitoring KPIs are consistently met, whereas user satisfaction deteriorates when perceived reliability is compared unfavourably with legacy systems. Moreover, reliability perception decreases rapidly when technical failures occur, demonstrating that even promising immersive or advanced services cannot deliver simplified-life value and trust in cases where the underlying network and application KPIs are unstable or extremely volatile.

6. SUMMARY & CONCLUSIONS

With progressive evolution of the networks toward 6G and the research maturity, there is a clear and structural need for the completion of the traditional measurement of performance approaches, toward value-driven assessment frameworks. While KPIs remain the cornerstone of measurement methodologies for defining and validating technical capabilities, there is an emerging emphasis on understanding the broader societal, environmental, and economic implications of 6G technologies. This transition places KVis at the epicentre of 6G research, enabling systematic assessment of how networks and services contribute to societal priorities and sustainability objectives. The involvement of societal values, ethical considerations, and sustainability objectives at the core of 6G design and evaluation, KVis ensure that technological progress is not only efficient and innovative but also responsible, inclusive, and aligned with the broader vision of a prosperous digital future for EU citizens.

Current research shows that Key Values and KVis demonstrate significant progress in defining, structuring, and operationalizing KVis, as complementary instruments to KPIs, expanding benefits beyond the immediate performance gains and contributing to the long-term impact, including emerging dimensions such as sustainability, privacy, and trust, as well as ethical AI. There is a strong interrelationship between KPIs and KVis, on the one hand, for the quantification of the performance of network functions and technologies, and a convergence toward the interpretation of the actual results in terms of value creation and impact. For example, improvements in latency, reliability, or security response latency directly contribute to enhanced trust, better user experience, and increased societal acceptance. To this end, KPIs and KVis showcase interdependency confirming the extension of their relevance toward broader impact evaluation.

At the current maturity stage of 6G research, KVis are increasingly integrated into project design, experimentation, and validation processes. SNS JU projects are actively defining Key Values and corresponding KVis, supported by both qualitative and quantitative methodologies. These include system-level measurements based on traditional KPIs (e.g., latency reductions, energy savings, security response improvements), compliance-based assessments based on standards definitions and guidelines, and user-centric evaluations (e.g., surveys, perception metrics, trust scores, etc.). This hybrid methodological approach reflects the inherently multi-dimensional nature of KVis, as well as the core challenges towards the establishment of a complete measurement framework.

However, despite this conceptual alignment, the maturity of KVI measurement methodologies remains uneven. Many projects are still in early stages of defining concrete validation frameworks, target values, and standardized measurement approaches. While some KVis—particularly those related to security, energy efficiency, and privacy - are already supported by well-established KPI mappings and quantifiable metrics, others - such as trust, democracy, inclusiveness, fairness, and societal acceptance—rely more heavily on qualitative assessments and context-specific methodologies. This reflects a broader challenge in translating abstract values into measurable indicators that are both robust and comparable across different use cases.

Another important finding is the significant heterogeneity observed across KVis addressing the same Key Value. This variation is largely driven by the diversity of vertical sectors (e.g., farming and agriculture, education, healthcare, mobility, etc.), PoCs and use cases, as well as the technological architectures explored within SNS JU projects. This raises the need for tailored KVis to specific operational contexts, leading to differentiations in the definitions, measurement techniques, and target values. While this flexibility is necessary to address domain-specific requirements, it also highlights the need for identifying common benchmark/baseline metrics and developing multi-domain KVis that can enable comparability and benchmarking of the results.

The identification and role of the key enablers also emerge as a critical aspect of KVI realization, given the rise of AI/ML models and AI agents, which stand out as central drivers across multiple Key Value families. Advancements in AI enable advanced capabilities improving performance, efficiency, and trustworthiness, but also enhance potential risks. Other key enablers include edge-cloud continuum architectures, distributed intelligence, privacy-enhancing technologies, and secure orchestration frameworks, all contributing to the realization of value-driven 6G systems.

The core and recurring conclusion across this analysis is the need for harmonization and standardization of Key Value definitions and KVI measurement methodologies. Establishing common definitions, standardized metrics, and validated methodologies is therefore essential for advancing KVI research and ensuring that results can be consistently interpreted and applied comparably, consolidating existing research and knowledge on 6G. This is particularly important for enabling interoperability, supporting policy development, and facilitating the integration of KVIs into future standardization processes.

Furthermore, the evaluation of KVIs reveals a strong trend towards end-to-end and system-level assessment. Unlike traditional KPI evaluation, which often focuses on individual network components (e.g., RAN, core), KVI measurement increasingly considers the full lifecycle and operational context of services, including data generation, processing, decision-making, and user interaction. This holistic perspective is essential for capturing the true impact of 6G technologies, particularly in complex and distributed environments.

At the same time, the validation of KVIs is evolving toward more comprehensive and realistic approaches, including large-scale lab experimentation, proofs-of-concept, use cases, real-world pilots, and cross-domain testing. While early results from controlled environments demonstrate promising improvements across multiple Key Value families (e.g., enhanced trust, improved privacy, reduced energy consumption), further work is needed to validate these outcomes under dynamic, large-scale, and heterogeneous conditions.

In conclusion, the findings of this white paper confirm that KVIs are essential instruments for guiding the development of 6G networks toward a value-driven and sustainable future. They provide a structured framework for assessing the long-term impact of technological innovations, ensuring alignment with societal needs, regulatory requirements, and global sustainability goals. While significant progress has been made in defining and applying KVIs across SNS JU projects, the field remains in an early and evolving stage, characterized by methodological diversity and varying levels of maturity. Moving forward, the SNS JU and the TMV Working Group are uniquely positioned to lead the coordination of efforts, support the harmonization of approaches, and contribute to the establishment of new standards and policies.

7. ANNEX I – KVIS TABLES BY FAMILY CATEGORIES

Table 1: Environmental Sustainability Key Value: Definitions, Description, Verticals, and Technology Enablers

Project	KVI	Definition within the context of the project	PoC/ UC where this KVI is/ will be evaluated	Technology enablers
SUNRISE-6G	Reduction of travel (Carbon Footprint Reduction)	Metaverse and holographic communications can reduce the need for travel to meet up with others	Federated Metaverse	Federation Framework, NaaS API for higher performance and interoperability
6G-PATH	Water Conservation	Quantifies reductions in freshwater consumption achieved through 6G-enabled precision irrigation and soil moisture sensing - expressed as % reduction in water use efficiency (WUE) relative to conventional irrigation baselines, aligned with FAO benchmarks.	UC-FARM-1, UC-FARM-2	IoT-based soil moisture sensors; hydric stress analytics; phenology-aware irrigation; AI-driven irrigation scheduling; edge computing
6G-PATH	Energy Efficiency	Measures improvements in energy consumption per unit of output or service - including reductions in network energy use (bits-per-joule), building/facility energy consumption, and operational energy intensity attributable to 6G optimisation.	All 10 UCs	Energy-efficient sensor networks; optimised AGV routing; edge processing reducing cloud load; reduced travel; smart lighting/adaptive signals; low-power wearable sensors
6G-PATH	Soil & Land Health	Evaluates improvements in soil quality indicators - organic matter, compaction, erosion, soil organism biodiversity - achieved through 6G-enabled precision application of inputs, reducing soil degradation.	UC-FARM-1, UC-FARM-2	Continuous soil sensing; AI-based interventions; soil moisture prediction, preventing waterlogging; precision fertilisation, protecting soil microbiome; soil chemical balance analytics
6G-PATH	Carbon Emissions Reduction	Quantifies reductions in CO ₂ -equivalent greenhouse gas emissions - reduced vehicle kilometres, optimised energy consumption,	All 10 UCs	Traffic optimisation; reduced patient/provider travel; virtual field trips; optimised nurse routing;

		displacement of carbon-intensive processes, and improved supply chain efficiency.		electrified AGVs; fewer emergency dispatches; reduced commuting
6G-PATH	Improved Air Quality	Measures improvements in local air quality parameters enabled by 6G-supported real-time environmental monitoring, smart traffic management, and industrial emission control.	UC-CITIES-1, UC-CITIES-2	Environmental IoT sensors; dynamic traffic rerouting from pollution hotspots; low-emission zone management; electric AGVs replacing diesel forklifts; smart ventilation
6G-PATH	Sustainable Mobility	Assesses shift towards more sustainable transport modes - increases in public transport usage, active travel, shared mobility adoption, and reductions in urban traffic congestion and associated emissions.	UC-CITIES-1	Public transport optimisation; MaaS platforms; bike-sharing integration; intermodal journey planning; real-time transit information; congestion-aware rerouting
6G-PATH	Biodiversity & Green Space	Evaluates contribution of 6G-enabled smart city infrastructure to preservation and enhancement of urban biodiversity and green space - species monitoring, habitat connectivity, green infrastructure coverage per EU Biodiversity Strategy 2030.	UC-CITIES-1	IoT environmental sensing; AI optimisation for green management; urban heat island monitoring; green corridor planning; biodiversity sensor networks
6G-PATH	Natural Resource Conservation	Measures reduction in consumption or degradation of natural resources (water, minerals, land, ecosystems) attributable to 6G-enabled monitoring and management systems -	UC-CITIES-1, UC-CITIES-3	Environmental sensor networks; situational awareness for rapid environmental emergency response; water usage monitoring; urban forest health tracking; wildfire/flood early detection
6G-PATH	Waste Reduction	Quantifies reductions in waste generation enabled by 6G-supported real-time monitoring, predictive maintenance, and circular economy practices - electronic waste, food waste, packaging waste, industrial by-products	All 10 UCs	Digital-first content delivery; on-site 3D bioprinting eliminating packaging; reusable XR scenarios; optimised AGV handling; digital evidence management; reduced consumables

6G-PATH	Water Quality Protection	Assesses protection and improvement of surface/groundwater quality through 6G-enabled continuous environmental sensing and early warning - monitoring pollutant levels, agricultural runoff, urban discharge	UC-FARM-1, UC-FARM-2, UC-CITIES-1	Precision fertigation systems; runoff monitoring sensors; soil chemical balance analytics; environmental IoT sensors; real-time pollution detection
6G-EWOC	Precise positioning / localization		Crowdsourced Simultaneous Localization and Mapping (SLAM) data fusion for safe and efficient Advanced Driver Assistance Systems (ADAS) driving	
6G-EWOC	Provisioning of traffic flows,, achieving 50% reduction in energy consumption		AI-assisted network management and orchestration of packet optical infrastructure	
6G-SANDBOX	Reduction of the energy footprint of telecommunication solutions	Minimize the energy consumed by telecom infrastructure and services throughout their operation. It reflects improvements in energy efficiency of network components, optimized resource management, and intelligent network operation to deliver connectivity with lower overall energy consumption.	Sustainability-focused use cases evaluated via energy-aware experimentation on Trial Networks and Open Call projects	Energy Efficient Solution, Technologies with neutral environmental footprint
6G-SANDBOX	Reduction of materials usage of telecommunication solutions	Decrease the amount of physical materials (e.g., metals, electronics, cabling, and infrastructure components) required to deploy and operate telecom networks.	6G-SANDBOX Open Call experiments / Trial Networks	Energy Efficient Solution, Technologies with neutral environmental footprint

6G-SANDBOX	Environmentally neutral materials lifecycle of telecommunication solutions	Design, produce, operate, and dispose of telecom equipment in a way that minimizes environmental impact across its entire lifecycle. This includes using sustainable materials, improving recyclability, extending equipment lifetime, and promoting circular economy practices to reduce waste and resource consumption.	6G-SANDBOX Open Call experiments / Trial Networks	Energy Efficient Solution, Technologies with neutral environmental footprint
ITrust6G	Resource Efficiency.	Quick threat detection and mitigation minimizes prolonged service disruption, leading to less computational waste and reduced energy consumption. Along with optimized dynamic orchestration ensures that security resources are only used when needed, minimizing over-provisioning and unnecessary energy use.	UC1, UC2	AI-driven threat detection, dynamic resource orchestration, telemetry monitoring, cloud-native (Kubernetes) orchestration, energy-aware scheduling
iSEE-6G	Lower energy burden via WPT/SWIPT and energy-aware JCCSP	Measures whether wireless power transfer / energy harvesting and energy-aware computation reduce battery dependence and energy consumption in UAV/IoE scenarios.	<i>UC6 Energy harvesting; ORO outdoor PoC with UAVs and IoT devices testing WPT capabilities</i>	<i>WPT/SWIPT; RF energy harvesting; efficient waveforms; beamforming/RIS; MEC/edge intelligence</i>
6G-BRICKS	Energy Efficiency	Reduced energy consumption in the operation of the 6G system end-to-end targeting the long-term challenge of a sustainable and carbon-neutral world by 20230, according to United Nations Sustainable Development Goals (UN SDGs)	<i>Metaverse</i>	<i>CF mMIMO</i>
Eco-eNET	Optimisation of Energy Footprint for given services	Stakeholders addressed: Providers & Users. Low Energy Consumption/ Low Energy Resources utilization	Energy and Latency AI-optimised confluent mesh	AI/ML and transport network sensing along with O-RAN enabling energy efficient network operation.
ETHER	Energy efficiency	In ETHER we showcase that the unification of terrestrial with non-terrestrial networks, which	<i>ETHER 3 Use Cases:</i>	<i>i) Semantics-aware information handling at IoT terminals for ETHER Use Case 1.</i>

		the project brings forward, results in a notably higher energy efficiency..	a) <i>Service Provision to Delay-Tolerant IoT Applications.</i> b) <i>Broadband direct handheld device access.</i> c) <i>Air-Space safety Critical Operations</i>	ii) <i>Energy-efficient vertical handovers, with respect to state-of-the-art methods, from a terrestrial gNB to a satellite-based gNB for ETHER Use Case 2</i> iii) <i>Energy-efficient resource allocation (user association and VNF placement taking into account energy consumption requirements), with respect to state-of-the-art methods for ETHER Use Case 3.</i>
6G-DALI	Energy efficiency	Energy efficiency	* PoC2.1 - Hyperparameter optimization and placement of ML models at the Cloud-Edge-Continuum	* 6G Data Space * 6G-DALI Framework (LLM-based)
BeGREEN	Energy Reduction Consumption	"	1) <i>ISAC & RIS assisted coverage extension ending in base station power reduction</i> 2) <i>AI/ML based optimisaiton of RAN operations (energy efficiency improvement)</i> 3) <i>RU/DU acceleration (energy efficiency improvement)</i>	<i>Hardware acceleration; Radio front end design optimisaiton; ISAC & RIS; AI engine (e.g. for RU on/off scheme); BeGREEN Intelligence Plane; Relays.</i>

			4) RU energy consumption reduction (Power Amplifier blanking PoC)	
ACROSS	Network capabilities are environmentally responsible and energy efficient"		TC3.2	Energy-aware orchestration
FLECON-6G	Sustainability	Minimises resource consumption considering environmental, economic, and societal impacts.	Applies to all PoCs (PoC #1–#4)	AI-native Network Digital Twins (NDTs), AI orchestration and energy-efficient network designs for predictive optimisation and resource efficiency; TRL 4–5
FLECON-6G	Energy Efficiency	Reduces energy consumption at all architectural levels in 6G networks.	Applies to all PoCs (PoC #1–#4)	AI-native Network Digital Twins (NDTs), AI orchestration and energy-efficient network designs for predictive optimisation and resource efficiency; TRL 4–5
ENVELOPE	Sustainability	Minimises resource consumption considering environmental, economic, and societal impacts.	It-UC1, It-UC2	Dynamic management and orchestration of network and computing resources
ENVELOPE	Resource Usage Optimization -	"Efficiency in resource allocation in cloud and edge computing environments to	Dt-UC3	More efficient/lightweight architecture with less HW on the vehicle and with more software functionalities in the cloud, in line with the software defined vehicle concept.
ENVELOPE	minimize idle processing power and unnecessary storage. Measurement unit:		Dt-UC4	Tests and validation of new features and functionalities in the virtual environment. Reduction of the testing

				time on the test track as well as in the real world.
ENVELOPE	resource utilization percentage or efficiency rate."		<i>Dt-UC5</i>	Safe teleoperation of the automated driving systems could reduce the deployment of safety drivers in case of emergency situations.
ENVELOPE	Waste Reduction	The amount of electronic waste generated due to hardware upgrades or obsolescence by the ENVELOPE use case compared to the baseline. A reduction in hardware devices required by the ENVELOPE use case compared to baseline (for instance, having a more efficient architecture with fewer hardware nodes) would mean a reduction in hardware waste	<i>Gr-UC6</i>	Highly available and resilient service.
OPTI-6G	Material Handling	Autonomously manipulating parts and materials by robots and workstations in factory manufacturing	factory of the future lab emulation use case	More flexible factory with fewer HW configurations on workstations and robots, and with more software functionalities in the cloud,
OPTI-6G	Smart Transportation Vehicles	Autonomously Transports parts and materials in AGV within the factory	factory of the future lab emulation use case	More efficient/lightweight architecture with less HW on the AGV and with more software functionalities in the cloud, in line with the software-defined vehicle concept for processing Imaging and LIDAR sensing data
OPTI-6G	Offloading of the PLC Control Function to the Edge	Remotely processes sensing data of parts and materials on edge servers within the factory	factory of the future lab emulation use case	More flexible factory with fewer HW configurations on workstations and robots, and with more software functionalities in the cloud,

6G-INTENSE	Energy Efficiency	Reduced energy consumption in the operation of the 6G system end-to-end, targeting the long-term challenge of a sustainable and carbon-neutral world by 20230, according to UN SDGs	For Distributed Continuum and Metaverse	Intent-Based Networking (IBN), Network-Compute Fabric (NCF) Abstraction, and AI-Native Toolkit & Federated AI Plane and V-Apps
6G-INTENSE	Sustainability	Sustainability is the ultimate objective of 6G network design, since 6G should be sustainable from a wider socio-economic and environmental perspective, encompassing not only energy related aspects, but also natural resources consumption, products lifecycles, social sustainability, etc.	For Distributed Continuum	N/A
ADROIT6G	Energy Efficiency	Measures reduction in energy consumption across network, edge, AI processing and end devices, including energy-aware orchestration and AI-driven optimization.	PoC1, PoC2a, PoC2b, PoC3	Crowdsourcing AI, federated learning, AI compression, edge computing, energy-efficient orchestration
ADROIT6G	Sustainability	Measures environmental and socio-economic sustainability of 6G systems including CO2 reduction, resource optimization and efficient digital infrastructures.	PoC1, PoC2a, PoC2b, PoC3	AI-driven optimization, edge computing, NTN, energy-efficient orchestration
6G-VERSUS	Reduction of the energy consumption in remote sites (in remote base stations)	Advance features of 6G technology contributes to reduce energy consumption in remote sites.	<i>Finland Cluster</i>	<i>AI-based energy management; energy-aware network slicing; edge-cloud optimization; renewable-powered base stations</i>
6G-VERSUS	Avoiding energy waste - inefficient use or loss of energy during generation, transmission, or consumption	Advance features of 6G technology contributes to reduce energy waste.	<i>Finland Cluster</i>	<i>AI-driven optimization; predictive analytics; energy-aware scheduling; dynamic resource allocation</i>
6G-VERSUS	Increase in Renewable Energy Sources (RES)	The transition of energy systems towards RES will reduce the carbon footprint.	<i>Finland Cluster</i>	<i>Renewable energy integration; energy-aware orchestration; energy storage management</i>

6G-VERSUS	Increase in utilisation of RES (lead by avoiding of RES curtailment by 15%)	The use case will avoid RES curtailment by 15% which will increase the use of RES for energy generation.	Bulgarian Cluster	AI-based grid optimization; real-time monitoring; edge computing; network slicing; smart grid integration
6G-VERSUS	Reduced Land Disturbance and Habitat Disruptions.	The use case replaces the need for wired communication with mobile communication by connecting the monitoring and control functionality of renewable energy resources to the control centre of the grid via 5G. Therefore, the investment on wired connection is avoided.	Bulgarian Cluster	Wireless 6G connectivity replacing wired infrastructure; NTN; remote monitoring via IoT
6G-VERSUS	Increase in use of RES for energy generation.	Due to the faster and efficient integration of renewable energy to the grid, its capacity increase to absorb more renewable energy. Therefore, more RES will be used in energy generation.	Bulgarian Cluster	Renewable energy integration; smart grid interaction; energy-aware orchestration; energy storage management
6G-VERSUS	Efficient resource allocation (optimal use of resources)	Energy & Resource Efficiency: To what extent have 6G-based solutions (e.g., automation, real-time data sharing) helped reduce energy use or improve resource efficiency during operations?	Greek Cluster	<i>AI-driven resource orchestration; edge intelligence; digital twin of environmental systems; IoT-enabled sensing; network slicing</i>
6G-VERSUS	Prevention of wildfire spread.	Wildfire Spread Mitigation: How much do you think the 6G-based tools and early detection systems help in preventing or reducing the spread of wildfires?	Greek Cluster	Integrated sensing and communication (ISAC); UAV-assisted monitoring; AI-based early detection models; real-time data analytics at the edge; ultra-reliable low-latency communication (URLLC)
6G-VERSUS	Reduce of the disruptive use of the technology	Reduced Traditional/Disruptive Methods: In your opinion, have the 6G-enabled technologies reduced the need for traditional, more disruptive methods (e.g., helicopter surveillance) during emergencies?	Greek Cluster	low-power IoT devices; NTN; sustainable network deployment
6G-VERSUS	Energy Consumption	How do the advanced energy management features of 6G technology help optimise the	Portuguese Cluster	AI-driven energy optimization; energy-aware network orchestration; edge

		energy consumption of critical port infrastructure like smart lighting and network infrastructure, contributing to sustainability and operational efficiency?		computing for workload distribution; smart grid integration
6G-VERSUS	Proportion of Renewable Energy Use (EV Charging)	How does 6G-enabled monitoring and management enable increased use of renewable energy in EV charging, reducing the port's carbon footprint and supporting green transport initiatives?	Portuguese Cluster	Smart grid integration; AI-based energy scheduling; IoT-enabled EV charging infrastructure; demand-response optimization
6G-VERSUS	Proportion of Renewable Energy Use (Smart Lighting)	How can precise energy source tracking through 6G technology demonstrate the contribution of renewables powering smart lighting systems at the port, reinforcing clean energy adoption?	Portuguese Cluster	IoT-based smart lighting systems; adaptive control via AI; edge intelligence; energy-efficient communication protocols
6G-VERSUS	Environmental Incident Detection & Prevention	In what ways does 6G technology enable advanced real-time detection and prevention of abnormal events at the port to enhance environmental protection?	Portuguese Cluster	Integrated sensing and communication (ISAC); AI-based anomaly detection; IoT environmental sensors; edge analytics
6G-VERSUS	IoT devices lifetime	How does dynamic context-aware configuration of communication capabilities (e.g. scheduling) helps extending the lifetime of IoT devices while preserving the Port's environmental awareness objectives?	Portuguese Cluster	Ultra-low-power IoT protocols; energy harvesting; AI-based duty cycling; lightweight communication stacks; edge-assisted processing
6G-VERSUS	Road safety incident Detection & Prevention	In what ways does 6G technology enable advanced real-time detection and prevention of abnormal events at the port to enhance safety, environmental protection, and operational resilience?	Portuguese Cluster	V2X communication; AI-based video analytics; real-time edge processing; high-precision positioning; URLLC
6G-VERSUS	Environmental Monitoring Coverage	How does the deployment of 6G-enabled sensors across the operational land port area improve	Portuguese Cluster	NTN; dense IoT sensing networks; wide-area 6G connectivity; distributed sensing platforms

		environmental monitoring and inform decision-making for sustainability and compliance?		
6G-VERSUS	Water Usage Efficiency	How can advanced water management enabled by 6G connectivity support farmers in using less water while maintaining or increasing crop yields?	Spanish Cluster	IoT soil-moisture and irrigation sensing; real-time 6G connectivity for field monitoring; edge AI for irrigation optimisation; digital twin support for precision agriculture; automated smart irrigation control
6G-VERSUS	Productivity Increase	How do real-time analytics and automation enabled by 6G contribute to increased crop productivity?	Spanish Cluster	Real-time monitoring; AI analytics for irrigation and crop management; autonomous/assisted control; edge computing for fast decisions
6G-VERSUS	Increase in Water Saving	How do advanced 6G features (real-time IoT sensing, AI-driven analytics) enable smarter irrigation for greater water savings in cities facing climate and demand stress?	French Cluster	Smart watering sensors; real-time 6G monitoring; AI-based scheduling; edge analytics; automated actuation
6G-VERSUS	Carbon Emissions Avoided	How can next-gen 6G connectivity and automation help us reduce the CO ₂ footprint in green infrastructure by optimizing resource use and operations?	French Cluster	AI-based optimisation of operations; smart resource management; remote monitoring; energy-efficient connectivity; digital twin for green infrastructure operations
6G-VERSUS	Cooling through Greenspace Watering	In what ways can ultra-low-latency 6G-powered monitoring optimize plant watering to reduce urban heatwaves and improve resilience?	French Cluster	Environmental sensing; real-time 6G control loops; edge AI for adaptive watering; automated irrigation systems
6G-VERSUS	Electronic Waste Footprint Reduction	How does virtualizing infrastructure with advanced 6G and AI reduce the need for physical devices, preventing e-waste and supporting a circular economy?	French Cluster	Virtualised/network-softwarised infrastructure; remote software updates; shared compute/network resources; circular device management

6G-VERSUS	Battery life extension	How can energy-efficient 6G architectures extend the operational life of IoT sensors, reducing waste and maintenance needs?	French Cluster	Ultra-low-power IoT communication; wake-up / duty-cycled sensing; edge-assisted processing; energy-efficient 6G protocols; adaptive transmission control
6G-VERSUS	Reduction in pollution incidents	How can integrated 6G data streams and stakeholder collaboration help us intercept urban pollutants before they harm waterways?	French Cluster	Multi-sensor environmental monitoring; AI-based anomaly/pollution detection; edge analytics; real-time alerting
6G-VERSUS	Preservation of green spaces	How do 6G-driven digital engagement and environmental monitoring help safeguard green spaces and support community stewardship?	French Cluster	Environmental monitoring platforms; digital community engagement tools; smart maintenance systems; remote sensing / IoT

Table 2: Environmental Sustainability Key Value: Validation Methods, Target Values and Related KPIs (and/or Results)

Project	KVIs	Validation Method	Target Value	Related KPIs to KVIs
SUNRISE-6G	Reduction of travels (Carbon Footprint Reduction)	Questionnaires and interviews [Likert Scale (1-5)]	>80% users agree with benefits of holographic comms and Metaverse; ask users for number of travels / year that could be saved (and associated km, and transport medium)	>80% users with positive feedback
6G-PATH	Water Conservation	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Energy Efficiency	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Soil & Land Health	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Carbon Emissions Reduction	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Improved Air Quality	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Sustainable Mobility	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Biodiversity & Green Space	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Natural Resource Conservation	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Waste Reduction	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Water Quality Protection	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-EWOC	Precise positioning / localization	Range precision better than 0.5 m and accuracy better than 60%.	Incremental reconstruction of scenes from multiple ego-poses and discrimination of	

			dynamic elements with range precision better than 0.5 m and ACC, better than 60%.	
6G-EWOC	Provisioning of traffic flows achieving 50% reduction of the energy consumption	50% reduction of the energy consumption	Provisioning of traffic flows achieving 50% reduction of the energy consumption	
6G-SANDBOX	Reduction of the energy footprint of telecommunication solutions	Actual system deployment / trials (energy monitoring during experiments; KPI-driven quantification) + stakeholder expert assessment		Network energy efficiency; Device energy efficiency; NFV energy efficiency; Computational resource utilization / optimization
6G-SANDBOX	Reduction of materials usage of telecommunication solutions	Expert assessment + lifecycle / desk-based analysis (e.g., LCA-style assessment) (not directly measurable in the testbed unless extra accounting is added)		Material efficiency (kg/unit service); Resource utilization efficiency; Equipment lifetime; Reusability / recyclability rate; Network energy efficiency
6G-SANDBOX	Environmentally neutral materials lifecycle of telecommunication solutions	Expert assessment + lifecycle / desk-based analysis (LCA / sustainability assessment)		Lifecycle carbon footprint; Material recyclability rate; Resource efficiency; Energy consumption; Waste reduction rate
ITrust6G	Resource Efficiency	Compare total energy consumption and CPU utilization during baseline vs. optimized orchestration; compute reduction in idle/wasted compute cycles using monitoring telemetry.	$\geq 15\%$ reduction in energy consumption during active security operations compared to baseline.	Energy consumption per workload, CPU utilization efficiency, resource utilization rate, carbon footprint per service, workload consolidation ratio. [ETSI (ES 203 228, Green ICT), ITU-T (L.1330, L.1470), 3GPP (TR 32.972 – Energy Efficiency), ISO/IEC 30134 (Data centre KPIs)]
iSEE-6G	Lower energy burden via WPT/SWIPT and energy-aware JCCSP	Testbed measurement of harvested or transferred energy and service continuity; compare energy use per task or device vs non-WPT baseline in lab and outdoor PoC.	N/A	Power consumption; harvested energy; WPT efficiency; service continuity; energy per delivered bit/task

6G-BRICKS	Energy Efficiency	Questionnaires/Group Surveys		
Eco-eNET	Optimisation of Energy Footprint for given services	Measurements in trials/experiments/simulations.	Less energy consumption than baseline.	KPI 1: Energy Consumption
ETHER	Energy efficiency	"i) For Use Case 1 we showcase that the incorporation of semantics-aware information handling for IoT terminals, that dispatch their gathered data to LEO satellites, significantly reduces the volume of data by keeping the most significant information. This results to a notable decrease in their energy consumption.		
6G-DALI	Energy efficiency	ii) For ETHER Use Case 3 we showase that the consideration of not only the largest SNR value as a target (which the current handover algorithms principally consider), but also the system energy consumption, load conditions, visibility (for the case of NTN nodes), results in a substantially higher energy-efficient vertical handover.		
BeGREEN	Energy Consumption Reduction	iii) For ETHER Use Case 3 we showcase that by associating the users to terrestrial and non-terrestrial gNBs and placing the VNFs in the 3D terrestrial-non-terrestrial ecosystem taking into account the system energy consumption, a significantly more energy-efficient resource allocation is achieved compared to state-of-the-art methods that do not take it into account."	"i) >75% higher energy efficiency for ETHER Use Case 1, with respect to state-of-the-art methods, for Use Case 1 by leveraging the semantics-aware information handling for IoT devices.	
ACROSS	Network capabilities are environmentally responsible and energy efficient"	li) >70% more energy-efficient vertical handover from a terrestrial gNB to a non-terrestrial gNB for ETHER Use Case 2, with respect to state-of-the-art methods.		

FLECON-6G	Sustainability	HEXA-X-II methodology, PoC validation	Societal: GHG –30%; Economical: OPEX –20%; Environmental: Energy –90%	KPI-COM-02, KPI-SVC-04, KPI-COM-01
FLECON-6G	Energy Efficiency	ETSI standard energy per bit calculation	>90% energy savings vs 5G	KPI-COM-02, KPI-SVC-04
ENVELOPE	Sustainability	Areal data from FMI's open data service to be applied to generate production/PV- yield forecasts	Updated every 3 hours	
ENVELOPE	Resource Usage Optimization -	To be used to generate cumulative emission counter for power intake (from the grid) as an avoided CO2 KPI.	Original data 1/3 min, to be processed to match system boundary meter readings	
ENVELOPE	minimize idle processing power and unnecessary storage. Measurement unit:	Validation via measurement of Energy Consumption of technology elements	Not identified so far, related KPIs are the following: KPI 1: Energy Consumption and KPI2: EMF exposure	
ENVELOPE	resource utilization percentage or efficiency rate"	Validation via measurement of Energy Efficient network planning enabled by 6G-SENSES technology solution	Not identified so far, related KPIs are the following: KPI1: Coverage and KPI2: Energy Consumption	
ENVELOPE	Waste Reduction	"Objective Measure for Assessment: Energy consumption and efficiency for same task, per person in use case activity. Comparison Lab Trial vs Field Trial.	field trial results that show minimal change from the lab trials.	Related KPIs: Measure on Resource Utilization (MRU); Energy saving; verage Throughput Data rate HMD/edge; E2E Latency; User ; Average Throughput and Data rate HMDConnectivity/edge
OPTI-6G	Material Handling	Metrics from edge server	Carbon Footprint Reduction 2%, Energy Efficiency 20%, Resource Consumption 10%	N/A
OPTI-6G	Smart Transportation Vehicles	Performance Metrics from network	Carbon Footprint Reduction 2%, Energy Efficiency 10%, Resource Consumption 5%	N/A
OPTI-6G	Offloading of the PLC Control Function to the Edge	Metrics from edge server	Carbon Footprint Reduction 1%, Energy Efficiency 0%, Resource Consumption 5%	N/A

6G-INTENSE	Energy Efficiency	Standardized methodologies for energy definition by ETSI	Energy consumption per bit >90% (Standardized methodologies of ETSI)	N/A
6G-INTENSE	Sustainability	Measurement of CO2 emissions reductions	>30% CO2 emissions reductions in 6G systems	N/A
ADROIT6G	Energy Efficiency	ETSI energy methodologies, PoC measurements, energy-per-bit analysis	>90% energy efficiency improvement; 10x efficiency gains in MERGE component; ≥30% improvement in AI model compression	Energy Efficiency, Resource Utilization Efficiency, Device Density
ADROIT6G	Sustainability	Sustainability assessment, CO2 analysis, stakeholder surveys	>30% CO2 reduction; >80–90% positive sustainability perception	Energy Efficiency, Resource Utilization Efficiency
6G-VERSUS	Reduction of the energy consumption in remote sites (in remote base stations)	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Network energy efficiency; device energy efficiency; power consumption
6G-VERSUS	Avoiding energy waste - inefficient use or loss of energy during generation, transmission, or consumption	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Network energy efficiency; energy consumption; utilization efficiency; idle energy reduction
6G-VERSUS	Increase in Renewable Energy Sources (RES)	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Network energy efficiency; renewable energy utilization ratio
6G-VERSUS	Increase in utilisation of RES (lead by avoiding of RES curtailment by 15%)	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Network energy efficiency; renewable energy utilization ratio; power consumption; latency; reliability
6G-VERSUS	Reduced Land Disturbance and Habitat Disruptions.	(Questionnaires, surveys, focus group discussions, interviews)	N/A	

6G-VERSUS	Increase in use of RES for energy generation.	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Renewable energy utilization; network energy efficiency; service availability; data rate; latency
6G-VERSUS	Efficient resource allocation (optimal use of resources)	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Energy efficiency; latency; reliability; resource utilization efficiency; data processing efficiency
6G-VERSUS	Prevention of wildfire spread.	Questionnaires, surveys, focus group discussions, interviews)	N/A	
6G-VERSUS	Reduce of the disruptive use of the technology	Questionnaires, surveys, focus group discussions, interviews)	N/A	
6G-VERSUS	Energy Consumption	Quantitative; Qualitative (Focus groups or interviews)	N/A	Energy efficiency; network energy consumption; latency; network efficiency
6G-VERSUS	Proportion of Renewable Energy Use (EV Charging)	Quantitative; Qualitative: (Surveys)	N/A	Renewable energy utilization rate; energy efficiency; latency; service availability
6G-VERSUS	Proportion of Renewable Energy Use (Smart Lighting)	Quantitative; Qualitative: (Stakeholder interviews and focus groups)	N/A	Energy efficiency; energy consumption reduction; latency; reliability
6G-VERSUS	Environmental Incident Detection & Prevention	Quantitative; Qualitative: (Stakeholder interviews and focus groups)	N/A	Latency; reliability; detection accuracy; coverage; service availability
6G-VERSUS	IoT devices lifetime	Qualitative: Surveys	N/A	Device energy efficiency; battery lifetime; connectivity density; energy consumption
6G-VERSUS	Road safety incident Detection & Prevention	Quantitative; Qualitative: Stakeholder interviews and focus groups	N/A	Latency; reliability; positioning accuracy; service availability; throughput
6G-VERSUS	Environmental Monitoring Coverage	Quantitative: GIS mapping of sensor deployments and coverage calculations over operational land areas. Qualitative: Staff feedback	N/A	Coverage; connectivity density; data rate; service availability; reliability

6G-VERSUS	Water Usage Efficiency	Quantitative (sensor data, water usage logs); Qualitative (interviews)	N/A	Water consumption per hectare; irrigation efficiency; latency; reliability; crop yield
6G-VERSUS	Productivity Increase	Quantitative (yield metrics, production data).	N/A	Productivity per hectare; latency; reliability; decision accuracy
6G-VERSUS	Increase in Water Saving	Qualitative methods like semi-structured interviews and focus groups. Open-ended surveys	N/A	Water savings; irrigation efficiency; latency; reliability; service availability
6G-VERSUS	Carbon Emissions Avoided	Stakeholder interviews and focus groups; Narrative case studies Quantitative : Calculate CO ₂ saved from water, plant management, travel, battery data.	N/A	Carbon emissions reduction; energy consumption; operational efficiency; latency; reliability
6G-VERSUS	Cooling through Greenspace Watering	Interviews and focus groups; Participant observation and community workshops. Combined with open-ended surveys	N/A	Cooling effect; water-use efficiency; latency; reliability; service availability
6G-VERSUS	Electronic Waste Footprint Reduction	Semi-structured interviews and focus groups; Ethnographic studies; Participatory mapping and community workshops Quantitative	N/A	Device lifetime; reduction in physical device deployments; maintenance reduction; energy efficiency; service availability
6G-VERSUS	Battery life extension	Semi-structured interviews and focus groups; Ethnographic studies; Participatory mapping and community workshops Quantitative measure.	N/A	Battery lifetime; device energy efficiency; reliability; connectivity availability; maintenance interval
6G-VERSUS	Reduction in pollution incidents	Interviews and focus groups; Participant observation and community workshops. Combined with open-ended surveys	N/A	
6G-VERSUS	Preservation of greenspaces	Interviews and focus groups; Participant observation and community workshops. Combined with open-ended surveys	N/A	

Table 3: Societal Sustainability Key Value: Definitions, Description, Verticals, and Technology Enablers

Project	KVI	Description of the KVI in the context of the project	PoC/ UC where this KVI is/ will be evaluated	Technology Enablers
SUNRISE-6G	Safety: avoid risky travels and tasks	Remote user can meet together and conduct (shared) activities in the Metaverse, without having to travel and operating real machinery	Federated Metaverse	Network Exposure, Federation Framework, NaaS APIs
6G-PATH	Improved Public Health & Safety	Assesses the contribution of 6G deployments to measurable improvements in population health outcomes and physical safety - including faster emergency response, reduced accident rates, improved disease surveillance, and safer working/care conditions.	All 10 UCs (UC-FARM-1, UC-FARM-2, UC-EDU-1, UC-EDU-2, UC-EDU-3, UC-HEALTH-1, UC-HEALTH-2, UC-CITIES-1, UC-CITIES-2, UC-CITIES-3)	Real-time IoT monitoring; AI-based incident detection; V2X communication; wearable sensors; AGV collision avoidance; continuous wound monitoring; XR safety training
6G-PATH	Enhanced Quality of Life	Captures broader subjective and objective improvements in individuals' daily lives resulting from 6G-enabled services - including enhanced access to healthcare, education, social participation, reduced stress, and improved personal autonomy.	All 10 UCs (UC-FARM-1, UC-FARM-2, UC-EDU-1, UC-EDU-2, UC-EDU-3, UC-HEALTH-1, UC-HEALTH-2, UC-CITIES-1, UC-CITIES-2, UC-CITIES-3)	Home-based care delivery; automation reducing manual workload; remote monitoring; XR immersive experiences; meineReha exercise programme; reduced travel burden
6G-PATH	Digital Inclusion & Accessibility	Measures extent to which 6G deployments extend meaningful digital access to previously underserved populations - including rural communities, elderly users, people with disabilities, and low-income groups	All 10 UCs (UC-FARM-1, UC-FARM-2, UC-EDU-1, UC-EDU-2, UC-EDU-3, UC-HEALTH-1, UC-HEALTH-2, UC-CITIES-1, UC-CITIES-2, UC-CITIES-3)	Rural 5G/6G coverage; Terraview Crates; ORO 5GSA commercial network; VR Caravan; nomadic micro-networks; multilingual interfaces; assistive-feature design
6G-PATH	Reduced Digital Divide	Evaluates narrowing of capability and connectivity gaps between advantaged and disadvantaged groups or regions - measuring whether 6G deployment reduces service	All 10 UCs (UC-FARM-1, UC-FARM-2, UC-EDU-1, UC-EDU-2, UC-EDU-3, UC-HEALTH-1, UC-HEALTH-2, UC-CITIES-1, UC-CITIES-2, UC-CITIES-3)	Scalable modular deployment; private 5G/6G networks; standardised MCx quality; affordable edge solutions; rural nursing home connectivity

		quality, coverage, and digital skill disparities relative to EU benchmarks.		
6G-PATH	Inclusiveness & Equity of Access	Assesses whether 6G services are designed and delivered in ways equally accessible and usable across diverse demographic groups	All 10 UCs (UC-FARM-1, UC-FARM-2, UC-EDU-1, UC-EDU-2, UC-EDU-3, UC-HEALTH-1, UC-HEALTH-2, UC-CITIES-1, UC-CITIES-2, UC-CITIES-3)	Shared XR infrastructure; inclusive UX design; personalised environments; adaptive interfaces; modular Terraview Crates; tiered service models
6G-PATH	Improved Digital Skills & Competency	Measures gains in digital competencies resulting from 6G-enabled tool use - including basic digital literacy, advanced technical skills, and sector-specific capabilities (precision agriculture, XR clinical training, AGV operation).	All 10 UCs (UC-FARM-1, UC-FARM-2, UC-EDU-1, UC-EDU-2, UC-EDU-3, UC-HEALTH-1, UC-HEALTH-2, UC-CITIES-1, UC-CITIES-2, UC-CITIES-3)	Training programmes; XR interaction; digital dashboards; Nurse Care App proficiency; Digitaliada platform; 3D scanning; AGV operation interfaces
6G-PATH	Technology Adoption & Uptake	Evaluates rate and breadth of voluntary adoption of 6G-enabled services among target users	All 10 UCs (UC-FARM-1, UC-FARM-2, UC-EDU-1, UC-EDU-2, UC-EDU-3, UC-HEALTH-1, UC-HEALTH-2, UC-CITIES-1, UC-CITIES-2, UC-CITIES-3)	Demonstrated ROI; user-friendly interfaces; institutional pilots; cooperative adoption pathways; health authority endorsement; modular deployment
6G-PATH	Emergency Response & Preparedness	Assesses improvements in emergency response capability, coordination, and preparedness - including reduced response times, improved situational awareness, enhanced inter-agency communication, and crisis readiness	All 10 UCs (primary: UC-CITIES-3, UC-HEALTH-1/2, UC-CITIES-1)	Ultra-low latency MCx networks; real-time bodycam streaming; edge analytics; cross-agency dispatch; resilient nomadic networks; fall detection; XR emergency simulation
6G-PATH	Community Engagement & Trust	Measures degree to which 6G deployments foster community participation, stakeholder trust, and social licence to operate - including	All 10 UCs	Transparent data platforms; participatory dashboards; open data initiatives; community consultation;

		transparency of data use, community co-design, and public perception of benefit.		bodycam accountability mechanisms; cooperative data sharing
6G-PATH	Social Connectivity & Participation	Evaluates whether 6G-enabled services strengthen social bonds and civic participation - improved access to community services, enhanced remote collaboration, and greater participation in social, cultural, and civic life.	All 10 UCs	Cooperative data-sharing platforms; community irrigation scheduling; multi-trainee XR scenarios; cross-campus virtual teamwork; home-based care reducing isolation; public alert systems
6G-PATH	User Satisfaction & Perceived Value	Captures users' overall satisfaction with 6G-enabled services and subjective perception of value received relative to effort and cost	All 10 UCs	Demonstrated yield improvement; visible water savings; reduced labour burden; positive farmer/patient/operator experience; trainee confidence; effective emergency coordination
6G-PATH	Food Security Contribution	Measures the contribution of 6G-enabled precision agriculture to food security outcomes - crop yields, reduced post-harvest losses, improved supply chain reliability, and resilience of food production against climate variability	UC-FARM-1, UC-FARM-2	Drone-based phenology detection; hydric stress analytics; soil moisture prediction; predictive yield models; climate adaptation strategies; WUE optimisation
iTrust6G	Community-wide protection mechanisms benefiting all stakeholders.	The iTrust6G security mechanisms are designed to protect all entities—public services, private enterprises, and individual users—within a multi-domain network.	UC1, UC2, UC3	AI-based threat detection, cross-domain security orchestration, federated identity management, zero-trust architecture, Measure number and diversity of stakeholder domains protected (public/private/users); analyse incidents prevented or mitigated across domains; stakeholder satisfaction survey.

iSEE-6G	More resilient public services through integrated UAV corridors and 6G coordination	Measures the broader social value of safer UAV integration, improved disaster response, agricultural monitoring and autonomous-mobility support enabled by JCCSP.	UC2 UAV corridors; UC3 Safety enhancement; UC4 Agricultural industrial IoT; UC5 Connected & cooperative autonomous mobility	UAV corridors; JCCSP; MEC; integrated sensing; AI/ML; collaborative positioning
BeGREEN	Service Availability & Network Optimisation User experience improvement	Services are accessible and available to everyone	1) ISAC & RIS assisted coverage improvement 2) Relay assisted coverage efficiency improvement	ISAC; RIS; Relay.
OPTI-6G	Employee Safety and Well-being	Measures the extent to which employees remain safe	Autonomously manipulating parts and materials in manufacturing workstations; Autonomously Transports parts and materials within factory;	ISAC Cloud Edge Computing
OPTI-6G	Skills Development	Measures the extent to which AI is learnt	Remotely processes sensing data of parts and materials on edge servers within factory.	Cloud Edge Computing
OPTI-6G	Job Creation vs Automation Balance	Measures the jobs lost and won	Autonomously manipulating parts and materials in manufacturing workstations;	Cloud Edge Computing

			Autonomously Transports parts and materials within factory;	
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Table 4: Societal Sustainability Key Value: Validation Methods, Target Values and Related KPIs (and/or Results)

Project	KVI Name	Validation Method	Target Value	Related KPIs to KVIs
SUNRISE-6G	Safety: avoid risky travels and tasks	Questionnaires and interviews [Likert Scale (1-5)]	>80% users agree with benefits	>80% users agree with benefits
6G-PATH	Improved Public Health & Safety	Survey during and after trials, Focused Group Discussions/Interviews	N/A	
6G-PATH	Enhanced Quality of Life	Survey during and after trials, Focused Group Discussions/Interviews	N/A	
6G-PATH	Digital Inclusion & Accessibility	Survey during and after trials, Focused Group Discussions/Interviews	N/A	
6G-PATH	Reduced Digital Divide	Survey during and after trials, Focused Group Discussions/Interviews	N/A	
6G-PATH	Inclusiveness & Equity of Access	Survey during and after trials, Focused Group Discussions/Interviews	N/A	
6G-PATH	Improved Digital Skills & Competency	Survey during and after trials, Focused Group Discussions/Interviews	N/A	

6G-PATH	Technology Adoption & Uptake	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Emergency Response & Preparedness	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Community Engagement & Trust	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Social Connectivity & Participation	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	User Satisfaction & Perceived Value	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Food Security Contribution	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
ITrust6G	Community-wide protection mechanisms benefiting all stakeholders.	Measure number and diversity of stakeholder domains protected (public/private/users); analyse incidents prevented or mitigated across domains; conduct stakeholder satisfaction surveys and cross-domain security audits.	≥ 90% of stakeholder domains protected; ≥ 25% reduction in cross-domain incidents; ≥ 80% stakeholder satisfaction	Number of protected domains, incident reduction rate, stakeholder satisfaction index [ETSI ZSM, ITU-T X.805, 3GPP SA3 (Security), ISO/IEC 27001]

iSEE-6G	More resilient public services through integrated UAV corridors and 6G coordination	Cross-use-case validation in simulation, lab/HIL and PoC using service-continuity, safety-support and operational-effectiveness metrics.	N/A	Reliability; latency; localization accuracy; sensing accuracy; coverage; service continuity
BeGREEN	Service Availability & Network Optimisation User experience improvement	Lab demonstrations; Simulations.	Up to 50% energy saving in simulated scenarios	Same as previous column
OPTI-6G	Employee Safety and Well-being	factory of the future Lab demonstrations	Student projects	100% safe
OPTI-6G	Skills Development	factory of the future Lab demonstrations	Student projects	AI+ Robots, AI+AGVs
OPTI-6G	Job Creation vs Automation Balance	factory of the future Lab demonstrations	Student projects	50% gain / 50% loss

Table 5: Economic Sustainability Key Value: Definitions, Description, Verticals, and Technology Enablers

Project	KVI	Description of the KVI in the context of the project	PoC/ UC where this KVI is/ will be evaluated	Technology Enablers
SUNRISE-6G	Increase Productivity	The integration of 6G enablers in distributed Metaverse and holographic comm services will result in an increased productivity for online meetings and even shared collaborative tasks	Federated Metaverse	Network Exposure, Federation Framework, NaaS APIs
SUNRISE-6G	Increased efficiency in mining business	Mining robot applications rely on autonomous multi-agent systems for monitoring and exploration tasks. Efficiency of these tasks can be increased by offering low-latency, scalable, and self-healing capabilities through 6G-enabled edge-computing and high 6G uplink capacity.	Collaborative Robotic Exploration of Mining Environments UC	Edge computing, AI, RAN
6G-PATH	Operational Cost Savings	Measures the reduction in direct operational expenditure achieved through 6G-enabled automation, remote monitoring, and process optimisation - including labour, energy, and maintenance cost reductions attributable to the use case deployment.	All 10 UCs (UC-FARM-1, UC-FARM-2, UC-EDU-1, UC-EDU-2, UC-EDU-3, UC-HEALTH-1, UC-HEALTH-2, UC-CITIES-1, UC-CITIES-2, UC-CITIES-3)	IoT sensors; AI-driven automation; edge computing; precision monitoring; remote consultation platforms; AGV fleet management
6G-PATH	Profit / Revenue Enhancement	Captures improvements in revenue generation or profit margins enabled by 6G connectivity - e.g., higher crop yields, premium product quality, improved asset utilisation translating into financial returns for the operator.	UC-FARM-1, UC-FARM-2, UC-CITIES-1, UC-CITIES-2	Yield prediction models; quality optimisation analytics; digital advisory services; dynamic pricing engines; premium product certification
6G-PATH	New Revenue Streams	Assesses creation of entirely new income sources or business models made possible by 6G - e.g., data-as-a-service, precision agriculture platforms, nomadic healthcare micro-network services, remote clinical provision.	UC-FARM-1, UC-FARM-2, UC-HEALTH-1, UC-HEALTH-2, UC-CITIES-1, UC-CITIES-2, UC-CITIES-3	Data monetisation platforms; nomadic micro-network-as-a-service; MaaS subscription models; smart parking revenue; meineReha digital subscription

6G-PATH	Productivity & Efficiency Gains	Quantifies improvements in output per unit of input (time, resource, labour) attributable to 6G-enabled tools - including faster task completion, reduced downtime, and higher throughput in operational workflows.	All 10 UCs (UC-FARM-1, UC-FARM-2, UC-EDU-1, UC-EDU-2, UC-EDU-3, UC-HEALTH-1, UC-HEALTH-2, UC-CITIES-1, UC-CITIES-2, UC-CITIES-3)	Real-time monitoring; URLLC connectivity; AI-based scheduling; automated workflows; edge analytics; XR-assisted teaching; AGV automation
6G-PATH	Resource Efficiency Gains	Evaluates more effective utilisation of physical resources - water, materials, energy, spectrum - enabled by real-time 6G sensing and control, reducing waste and input costs while maintaining output quality.	All 10 UCs (UC-FARM-1, UC-FARM-2, UC-EDU-1, UC-EDU-2, UC-EDU-3, UC-HEALTH-1, UC-HEALTH-2, UC-CITIES-1, UC-CITIES-2, UC-CITIES-3)	Edge computing; AI-driven resource optimisation; precision sensing; energy-aware scheduling; optimised AGV routing; regenerative braking
6G SANDBOX	Affordable Cost for industry stakeholders to manufacture and provide the solution	Ensure that telecommunication solutions can be developed, produced, and deployed at economically viable costs for industry actors. It evaluates whether sustainable technologies and architectures remain financially feasible for manufacturers, operators, and service providers while delivering the intended services.	6G-SANDBOX Open Call experiments / Trial Networks	Low CAPEX/ OPEX solution
6G SANDBOX	High Benefit vs Cost ratio - for Industry to manufacture and proliferate/commercialise the solution	The ability of a telecommunication solution to deliver significant technical, operational, or economic benefits relative to its development, manufacturing, and deployment costs.	6G-SANDBOX Open Call experiments / Trial Networks	Low CAPEX/ OPEX solution
iTrust6G	Cost Reduction from Automated Security Provisioning and Reconfiguration.	Reduced costs in automated tasks that would have been done traditionally managed manually.	UC1,	Compare operational cost (man-hours, service downtime) between manual vs. automated security provisioning scenarios, Automation, intent-based networking, orchestration platforms (e.g., Kubernetes), AI-driven provisioning
iTrust6G	Reduced human resource	Intent-based management enables security to be configured without deep technical	UC1,	Intent-based management, AI/ML policy engines, low-

	dependency in deploying security policies.	knowledge, reducing the need for specialized personnel.		code/no-code interfaces, Record number of manual interventions required before vs. after intent-based automation deployment.
iTrust6G	Reduced Attack Costs	The project framework protects economic sustainability by reducing attack-induced costs.	UC2	AI-based threat mitigation, predictive analytics, automated incident response, Compare cost impact of simulated attacks with and without iTrust6G mitigation (downtime, recovery, service loss).
iTrust6G	Innovation Potential	Number and quality of innovative cybersecurity solutions developed and validated for 6G ecosystems	UC1	AI/ML innovation frameworks, open APIs, modular 6G architectures, Count of novel modules, patents, or research outputs validated in pilots; expert review of innovation score.
iSEE-6G	Resource and cost efficiency from unified JCCSP platform / aerial corridors	Measures whether integrating communication, computation, sensing and power transfer on one platform, plus aerial-corridor operation, reduces duplicated infrastructure/operations and enables new JCCSP-as-a-service models.	UC2 UAV corridors; UC5 Connected & cooperative autonomous mobility; ORO PoC / JCCSP-as-a-service	Unified JCCSP platform; aerial corridors; O-RAN/cell-free; edge computing; caching; AI-driven resource allocation
6G-BRICKS	Open Collaboration	Use methods based on collaboration and knowledge sharing and interaction according to their capacities	Metaverse	CF mMIMO
6G-BRICKS	Business Value	6G systems should demonstrate their commercial benefit for vertical industries and telco operators	Industry 4.0	RIS
6G-BRICKS	Economic Growth	Building a competitive and resilient economy, investing in skills, education, and digital transformation	Industry 4.0	RIS

6G-BRICKS	New Value Chain	The value chain in 6G is expected to increase as a consequence of inclusive (cooperative and interactive) industrialization	Industry 4.0	RIS
Eco-eNET	Reduction of TCO for service provisioning	Economically efficient solution provided to network operators. Economically efficient service provisioning to end users/ other actors	UC#3: CF/D-MIMO structures enabling Immersive Communication and HRLLC Usage Scenarios. UC#4: Energy and Latency AI-optimised confluent mesh.	CF/D-MIMO structures, AI/ML - optimised network management
PREDICT-6G	Business Value	Business impact and migration guidelines towards 6G scenarios	Smart Factory, Multi-Domain and Non-Deterministic Devices	TSN Networks, Non-Public Networks and Multi-Domain solutions
PREDICT-6G	Economic Growth	Business impact and migration guidelines towards 6G scenarios	Smart Factory, Multi-Domain and Non-Deterministic Devices	TSN Networks, Non-Public Networks and Multi-Domain solutions
ETHER	Sustainability	In ETHER we showcase that the unification of terrestrial with non-terrestrial networks, that the project brings forward, results in a substantial CAPEX and OPEX reduction with respect to a terrestrial-only deployment	ETHER Use Case 3: Air-Space safety Critical Operations	Horizontal and vertical handovers among terrestrial, aerial, and satellite-based gNBs for ETHER Use Case 3.
BeGREEN	Cost and resource usage reduction	vRAN deployments with shared computing infrastructure joint orchestration of vRAN and mobile edge services traffic aware management of NFV UPF	BeGREEN Intelligence plane PoC	AI engine BeGREEN Intelligence Plane
ACROSS	KVI 1.3 – Economic Growth	Cost savings via automation and faster service ordering (KPI-10, KPI-9.11–9.13).	<i>TC1.3, TC4.5</i>	<i>Cost-aware orchestration</i>
FLECON-6G	Business Value	Demonstrates benefits of 6G networks to MNOs; supports value creation and ROI.	Applies to all PoCs (PoC #1–#4)	Smart Marketplace, Arcadia framework; TRL 4–5
FLECON-6G	Economic Growth	Supports competitive and resilient economy via next-gen 6G services, skills, and digital transformation.	Applies to all PoCs (PoC #1–#4)	6G service performance, AI orchestration

FLECON-6G	Open Collaboration	Promotes knowledge sharing and collaborative methods across projects and stakeholders.	Applies to all PoCs (PoC #1–#4)	Technology clusters, SNS JU collaborations, DIH/6G-IA
FLECON-6G	New Value Chain	Engages new stakeholders to enhance and expand existing 5G value chains.	Applies to all PoCs (PoC #1–#4)	Workshops, webinars, dissemination platforms
ENVELOPE	Operational Cost Savings	Assesses the savings in vehicle operation and maintenance due to optimized routes, reduced idling, and real-time information sharing.	1) <i>It-UC1</i> , 2) <i>It-UC2</i> , 3) <i>Gr-UC6</i>	1) Vertical service for Advanced In-Service Reporting for Automated Driving Vehicles. 2) Vertical service for Dynamic Collaborative Mapping for Automated Driving. 3) Zero-touch automation, Predictive QoS.
ENVELOPE	CapEx Reduction	Cost reduction in acquiring, upgrading, and maintaining physical assets in comparison to baseline.	<i>It-UC2</i>	Vertical service for Dynamic Collaborative Mapping for Automated Driving.
ENVELOPE	Time To Market Reduction	Tracks the time taken to develop and launch new solutions or technologies.	1) <i>Dt-UC3</i> , 2) <i>Dt-UC4</i>	1) Monitoring and diagnostics software running in the cloud, much easier to update and maintain compared with the baseline situation, running on ECU, installed in the vehicle. 2) Virtualization of the tests, which reduces the resources needed during test track and real-world testing.
6G-INTENSE	Business Value	6G systems should demonstrate their commercial benefit for vertical industries and telco operators	Distributed Continuum and Metaverse	N/A
6G-INTENSE	Economic Growth	Building a competitive and resilient economy, investing in skills, education, and digital transformation	Distributed Continuum and Metaverse	N/A

6G-INTENSE	Open Collaboration	Use methods based on collaboration and knowledge sharing and interaction according to their capacities:	Distributed Continuum and Metaverse	N/A
6G-INTENSE	New Value Chain	The value chain in 6G is expected to increase as a consequence of inclusive (cooperative and interactive) industrialisation	N/A	N/A
ADROIT6G	Business Value	Evaluates commercial viability and business impact of 6G-enabled services and applications.	PoC2a, PoC2b, PoC3	AI-enabled orchestration, industrial IoT, NTN, holographic services
ADROIT6G	Economic Growth	Measures contribution of 6G systems to economic competitiveness, industrial productivity and digital transformation.	PoC2a, PoC2b, PoC3	6G-enabled industrial automation, AI optimization, edge computing
ADROIT6G	Open Collaboration	Measures collaboration, clustering and knowledge sharing across stakeholders, verticals and SNS/6G ecosystems.	PoC1, PoC3	Open APIs, orchestration frameworks, SNS clustering mechanisms
ADROIT6G	New Value Chain	Measures creation of new industrial ecosystems, new stakeholders and emerging vertical business models enabled by 6G.	PoC3	NTN, AI orchestration, collaborative robotics, holographic services
6G-VERSUS	Reduction of Capital Expenditure.	Advanced features of 6G technology contribute to the reduction of capital expenditure.	Finland Cluster	Network virtualization (NFV); cloud-native architecture; open RAN
6G-VERSUS	Reduction of Operating Cost	Advanced features of 6G technology contribute to reducing operational cost.	Finland Cluster	AI-driven automation; zero-touch network management; orchestration; predictive maintenance
6G-VERSUS	Increase in revenue of businesses in remote areas (reindeer owners, tourism related business in arctic region) / No of Businesses	Advanced features of 6G technology contribute to an increase in revenue of businesses in remote areas.	Finland Cluster	

6G-VERSUS	Increased participation in energy generations. (Wind, Solar and Microgrids)	Due to the faster and efficient integration of renewable energy to the grid, its capacity increase to absorb more renewable energy which will provide an opportunity for new RES owners to participate in energy generation.	Bulgarian Cluster	AI-based grid optimization; real-time monitoring; smart grid integration; IoT-based distributed energy management
6G-VERSUS	Optimizing revenue management of RES Owners	How do the advanced features of 6G technology contribute to optimize revenue management of RES owners?	Bulgarian Cluster	AI-driven automation; zero-touch network management; orchestration; predictive market modeling
6G-VERSUS	Reduction of Investment in communication infrastructure cost due to avoidance of using wired communication to mobile connection.	The use case avoids the use of wired communication with mobile network by to connect renewable energy resources to the grid. Therefore, the investment in wired connection is avoided.	Bulgarian Cluster	Network virtualization (NFV); network slicing; cloud-native architecture; open RAN
6G-VERSUS	Operational Cost saving	Operational Cost Reduction: To what extent have 6G technologies helped reduce operational costs (e.g., less manual work [reducing fully manual surveillance ultimately lowering overall operational expenses], fewer field missions, deploy portable systems)?	Greek Cluster	AI-driven network automation; SDN/NFV softwarization; edge computing; predictive maintenance
6G-VERSUS	CAPEX reduction	Lower Equipment Investments: Have the 6G-enabled systems reduced the need for expensive equipment or infrastructure investments?	Greek Cluster	Infrastructure sharing; NTN integration; virtualized network functions; cloud-native architecture; open RAN
6G-VERSUS	Operational cost savings	In what ways can data-driven decision-making supported by 6G reduce operational costs for growers?	Spanish Cluster	AI-based optimisation; precision irrigation/fertilisation control; predictive analytics; automation of field operations; edge/cloud decision support

6G-VERSUS	ROI from sustainability investments	In what ways do 6G-enabled efficiencies transform environmental actions into measurable financial returns for urban services?	French Cluster	Data-driven sustainability management; digital twin / analytics for cost-benefit tracking; AI optimisation of urban services
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Table 6: Economic Sustainability Key Value: Validation Methods, Target Values and Related KPIs to KVIs (and/or Results)

Project	KVI Name	Validation Method	Target Value	Related KPIs to KVIs
SUNRISE-6G	Increase Productivity	Session stability. Likert Scale (1-5)	>=20% Improvement in stability metrics (delays, fps, packet loss) compared to 5G baselines; >80% users agree with increased productivity	>=20% Improvement in objective metrics; >80% users with positive feedback
SUNRISE-6G	Increased efficiency in mining business	Measure resource allocation improvements and data transfer capability	KPI-UC2-1: 10Hz, KPI-UC2-3 not set	KPI-UC2-1 & KPI-UC2-3
6G-PATH	Operational Cost Savings	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	N/A
6G-PATH	Profit / Revenue Enhancement	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	N/A
6G-PATH	New Revenue Streams	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	N/A
6G-PATH	Productivity & Efficiency Gains	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	N/A
6G-PATH	Resource Efficiency Gains	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	N/A
6G SANDBOX	Affordable Cost for industry stakeholders to manufacture and provide the solution	Not assessable within 6G-SANDBOX experimentation (out of scope); expert assessment / business modelling	N/A	CAPEX; OPEX; Total Cost of Ownership (TCO); Cost per service delivered; Deployment cost
6G SANDBOX	High Benefit vs Cost ratio - for Industry to manufacture and proliferate/commercialise the solution	Not assessable within 6G-SANDBOX experimentation (out of scope); expert assessment / cost-benefit analysis	N/A	Cost-benefit ratio; ROI; Cost per performance unit; Service efficiency per cost; Revenue per service

iTrust6G	Cost Reduction from Automated Security Provisioning and Reconfiguration.	Compare operational cost (man-hours, service downtime) between manual vs. automated security provisioning scenarios using pilot deployments and cost modelling.	≥ 30% reduction in operational costs; ≥ 40% reduction in manual provisioning time	OPEX reduction, provisioning time, service downtime
iTrust6G	Reduced human resource dependency in deploying security policies.	Record number of manual interventions required before vs. after intent-based automation; measure reduction in required expert involvement through operational logs and task tracking.	≥ 50% reduction in manual interventions; ≥ 30% reduction in need for specialized personnel	Number of manual interventions, deployment time, staff effort
iTrust6G	Reduced Attack Costs	Compare cost impact of simulated cyberattacks (downtime, recovery time, service loss) with and without iTrust6G mitigation using controlled experiments.	≥ 35% reduction in attack-related costs; ≥ 40% reduction in downtime	Cost of incidents, downtime duration, recovery time
iTrust6G	Innovation Potential	Count number of developed modules, patents, and validated solutions in pilots; perform expert evaluation scoring and TRL assessment.	≥ 5 innovative solutions validated; ≥ 2 patents or exploitable results	Number of innovations, patents, technology readiness level (TRL) improvement
iSEE-6G	Resource and cost efficiency from unified JCCSP platform / aerial corridors	Comparative techno-economic assessment and PoC efficiency analysis against separated-function baseline; include infrastructure utilization and service continuity in representative scenarios.	N/A	Resource utilization; throughput; latency; availability; supported UAV/IoT nodes; coverage probability; operational-cost proxy
6G-BRICKS	Open Collaboration	Questionnaires	N/A	N/A
6G-BRICKS	Business Value	Group Surveys	N/A	N/A
6G-BRICKS	Economic Growth	Group Surveys	N/A	N/A
6G-BRICKS	New Value Chain	Group Surveys	N/A	N/A
Eco-eNET	Reduction of TCO for service provisioning	Assessment by technoeconomic studies.	CAPEX/OPEX costs less than baseline.	KPIs: CAPEX, OPEX, TCO
PREDICT-6G	Business Value	Ongoing work	Ongoing work	Ongoing work
PREDICT-6G	Economic Growth	Ongoing work	Ongoing work	Ongoing work

ETHER	Sustainability	In ETHER we validate this KVis by showcasing that the unified terrestrial-non-terrestrial architecture that it proposes meets the service requirements of Use Case 3 while resulting at the same time in a substantially lower CAPEX and OPEX reduction through our technoeconomic analysis model that has been reported in ETHER D2.3: Technoeconomic analysis and business plan	90% CAPEX and OPEX reduction of the ETHER 3D architecture with a respect to a solely terrestrial deployment	90% CAPEX and OPEX reduction of the ETHER 3D architecture with a respect to a solely terrestrial deployment
BeGREEN	Cost and resource usage reduction	Lab demonstrations.	NA	NA
ACROSS	KVI 1.3 – Economic Growth	Ordering time tests	Qualitative OPEX reduction	KPI-10; KPI-9.11–9.13; KPI-15.2
FLECON-6G	Business Value	Workshops with stakeholders	>30% increase in revenue streams	KPI-SVC-04
FLECON-6G	Economic Growth	Market analysis, PoC evaluation	N/A growth metrics	KPI-CAP-01, KPI-CAP-02, KPI-CAP-03
FLECON-6G	Open Collaboration	Engagement reporting, clustering activities	As per D&C KPIs (DoA sections 2.2.1.1 & 2.2.2)	KPI-COM-01
FLECON-6G	New Value Chain	Stakeholder registration and engagement tracking	>500 new stakeholders engaged	KPI-CAP-05
ENVELOPE	Operational Cost Savings	Assessment by expert.	Operational costs less than baseline.	N/A
ENVELOPE	CapEx Reduction	Assessment by expert.	CapEx costs less than baseline.	N/A
ENVELOPE	Time To Market Reduction	Assessment by expert.	1) Efficient and more economical software update related to advanced diagnostic features. 2) Reduction with 20% of test track and real-world testing, by test virtualization	N/A
ADROIT6G	Business Value	Arcadia framework workshops, stakeholder analysis, market assessment	Positive stakeholder perception; stakeholder measurable	QoE, Reliability, Scalability

			business growth and cost savings	
ADROIT6G	Economic Growth	Stakeholder workshops, economic assessments, industrial validation	Increased productivity and industrial efficiency	Throughput, Latency, Reliability
ADROIT6G	Open Collaboration	Participation tracking, collaboration KPIs, dissemination activities	Increased stakeholder engagement and collaborative activities	Connected devices, QoE
ADROIT6G	New Value Chain	Dissemination metrics, stakeholder participation, vertical onboarding	Increased number of verticals, devices and community networks	Scalability, Device Density, Reliability
6G-VERSUS	Reduction of Capital Expenditure.	(Questionnaires, surveys, focus group discussions, interviews)	N/A	CAPEX reduction; deployment cost; scalability; coverage; energy efficiency
6G-VERSUS	Reduction of Operating Cost	(Questionnaires, surveys, focus group discussions, interviews)	N/A	OPEX reduction; energy efficiency; latency; service availability; network efficiency
6G-VERSUS	Increase in revenue of businesses in remote areas (reindeer owners, tourism-related businesses in the Arctic region) / No of Businesses	(Questionnaires, surveys, focus group discussions, interviews)	N/A	N/A
6G-VERSUS	Increased participation in energy generation. (Wind, Solar, and Microgrids)	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Cost efficiency; service availability; latency; transaction throughput; reliability
6G-VERSUS	Optimizing revenue management of RES Owners	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Cost efficiency; latency; data processing efficiency; service availability

6G-VERSUS	Reduction of Investment in communication infrastructure cost due to the avoidance of using wired communication to mobile connection.	(Questionnaires, surveys, focus group discussions, interviews)	N/A	CAPEX/OPEX reduction; deployment cost; energy efficiency; service availability; scalability
6G-VERSUS	Operational Cost saving	(Questionnaires, surveys, focus group discussions, interviews)	N/A	OPEX reduction; energy efficiency; latency; service availability; network efficiency
6G-VERSUS	CAPEX reduction	(Questionnaires, surveys, focus group discussions, interviews)	N/A	CAPEX reduction; deployment cost; scalability; coverage; energy efficiency
6G-VERSUS	Operational cost savings	Quantitative	N/A	OPEX reduction; input cost reduction; water-use efficiency; productivity; latency
6G-VERSUS	ROI from sustainability investments	Qualitative: Interviews; Case studies and narrative analysis. Participatory workshops can enable stakeholders to define value and validate qualitative ROI indicators beyond financial metrics (Hubbard et al., 2010).	N/A	ROI; OPEX reduction; resource efficiency; service availability; operational efficiency

Table 7: Privacy & Confidentiality and Trust Key Value: Definitions, Description, Verticals, and Technology Enablers

Project	KVI	Description of the KVI in the context of the project	PoC/ UC where this KVI is/ will be evaluated	Technology Enablers
iTrust6G	Threat Intelligence Sharing Timeliness	Once threats are score and shared this KVI can measure how promptly and securely threat-related information is shared across stakeholders within the 6G ecosystem.	UC1, UC3	Secure information sharing platforms, encryption, CTI platforms, Measure time difference between threat identification and sharing across domains (CTI timestamps).
iTrust6G	Vulnerability Management Speed	How the iTrust6G framework assesses how quickly security vulnerabilities impacting privacy and confidentiality are identified, prioritized, and remediated within 6G systems.	UC3	Vulnerability scanning tools, patch management systems, AI-based prioritization, Measure time from vulnerability detection to patching/remediation using system logs.
6G-DALI	Accuracy	Accuracy of AI/ML models	PoC2.1 - Hyperparameter optimization and placement of ML models at the Cloud-Edge-Continuum PoC2.2 - ML model Benchmarking and drift detection during vertical application testing PoC3.1 - Large-scale experimentation for RLOps PoC3.2 - Medium-scale DT experimentation for O-RAN	* 6G Data Space * 6G-DALI Framework (LLM-based)"
6G-DALI	Reliability	Reliability of AI/ML models		
6G-DALI	Robustness	Robustness of AI/ML models		
6G-DALI	Accountability	Accountability of AI/ML models		
6G-DALI	Transparency	Transparency of AI/ML models		
6G-DALI	Bias	Bias in AI/ML models	PoC2.2 - ML model Benchmarking and drift detection during vertical application testing	"* 6G Data Space

ACROSS	KVI 3.2 – Security	AI robustness measured via reaction times, ACL effectiveness, recovery (KPI-8.x, KPI-14.x, KPI-6).	TC3.*, TC4.*	Robust ML detection + secure orchestration
ACROSS	KVI 3.3 – Privacy	Privacy-preserving analytics via KPI-9.20, KPI-12.x, KPI-15.x.	TC4.6, TC3.*	GDPR-aligned data flows
FLECON-6G	Privacy	Ensures appropriate use of end-user data, aligning with GDPR and enhancing confidence in data protection.	Applies to all PoCs (PoC #1–#4)	Privacy-preserving AI, data anonymization; TRL 4–5
FLECON-6G	Fairness	AI/ML algorithms perform decisions free from discrimination and bias, ensuring social justice and high-quality techniques.	Applies to all PoCs (PoC #1–#4)	Whitebox testing, debiasing AI models, metadata curation; TRL 4–5
FLECON-6G	Security	Protection of 6G networks and data against cybersecurity threats, ensuring robust design against attacks.	Applies to all PoCs (PoC #1–#4)	AI-driven framework, NDT security modules; TRL 4–5
FLECON-6G	Trustworthiness	6G networks support trust and distributed learning, ensuring end-to-end confidence in AI decisions.	Applies to all PoCs (PoC #1–#4)	NDTs, trustworthy AI, distributed learning; TRL 4–5
FLECON-6G	Responsibility	Ensures accountability and control in 6G networks through responsible innovation.	Applies to all PoCs (PoC #1–#4)	RACI methodology, Plan-Do-Check-Act; TRL 4–5
6G-INTENSE	Regulation	Comply with the legal and regulatory framework imposed by the law	Distributed Continuum	N/A
6G-INTENSE	Responsibility	Discrete roles/accountability for collaborating partners towards the design, management and use of 6G systems.	Distributed Continuum	N/A
ADROIT6G	Security	Evaluates robustness of 6G systems against cyber threats, protection of data, trusted orchestration and secure AI/ML operations across distributed infrastructures and multi-vendor environments.	PoC1, PoC2a, PoC3	AI-enabled security orchestration, BDix agents, federated learning, secure transfer learning, Zero-Touch Management
ADROIT6G	Privacy	Evaluates confidentiality, GDPR compliance and protection of user data during AI training, orchestration and communications.	PoC1, PoC3	Privacy-aware AI/ML pipelines, federated learning, secure orchestration

ADROIT6G	Fairness	Measures absence of algorithmic bias and fairness of AI/ML decisions across users, devices and services.	PoC1, PoC3	Fairness-aware AI models, metadata de-biasing, white-box testing
ADROIT6G	Trustworthiness	Measures trust in AI-driven decisions, infrastructure reliability, explainability and dependable network behaviour.	PoC1, PoC2a, PoC2b, PoC3	BDIx agents, Zero-Touch Management, AI orchestration, explainable AI
ADROIT6G	Responsibility	Evaluates accountability, transparency and controllability of AI-enabled 6G systems and orchestration mechanisms.	PoC1, PoC3	AI/ML orchestration, governance modules, BDIx agents, RACI governance structures
6G-VERSUS	Stakeholder Engagement Activities	How do 6G-enabled digital platforms and communication tools facilitate inclusive, diverse, and effective stakeholder engagement across port operations and community interactions?	Portuguese Cluster	Immersive communication; cloud-based collaboration tools; data-sharing platforms
6G-VERSUS	Cultural Acceptance Rate	How do advanced 6G features foster trust and acceptance of digital innovations within traditional farming communities?	Spanish Cluster	Explainable AI tools; trusted data governance; digital platforms; secure connectivity
6G-VERSUS	Trust in AI alert management	How do secure, transparent 6G-enabled AI alert systems foster greater trust for users managing critical infrastructure?	French Cluster	Secure and explainable AI alerting; trustworthy data governance; resilient 6G communication; human-in-the-loop alert management

Table 8: Privacy & Confidentiality and Trust Key Value: Validation Methods, Target Values and Related KPIs to KVIs (and/or Results)

Project	KVI	Validation Method	Target Value	Related KPIs
iTrust6G	Threat Intelligence Sharing Timeliness	Measure time difference between threat detection and information sharing using CTI timestamps; verify secure transmission via logging and encryption checks.	≤ 5 minutes average sharing delay; ≥ 95% secure transmission rate.	Sharing latency, data integrity, confidentiality compliance. STIX/TAXII (OASIS), ISO/IEC 27001, ETSI TS 103 645
iTrust6G	Vulnerability Management Speed	Measure time from vulnerability detection to remediation using system logs; compare performance before and after automation deployment.	≥ 40% reduction in remediation time; ≤ 24h critical patch deployment	Mean time to detect (MTTD), mean time to respond (MTTR), patching rate. CVE/NVD, ISO/IEC 30111, NIST SP 800-40
6G-DALI	Accuracy	ETHAI Methodology	N/A	N/A
6G-DALI	Reliability	ETHAI Methodology		
6G-DALI	Robustness	ETHAI Methodology		
6G-DALI	Accountability	ETHAI Methodology		
6G-DALI	Transparency	ETHAI Methodology		
6G-DALI	Bias	ETHAI Methodology	To be defined	To be defined
ACROSS	KVI 3.2 – Security	Reaction time + blocked traffic tests	Various KPIs achieved	KPI-8.x; KPI-14.1–14.2; KPI-6 [Hexa-X Security]

ACROSS	KVI 3.3 – Privacy	Data ingestion + inference resource logs	Qualitative	KPI-9.20; KPI-12.x; KPI-15.x. [Hexa-X Privacy]
FLECON-6G	Privacy	Dataset risk assessment, PoC evaluation, surveys	100% data anonymized	KPI-SEC-03
FLECON-6G	Fairness	PoC testing and verification methodology	100% AI models free from discrimination	KPI-COM-01
FLECON-6G	Security	Questionnaires, PoC security log analysis	(i) Address >95% of security concerns, (ii) 0% threats penetration	KPI-SEC-01, KPI-SEC-02, KPI-SEC-03
FLECON-6G	Trustworthiness	SLA measurements, PoC validation	Reduce SLA violations by ≥90%	KPI-SVC-01, KPI-SVC-02
FLECON-6G	Responsibility	Interviews of consortium partners	100% of technological consortium partners interviewed	KPI-SVC-02, KPI-SVC-03
6G-INTENSE	Regulation	Directly engage with policy makers	N/A	N/A
6G-INTENSE	Responsibility	RACI charts (identify and Interview consortium stakeholders)	N/A	N/A
6G-INTENSE	Privacy	N. of privacy issues in the datasets for ML/AI training	N/A	N/A
6G-INTENSE	Fairness	Whitebox testing	N/A	N/A
6G-INTENSE	Trustworthiness	Demonstration of trust through PoCs	N/A	N/A
ADROIT6G	Security	Security issue logs, vulnerability assessments, questionnaires, penetration testing, trust evaluation	100% personal data protected; reduced vulnerabilities; secure orchestration and trusted decisions	Reliability, Orchestration Efficiency, AI Model Selection Latency, Service Recovery Time
ADROIT6G	Privacy	Risk assessments, dataset analysis, privacy audits, surveys	>95% user privacy concerns addressed	Reliability, QoE, AI orchestration KPIs

ADROIT6G	Fairness	White-box testing, stakeholder evaluations, dataset audits	0% detectable bias; high stakeholder trust in fairness	QoE, AI Model Selection Latency
ADROIT6G	Trustworthiness	Trust assessments, operational validation, stakeholder perception analysis	>90% stakeholders deem system dependable; 100% network consistency	Reliability, Latency, QoE, Orchestration Efficiency
ADROIT6G	Responsibility	Governance mapping, system accountability review	0 user manipulation incidents; accountable system behaviours	AI Model Selection Latency, Orchestration Efficiency
6G-VERSUS	Stakeholder Engagement Activities	"Quantitative: Tracking number and type of engagement events (workshops, interviews, focus groups, trials).	N/A	Service availability; latency; data rate; user experience (QoE); reliability
6G-VERSUS	Cultural Acceptance Rate	Qualitative: Participant feedback surveys and interviews"	N/A	User acceptance rate; trust / satisfaction score; adoption rate; service reliability; service availability
6G-VERSUS	Trust in AI alert management	Quantitative (survey results); Qualitative (interviews, focus groups, ethnographic studies, participatory observation story telling)	N/A	User trust score; alert accuracy; false alarm rate; reliability; service availability

Table 9: Simplified Life Key Value: Definitions - Description, Verticals and Technology Enablers

Project	KVI	Description of the KVI in the context of the project	PoC/ UC where this KVI is/ will be evaluated	Technology Enablers
SUNRISE-6G	Service Availability / Reliability	Dedicated edge capacities can be requested and allow the service to run optimized with ideal capacities. Thanks to NaaS APIs, deployment can be requested as close as possible to the user.	Federated Metaverse	Network Exposure, Federation Framework, NaaS APIs
SUNRISE-6G	Service Availability / Reliability	Measures the percentage of time the UE retains active PDU session during and immediately after the inter-PLMN handover between terrestrial (PLMN-A) and satellite (PLMN-B). Evaluates network reliability during transition.	Multi-Operator and Multi-Access in NTN - Inter-PLMN Handover	MultiRAT dual connectivity
SUNRISE-6G	Session Continuity	Evaluates the ability of the system to maintain uninterrupted user sessions (TCP, ping, or video stream) across PLMNs. Quantifies interruption duration and reconnection success rate perceived at application level.	Multi-Operator and Multi-Access in NTN - Inter-PLMN Handover	MultiRAT dual connectivity
SUNRISE-6G	Path Resilience	Ability of the service to maintain performance when one path degrades or fails	Multi-Operator and Multi-Access in NTN - Dual Connectivity with MPTCP	MultiRAT dual connectivity
SUNRISE-6G	Coverage	Extending connectivity to remote locations, democratizing network access	Mobile Industrial Assets supported by NTN Edge Cloud and Communications	NTN Edge Cloud System Emulator
6G-PATH	Service Availability / Reliability	Measures the percentage of time the UE retains active PDU session during and immediately after the inter-PLMN handover between terrestrial (PLMN-A) and satellite (PLMN-B). Evaluates network reliability during transition.	Multi-Operator and Multi-Access in NTN - Inter-PLMN Handover	
6G-PATH	System Trustworthiness	Evaluates users' confidence in reliability, integrity, and dependability of the 6G-enabled system - trust in data accuracy, system uptime, vendor accountability	All 10 UCs	Certified devices; secure networks; AI wound assessment validation; bodycam footage security; explainable AI; URLLC deterministic networking; scenario accuracy validation

6G-PATH	Perceived Data Security & Privacy	Assesses users' subjective perception of how well personal and operational data is protected within the 6G-enabled service - perceived GDPR compliance, data minimisation, transparency of data processing, confidence in access controls	All 10 UCs	End-to-end encryption; GDPR-compliant data handling; edge-local processing (privacy-by-design); private 5G/6G network isolation; farmer/patient data ownership protocols
6G-PATH	Perceived Ease of Use	Measures degree to which users perceive the 6G-enabled service as easy to learn and operate without excessive cognitive load	All 10 UCs	Intuitive UX design; simplified dashboards; automated reports; guided onboarding; scenario selection interfaces; Nurse Care App simple workflows; minimal elderly user interaction required
6G-PATH	Data/Service Accessibility	Evaluates extent to which 6G-enabled data services and interfaces are accessible to all intended users - including those with disabilities, limited digital literacy, low-bandwidth connectivity	All 10 UCs	Open API platforms; multi-device accessibility; real-time data feeds; accessible information design; offline capability; edge-stored local data; HL7 FHIR cross-system access
6G-PATH	Perceived System Reliability	Captures users' perception of consistency and dependability of 6G service availability - subjective experience of service interruptions, downtime, and recovery time	All 10 UCs	URLLC connectivity; resilient nomadic networks; stable 6G connections; fault-tolerant protocols; Edge-Cloud synchronisation; smartwatch battery reliability; network slicing redundancy
6G-PATH	Perceived Responsiveness	Assesses users' subjective experience of system response speed and latency - perceived delay in data transmission, command execution, and feedback loops - distinct from technically measured latency KPI, capturing experiential impact of 6G ultra-low latency.	All 10 UCs	Low-latency private networks; edge processing for real-time analytics; URLLC for AGV/AAV control; immediate irrigation actuation; rapid MCx service activation; instant fall detection alerts

6G-PATH	Perceived Scalability	Measures users' and operators' perception of the system's ability to maintain service quality under increasing load, expanding user bases, and growing data volumes	All 10 UCs	Scalable sensor networks; cloud-edge architecture; elastic network slicing; modular Terraview Crates; nomadic network replicability; multi-facility deployment readiness
6G-PATH	Interactive Experience Quality	Evaluates overall quality of user interaction with 6G-enabled interfaces and applications - particularly immersive technologies (XR, haptics, holographics) - capturing engagement, naturalness, presence, and interaction fluidity	All 10 UCs	High-resolution drone image rendering; interactive phenology maps; AR field overlays; AAV real-time camera feeds; holographic communication; meineReha gamified exercise; AGV fleet dashboards
6G-PATH	Content Quality	Assesses accuracy, completeness, timeliness, and relevance of data and content delivered through 6G-enabled services - medical records, agricultural sensor data, educational materials, mission-critical information	All 10 Ucs	AI wound detection accuracy; high-resolution visualisation; validated traffic predictions; curriculum-aligned XR modules; AI incident assessment accuracy; clinically accurate scenarios
6G-PATH	Learning / Clinical Outcome Quality	Measures quality of learning or clinical outcomes achieved through 6G-enabled educational or healthcare interventions - knowledge retention, skill acquisition, clinical competency, patient health outcomes - via validated pre/post instruments.	UC-EDU-1, UC-EDU-2, UC-EDU-3, UC-HEALTH-1, UC-HEALTH-2	Pre/post assessment scoring; clinical competency benchmarking; wound healing rate tracking; fall reduction measurement; knowledge retention metrics; procedural accuracy evaluation
iTrust6G	Policy Automation & Explainability	Ensures that AI-driven decisions related to network trust, security, and privacy are not only effective but also explainable to stakeholders, thereby fostering accountability and trustworthiness in autonomous 6G systems.	UC3	Explainable AI, dashboards, policy engines, Validate that automated decisions generate interpretable explanations in operator dashboards.

iTrust6G	Cloud Native Security Agility	Automated Process ensures that security mechanisms can dynamically adapt to evolving threats and network conditions, supporting rapid deployment, automation, and continuous protection across distributed environments.	UC1, UC3	Cloud-native architectures, Kubernetes, CI/CD pipelines, Measure time from threat detection to reconfiguration of cloud-native service; validate with orchestration logs.
iTrust6G	Increased trust	Supports the creation of a trustworthy digital ecosystem where users can rely on the integrity, resilience, and accountability of AI-driven and automated network functions.	UC2, UC3	Trust frameworks, AI assurance tools, monitoring dashboards, Conduct user and operator trust surveys before and after iTrust6G deployment; analyse changes in trust indicators.
iTrust6G	Increased network reliability	The iTrust6G platform ensures that 6G networks maintain high availability, low failure rates, and seamless performance, supporting a hassle-free and resilient digital lifestyle.	UC2	Resilience mechanisms, fault management, redundancy systems, Monitor uptime percentage and mean time between failures (MTBF) across testbeds.
iTrust6G	User burden reduction	User Burden Reduction – Simplicity and automation reducing operational overhead.	UC3	Automation tools, AI assistants, user-friendly interfaces
TrialsNet	Perceived easiness, enjoyment and emotional quality of the experience in the venue	Questionnaires, 5-point likert scale, Partial least squares structural equation model (PLS-SEM)	UC10	low latency, seamless change of positions
TrialsNet	Perceived easiness, enjoyment and emotional quality of the experience at home	Questionnaires, 5-point likert scale, Partial least squares structural equation model (PLS-SEM)	UC10	audio clarity, image resolution, immersive experience,
TrialsNet	Perceived usefulness and ease of use	Questionnaires, 5-point likert scale, Partial least squares structural equation model (PLS-SEM)	UC10	user-friendly device, immersive experience

TrialsNet	Reported confidence in the reliability of the devices, network and over-the-top developed services and applications.	% of the users expressing positive evaluation regarding the reliability of the devices, network, developed applications and services.	UC2	
6G-DALI	User satisfaction	User satisfaction from intent-based data requests. Alignment of results with users' objectives and priorities	"* PoC1.1 - Data search and extraction via Gaia-X service catalogue	
ENVELOPE	Trust In CCAM	Evaluates the level of public trust and willingness to adopt CCAM technologies	* PoC1.2 - Data on-demand and enhanced ELT pipelines"	"* 6G Data Space
6G-VERSUS	Indirectly offering solutions to enhance resilience of 4G/5G/6G networks	Reliable continuous 6G connectivity during electricity distribution disruptions.	<i>Finland Cluster</i>	<i>Multi-connectivity; network redundancy; AI-based fault detection; self-healing networks; network slicing</i>
6G-VERSUS	Safety in hard-to-reach areas	Provide access in remote areas e.g., in the cases of emergencies.	<i>Finland Cluster</i>	<i>UAV/drone connectivity; NTN; edge AI; real-time monitoring</i>
6G-VERSUS	Increase in the grid stability (Reduced risk of blackouts)	Advanced features of 6G technology contribute to increase grid stability.	Bulgarian Cluster	AI-based anomaly detection; real-time grid control via URLLC; digital twin for grid simulation and prediction
6G-VERSUS	Increase in affordable and stable Renewable Energy supply.	Increase in the annual operational uptime percentage of RES support affordable and stable energy supply to the community.	Bulgarian Cluster	AI-driven energy pricing optimization; edge-cloud orchestration; smart metering via IoT; network slicing for energy services
6G-VERSUS	Reduced emergency response times in emergency situations	Faster Emergency Response: How much faster are emergency responses thanks to the use of new 6G-based communication and coordination tools?	Greek Cluster	<i>URLLC-enabled communication; edge computing for real-time decision-making; AI-based situational awareness; network slicing; positioning technologies</i>

6G-VERSUS	Reduction of risk of injuries and casualties sustained in rescue operations for affected civilians and first respondents.	Risk & Injury Reduction: Have the new 6G-enabled tools (e.g., robotics, AI detection) helped reduce risks or injuries for responders and civilians?	Greek Cluster	<i>AI-based predictive analytics; IoT-based environmental sensing; real-time communications; digital twin for disaster simulation</i>
6G-VERSUS	Success rate in rescue operational efficiency	Rescue Coordination Efficiency: How much have the 6G connectivity and AI tools improved the efficiency and coordination of rescue operations?	Greek Cluster	<i>Multi-agent coordination via 6G; edge-cloud collaborative AI; real-time video analytics; high-throughput communication</i>
6G-VERSUS	Better emergency preparedness	Emergency Preparedness Readiness: Advanced features of 6G contribute to improved emergency preparedness by enabling flexible and rapidly deployable network to support dynamic, on-demand responses during an emergency. Do you feel that 6G technologies have improved your organization's readiness and ability to respond to emergencies?	Greek Cluster	<i>Digital twin of disaster scenarios; AI-based risk prediction; simulation platforms; distributed sensing infrastructure</i>
6G-VERSUS	Workforce Upskilling	How does 6G-driven digital training and upskilling of port administration staff foster a competent workforce capable of managing advanced technologies and supporting digital transformation?	Portuguese Cluster	<i>XR-based training platforms; edge/cloud AI-assisted learning systems; high-throughput connectivity; digital twin for training</i>

Table 10: Simplified Life Key Value: Validation Methods, Target Values and Related KPIs to KVIs (and/or Results)

Project	KVI	Validation Method	Target Value	Related KPIs
SUNRISE-6G	Service Availability / Reliability	Service Interruption below certain Service Level Agreement (SLA) levels	Service running continuously for over 99.9% times, with delays lower than 200ms and fps >14	Service Availability > 99.9%; Delay 99.9% of times below 200 ms; Holo-call with > 14 fps
SUNRISE-6G	Service Availability / Reliability	Continuous session monitoring (ping, iperf3, logs) and PDU session tracking during handover events	Service interruption < 50 ms	KPI-UC3.2
SUNRISE-6G	Session Continuity	Traffic continuity tests using iperf3/ping/video stream - analysis of interruption time and reconnection rate	> 99 % session continuity / interruption < 50 ms	KPI-UC3.2
SUNRISE-6G	Path Resilience	The proportion of service performance that is maintained after the degradation or failure of one connectivity path	99% Performance retention under path degradation	KPI-UC3.2
SUNRISE-6G	Coverage	Measurements on extended remote locations number	RTT measurements via ping and iperf3 timestamping before/during/after handover, estimated equal access (e.g., data rate, latency, jitter) to resources when compared to traditionally good-coverage locations	All KPIs for UC3.1
6G-PATH	User Satisfaction	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	System Trustworthiness	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Perceived Data Security & Privacy	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Perceived Ease of Use	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Data/Service Accessibility	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	

6G-PATH	Perceived System Reliability	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Perceived Responsiveness	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Perceived Scalability	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Interactive Experience Quality	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Content Quality	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
6G-PATH	Learning / Clinical Outcome Quality	Survey during and after trials, Focused Group Discussions/ Interviews	N/A	
iTrust6G	Policy Automation & Explainability	Validate that AI-driven decisions generate interpretable explanations in dashboards; perform usability testing with operators.	≥ 90% explainable decisions; ≥ 85% operator satisfaction	Explainability index, user trust score, decision clarity
iTrust6G	Cloud Native Security Agility	Measure time from threat detection to system reconfiguration using orchestration logs; compare with baseline response times.	≤ 5 minutes reconfiguration time; ≥ 50% faster response vs baseline	Reconfiguration time, deployment speed, automation rate
iTrust6G	Increased trust	Conduct pre- and post-deployment surveys for users and operators; analyse changes in trust indicators and perception metrics.	≥ 20% increase in trust score post-deployment	Trust index, user satisfaction, system reliability perception
iTrust6G	Increased network reliability	Monitor uptime, failure rates, and MTBF across testbeds; compare against baseline network performance.	≥ 99.999% availability; ≥ 30% reduction in failure rates	Uptime, MTBF, failure rate
iTrust6G	User burden reduction	Measure task completion time and number of manual steps before and after automation; conduct usability assessments and workload analysis.	≥ 40% reduction in user/operator workload; ≥ 30% faster task completion	Task completion time, workload reduction, usability score
TrialsNet	Perceived easiness, enjoyment and emotional quality of the experience in the venue	Questionnaires	80.5% positive (target 70%)	"KPI#03 Downlink aggregate throughput

TrialsNet	Perceived easiness, enjoyment and emotional quality of the experience at home	Questionnaires	92.5% positive (target 70%)	KPI#04 Uplink aggregate throughput"
TrialsNet	Perceived usefulness and ease of use	Questionnaires	90.5% positive (target 70%)	"KPI#03 Downlink aggregate throughput
TrialsNet	Reported confidence in the reliability of the devices, network and over-the-top developed services and applications.	Questionnaires	88% positive (target 70%)	KPI#04 Uplink aggregate throughput"
6G-DALI	User satisfaction	ETHAI Methodology	90%	"KPI#03 Downlink aggregate throughput
ENVELOPE	Trust In CCAM	1) Assessment by expert 2) Assessment by expert 3) Questionnaires, interviews or focus groups	"1) A more efficient and safer approach to testing the CCAM, ADAS, and AV	
6G-VERSUS	Indirectly offering solutions to enhance resilience of 4G/5G/6G networks	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Service availability; reliability; packet loss rate; latency; recovery time
6G-VERSUS	Safety in hard-to-reach areas	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Latency; reliability; service availability; throughput
6G-VERSUS	Increase in the grid stability (Reduced risk of blackouts)	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Reliability; latency; service availability; packet loss rate; network resilience
6G-VERSUS	Increase in affordable and stable Renewable Energy supply.	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Energy efficiency; service availability; latency; cost efficiency; throughput

6G-VERSUS	Reduced emergency response times in emergency situations	(Questionnaires, surveys, focus group discussions, interviews)	N/A	End-to-end latency; reliability; service availability; positioning accuracy; throughput
6G-VERSUS	Reduction of risk of injuries and casualties sustained in rescue operations for affected civilians and first respondents.	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Reliability; latency; availability; prediction accuracy; coverage
6G-VERSUS	Success rate in rescue operational efficiency	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Throughput; latency; reliability; service availability
6G-VERSUS	Better emergency preparedness	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Reliability; availability; coverage; data rate; prediction accuracy
6G-VERSUS	Workforce Upskilling	"Quantitative;	N/A	

Table 11: Personal Health & Protection from Harm Key Value: Definitions – Description, Verticals, and Technology Enablers

Project	KVI	Description of the KVI in the context of the project	PoC/ UC where this KVI is/ will be evaluated	Technology Enablers
6G-EWOC	Joint communication and sensing	N/A	Connected LiDAR	Joint communication and sensing
6G-EWOC	Joint communication and sensing	N/A	Connected radar	Joint communication and sensing
6G-EWOC	Multi-agent supporting network architecture	N/A	AI-assisted energy-efficiency algorithm(s) and/or heuristics for multi-layer (packet/optical) networks	Multi-agent supporting network architecture
6G SANDBOX	Improved response times for critical and emergency service providers represented by various stakeholders.	Resilience is the ability to adapt and recover from challenging and unforeseen situations. In the context of a multi-stakeholder and open experimentation facility for 6G, resilience can be related to the ability of the facility to withstand unexpected events and continue to function effectively.	Resilience-oriented use cases addressing critical infrastructures (e.g., emergency response, healthcare, smart city safety), implemented via Trial Networks and Open Call experiments.	Improved response times for critical and emergency service providers represented by various stakeholders.
6G SANDBOX	Improved effectiveness of services in the event of disruptions of communication infrastructure or another crisis.	The ability of telecommunication systems to maintain or quickly restore essential services during failures, disasters, or emergency situations. It reflects the resilience and adaptability of the network to ensure reliable communication and service continuity under adverse conditions.	Resilience and crisis-management use cases evaluated through Trial Networks under disruption scenarios (Open Call experiments)	Improved effectiveness of services in the event of disruptions of communication infrastructure or another crisis.
iTrust6G	Protection from Cyber Harm and Service Disruption	The iTrust6G framework enhances protection against cyber threats that could impact users' safety, well-being, and access to critical services. By ensuring rapid threat detection and mitigation, the system reduces risks of	UC1, UC2, UC3	Protection from Cyber Harm and Service Disruption

		harm caused by service disruption, data breaches, or malicious attacks.		
iSEE6G	Protection from Cyber Harm and Service Disruption	The iTrust6G framework enhances protection against cyber threats that could impact users' safety, well-being, and access to critical services. By ensuring rapid threat detection and mitigation, the system reduces risks of harm caused by service disruption, data breaches, or malicious attacks.	UC1, UC2, UC3	AI-based threat detection, intrusion detection systems (IDS), automated incident response, resilience and redundancy mechanisms, secure communication protocols
6G-BRICKS	Safer emergency response through UAV-enabled situational awareness	Measures how JCCSP-enabled UAV monitoring, accurate positioning, sensing and edge support improve protection from harm in PPDR and hazardous environments.	UC3 Safety enhancement; aerial-corridor PoC with vehicular emergency-response incident (IMEC testbed)	UAVs; JCCSP/ISAC; integrated sensing; cell-free/O-RAN; MEC; AI/ML Enricher; collaborative positioning
6G-BRICKS	Safety	Safety refers to the ability of a system to avoid harming human life, the environment, or private property due to its unavailability (lack of communication)	Metaverse	CF mMIMO
6G-BRICKS	Safety	Safety refers to the ability of a system to avoid harming human life, the environment, or private property due to its unavailability (lack of communication)	Industry 4.0	RIS
FLECON-6G	Safety	Evaluates that unavailability or degradation of communication service does not negatively impact humans or the environment. Measures how 6G architectures improve confidence in technology acceleration regarding safety of people and processes.	Applies to all PoCs (PoC #1–#4)	AlaaS and AI-native Network Digital Twins supporting predictive analysis, service optimisation and business innovation; TRL 4–5
ENVELOPE	Accident Rate Reduction	Assesses the effectiveness of ENVELOPE solutions in preventing accidents	1) It-UC1, 2) It-UC2, 3) GR-UC6	(1) & (2) Vertical service for Advanced In-Service Reporting for Automated Driving Vehicles, 3).Driver assistance

				system that helps reducing safety risks, predictive QoS.
ENVELOPE	Emergency Response Time	Assesses the decrease in response time for emergencies	1) It-UC1, 2) Dt-UC5	1) Vertical service for Advanced In-Service Reporting for Automated Driving Vehicles. 2) Advanced remote monitoring and safe teleoperation significantly reduce the response time in case of emergencies and allow the execution of certain emergency maneuvers via safe teleoperation
ENVELOPE	Less Stressful Mobility	Assesses the decrease in stress levels of citizens when using ENVELOPE mobility solutions compared to baseline	Dt-UC3	Autonomous vehicles (AVs) can decrease stress levels as users do not need to drive and can relax during travel
6G-INTENSE	Safety	Safety refers to the ability of a system to avoid harming human life, the environment, or private property due to its unavailability (lack of communication)		
6G-INTENSE	Safety	It entails the creation of systems that outline who has responsibility for monitoring threats as failure, hacking, and infection		
ADROIT6G	Safety	Measures how 6G systems improve operational safety, protection of humans, safer industrial environments, and confidence in autonomous and collaborative systems.	PoC1, PoC2a, PoC2b, PoC3	AI/ML BDlx agents, Zero-Touch Management, IIoT sensors, NTN, AI-driven orchestration, collaborative robots
6G-VERSUS	Community Health Engagement	How does 6G-facilitated information sharing and community engagement enhance awareness and action on health issues among agricultural communities?	Spanish Cluster	Community information platforms; real-time communication; edge-enabled data sharing; trusted local digital engagement tools

Table 12: Personal Health & Protection from Harm Key Value: Validation Methods, Target Values and Related KPIs to KVIs (and/or Results)

Project	KVI	Validation Method	Target Value	Related KPIs
6G-EWOC	Joint communication and sensing	"-High density point clouds within a camera-like FOV of 30°x20° at 7 fps	Demonstration of an enhanced pulsed MEMS-based LIDAR with sensing (high density point clouds within a camera-like FOV of 30°x20° at 7 fps) and FSO communication capabilities up to 200 m and <500 kHz PRR (bitrate) for ISAC applications in autonomous navigation systems	
6G-EWOC	Joint communication and sensing	- FSO communication capabilities up to 200 m and <500 kHz PRR"	Demonstration of a connected radar, showing simultaneously detection and communication capabilities for a range of <200 m and between 0.5 and 1 Gbps	
6G-EWOC	Multi-agent supporting network architecture	Detection and communication for a range of <200 m and between 0.5 and 1 Gbps	Provisioning of traffic flows in less than 60 seconds, considering packet and optical layers	
6G SANDBOX	Improved response times for critical and emergency service providers represented by various stakeholders.	Traffic flows in less than 60 seconds, considering packet and optical layers		U-Plane latency; C-Plane latency; Delay deviation / jitter; Packet loss rate; Service availability
6G SANDBOX	Improved effectiveness of services in the event of disruptions of communication infrastructure or another crisis.	Actual system deployment / trials (end-to-end experiment in Trial Network) + stakeholder expert assessment (compare response-time proxy metrics "before vs after"; validate with practitioner feedback)		Operational network reliability; Service availability; Packet / frame loss rate; U-Plane latency; Delay jitter
iTrust6G	Protection from Cyber Harm and Service Disruption	Measure reduction in security incidents impacting users; evaluate system response time to threats;	≥ 40% reduction in user-impacting incidents; ≥ 30% faster incident	Incident rate affecting users, MTTR, service availability, security breach

		assess service continuity during attacks through controlled simulations	response time; $\geq 99.99\%$ service availability during attacks	frequency, user safety perception index
iSEE6G	Protection from Cyber Harm and Service Disruption	Bottom-up validation via simulation, lab/clean-room HIL and PoCs; compare baseline vs JCCSP for localization, latency, coverage, sensing/tracking and service continuity in emergency scenarios.	N/A	Localization accuracy; end-to-end latency; reliability/availability; sensing detection/tracking accuracy; throughput
6G-BRICKS	Safer emergency response through UAV-enabled situational awareness	Questionnaires	N/A	N/A
6G-BRICKS	Safety	Questionnaires	N/A	N/A
6G-BRICKS	Safety	Technical assessment, and impact assessment study.	Increase in network availability	KPIs: Datarate, Latency, Jitter, Availability
6G-BRICKS	Safety	Technical assessment, and impact assessment study.	Increase in network availability	KPIs: Datarate, Latency, Jitter, Availability
6G-BRICKS	Accident Rate Reduction	Technical assessment, and impact assessment study.	Increase in network availability	KPIs: Datarate, Latency, Jitter, Availability
FLECON-6G	Emergency Response Time	Questionnaires, focused group surveys, PoC testing of hybrid model-based/data-driven AI	>95% optimal synthesis between data-driven and model-based learning	KPI-SVC-03, KPI-SVC-01
ENVELOPE	Less Stressful Mobility	Assessment by expert	1) 50% reduction in accidents compared to not using the driver assistance system implemented in ENVELOPE 2) Reduction in accidents compared to not using the driver assistance system implemented in ENVELOPE 3) Reduction of accidents due to early notification of hazards ahead, compared with baseline	
ENVELOPE	Safety	1) Assessment by expert 2) Measurements in trials/experiments/simulations	1) 30% reduction of time spent than baseline 2) Less time spent than baseline	

ENVELOPE	Safety	Assessment by expert	Less stress than baseline, since the vehicle operation is remotely monitored during operation. In some countries for driverless vehicles, remote monitoring is already required by the local regulation	
6G-INTENSE	Safety	Questionnaire and focused group surveys of stakeholders	N/A	N/A
6G-INTENSE	Community Health Engagement	Questionnaire and focused group surveys of stakeholders	N/A	N/A
ADROIT6G	Safety	User surveys, focused groups, PoC validation tests, safety incident monitoring, operational risk assessment	High user-centric perception of safety; decrease of operational risk; >95% system uptime in harsh environments	Reliability, End-to-End Latency, QoE, Service Recovery Time, Positioning Accuracy
6G-VERSUS	Joint communication and sensing	Quantitative (workshop attendance records, participation rates); Qualitative (participant feedback..interviews, focus groups)	N/A	Participation rate; service availability; user engagement rate; latency; reliability.

Table 13: Personal Health & Protection from Harm Key Value: Definitions – Description, Verticals, and Technology Enablers

Project	KVI	Description of the KVI in the context of the project	PoC/ UC where this KVI is/ will be evaluated	Technology Enablers
6G-EWOC	Joint communication and sensing	N/A	Connected LiDAR	Joint communication and sensing
6G-EWOC	Joint communication and sensing	N/A	Connected radar	Joint communication and sensing
6G-EWOC	Multi-agent supporting network architecture	N/A	AI-assisted energy-efficiency algorithm(s) and/or heuristics for multi-layer (packet/optical) networks	Multi-agent supporting network architecture

6G SANDBOX	Improved response times for critical and emergency service providers represented by various stakeholders.	Resilience is the ability to adapt and recover from challenging and unforeseen situations. In the context of a multi-stakeholder and open experimentation facility for 6G, resilience can be related to the ability of the facility to withstand unexpected events and continue to function effectively.	Resilience-oriented use cases addressing critical infrastructures (e.g., emergency response, healthcare, smart city safety), implemented via Trial Networks and Open Call experiments.	Improved response times for critical and emergency service providers represented by various stakeholders.
6G SANDBOX	Improved effectiveness of services in the event of disruptions of communication infrastructure or another crisis.	The ability of telecommunication systems to maintain or quickly restore essential services during failures, disasters, or emergency situations. It reflects the resilience and adaptability of the network to ensure reliable communication and service continuity under adverse conditions.	Resilience and crisis-management use cases evaluated through Trial Networks under disruption scenarios (Open Call experiments)	Improved effectiveness of services in the event of disruptions of communication infrastructure or another crisis.
iTrust6G	Protection from Cyber Harm and Service Disruption	The iTrust6G framework enhances protection against cyber threats that could impact users' safety, well-being, and access to critical services. By ensuring rapid threat detection and mitigation, the system reduces risks of harm caused by service disruption, data breaches, or malicious attacks.	UC1, UC2, UC3	Protection from Cyber Harm and Service Disruption
iSEE6G	Protection from Cyber Harm and Service Disruption	The iTrust6G framework enhances protection against cyber threats that could impact users' safety, well-being, and access to critical services. By ensuring rapid threat detection and mitigation, the system reduces risks of harm caused by service disruption, data breaches, or malicious attacks.	UC1, UC2, UC3	AI-based threat detection, intrusion detection systems (IDS), automated incident response, resilience and redundancy mechanisms, secure communication protocols
6G-BRICKS	Safer emergency response through UAV-enabled situational awareness	Measures how JCCSP-enabled UAV monitoring, accurate positioning, sensing and edge support improve protection from harm in PPDR and hazardous environments.	UC3 Safety enhancement; aerial-corridor PoC with vehicular emergency-response incident (IMEC testbed)	UAVs; JCCSP/ISAC; integrated sensing; cell-free/O-RAN; MEC; AI/ML Enricher; collaborative positioning

6G-BRICKS	Safety	Safety refers to the ability of a system to avoid harming human life, the environment, or private property due to its unavailability (lack of communication)	Metaverse	CF mMIMO
6G-BRICKS	Safety	Safety refers to the ability of a system to avoid harming human life, the environment, or private property due to its unavailability (lack of communication)	Industry 4.0	RIS
FLECON-6G	Safety	Evaluates that unavailability or degradation of communication service does not negatively impact humans or the environment. Measures how 6G architectures improve confidence in technology acceleration regarding safety of people and processes.	Applies to all PoCs (PoC #1–#4)	AlaaS and AI-native Network Digital Twins supporting predictive analysis, service optimisation and business innovation; TRL 4–5
ENVELOPE	Accident Reduction Rate	Assesses the effectiveness of ENVELOPE solutions in preventing accidents	1) It-UC1, 2) It-UC2, 3) GR-UC6	(1) & (2) Vertical service for Advanced In-Service Reporting for Automated Driving Vehicles, 3).Driver assistance system that helps reducing safety risks, predictive QoS.
ENVELOPE	Emergency Response Time	Assesses the decrease in response time for emergencies	1) It-UC1, 2) Dt-UC5	1) Vertical service for Advanced In-Service Reporting for Automated Driving Vehicles. 2) Advanced remote monitoring and safe teleoperation significantly reduce the response time in case of emergencies and allow the execution of certain emergency maneuvers via safe teleoperation
ENVELOPE	Less Stressful Mobility	Assesses the decrease in stress levels of citizens when using ENVELOPE mobility solutions compared to baseline	Dt-UC3	Autonomous vehicles (AVs) can decrease stress levels as users do not need to drive and can relax during travel

6G-INTENSE	Safety	Safety refers to the ability of a system to avoid harming human life, the environment, or private property due to its unavailability (lack of communication)		
6G-INTENSE	Safety	It entails the creation of systems that outline who has responsibility for monitoring threats as failure, hacking, and infection		
ADROIT6G	Safety	Measures how 6G systems improve operational safety, protection of humans, safer industrial environments, and confidence in autonomous and collaborative systems.	PoC1, PoC2a, PoC2b, PoC3	AI/ML BDlx agents, Zero-Touch Management, IIoT sensors, NTN, AI-driven orchestration, collaborative robots
6G-VERSUS	Community Health Engagement	How does 6G-facilitated information sharing and community engagement enhance awareness and action on health issues among agricultural communities?	Spanish Cluster	Community information platforms; real-time communication; edge-enabled data sharing; trusted local digital engagement tools

Table 14: Personal Health & Protection from Harm Key Value: Validation Methods, Target Values and Related KPIs to KVIs (and/or Results)

Project	KVI	Validation Method	Target Value	Related KPIs
6G-EWOC	Joint communication and sensing	"-High density point clouds within a camera-like FOV of 30°x20° at 7 fps	Demonstration of an enhanced pulsed MEMS-based LIDAR with sensing (high density point clouds within a camera-like FOV of 30°x20° at 7 fps) and FSO communication capabilities up to 200 m and <500 kHz PRR (bitrate) for ISAC applications in autonomous navigation systems	
6G-EWOC	Joint communication and sensing	- FSO communication capabilities up to 200 m and <500 kHz PRR"	Demonstration of a connected radar, showing simultaneously detection and communication capabilities for a range of <200 m and between 0.5 and 1 Gbps	
6G-EWOC	Multi-agent supporting network architecture	Detection and communication for a range of <200 m and between 0.5 and 1 Gbps	Provisioning of traffic flows in less than 60 seconds, considering packet and optical layers	
6G SANDBOX	Improved response times for critical and emergency service providers represented by various stakeholders.	Traffic flows in less than 60 seconds, considering packet and optical layers		U-Plane latency; C-Plane latency; Delay deviation / jitter; Packet loss rate; Service availability
6G SANDBOX	Improved effectiveness of services in the event of disruptions of communication infrastructure or another crisis.	Actual system deployment / trials (end-to-end experiment in Trial Network) + stakeholder expert assessment (compare response-time proxy metrics "before vs after"; validate with practitioner feedback)		Operational network reliability; Service availability; Packet / frame loss rate; U-Plane latency; Delay jitter
iTrust6G	Protection from Cyber Harm and Service Disruption	Measure reduction in security incidents impacting users; evaluate system response time to threats;	≥ 40% reduction in user-impacting incidents; ≥ 30% faster incident	Incident rate affecting users, MTTR, service availability, security breach

		assess service continuity during attacks through controlled simulations	response time; $\geq 99.99\%$ service availability during attacks	frequency, user safety perception index
iSEE6G	Protection from Cyber Harm and Service Disruption	Bottom-up validation via simulation, lab/clean-room HIL and PoCs; compare baseline vs JCCSP for localization, latency, coverage, sensing/tracking and service continuity in emergency scenarios.	N/A	Localization accuracy; end-to-end latency; reliability/availability; sensing detection/tracking accuracy; throughput
6G-BRICKS	Safer emergency response through UAV-enabled situational awareness	Questionnaires	N/A	N/A
6G-BRICKS	Safety	Questionnaires	N/A	N/A
6G-BRICKS	Safety	Technical assessment, and impact assessment study.	Increase in network availability	KPIs: Datarate, Latency, Jitter, Availability
6G-BRICKS	Safety	Technical assessment, and impact assessment study.	Increase in network availability	KPIs: Datarate, Latency, Jitter, Availability
6G-BRICKS	Accident Rate Reduction	Technical assessment, and impact assessment study.	Increase in network availability	KPIs: Datarate, Latency, Jitter, Availability
FLECON-6G	Emergency Response Time	Questionnaires, focused group surveys, PoC testing of hybrid model-based/data-driven AI	>95% optimal synthesis between data-driven and model-based learning	KPI-SVC-03, KPI-SVC-01
ENVELOPE	Less Stressful Mobility	Assessment by expert	1) 50% reduction in accidents compared to not using the driver assistance system implemented in ENVELOPE 2) Reduction in accidents compared to not using the driver assistance system implemented in ENVELOPE 3) Reduction of accidents due to early notification of hazards ahead, compared with baseline	
ENVELOPE	Safety	1) Assessment by expert 2) Measurements in trials/experiments/simulations	1) 30% reduction of time spent than baseline 2) Less time spent than baseline	

ENVELOPE	Safety	Assessment by expert	Less stress than baseline, since the vehicle operation is remotely monitored during operation. In some countries for driverless vehicles, remote monitoring is already required by the local regulation	
6G-INTENSE	Safety	Questionnaire and focused group surveys of stakeholders	N/A	N/A
6G-INTENSE	Community Health Engagement	Questionnaire and focused group surveys of stakeholders	N/A	N/A
ADROIT6G	Safety	User surveys, focused groups, PoC validation tests, safety incident monitoring, operational risk assessment	High user-centric perception of safety; decrease of operational risk; >95% system uptime in harsh environments	Reliability, End-to-End Latency, QoE, Service Recovery Time, Positioning Accuracy
6G-VERSUS	Joint communication and sensing	Quantitative (workshop attendance records, participation rates); Qualitative (participant feedback..interviews, focus groups)	N/A	Participation rate; service availability; user engagement rate; latency; reliability.

Table 15: Other Key Value Families: Definitions, Description, Verticals, and Technology Enablers

Project	KVI	Description of the KVI in the context of the project	PoC/ UC where this KVI is/ will be evaluated	Technology Enablers
DEMOCRACY KEY VALUE				
6G-BRICKS	Fairness	Ability of the AI/ML algorithms to make decisions free of discrimination and bias	Metaverse	CF mMIMO
6G-DALI	Ethics and Regulatory Compliance	Compliance with relevant ethics and regulatory requirements	"* PoC1.1 - Data search and extraction via Gaia-X service catalogue	
ADROIT6G	Regulation	Measures compliance with legal, ethical, and regulatory frameworks, including network neutrality, spectrum usage, data governance, and interoperability obligations.	PoC1, PoC2a, PoC2b, PoC3	MVNO support, orchestration platforms.
FLECON-6G	Regulation	Compliance with legal and policy frameworks, promoting network neutrality, and the adoption of 6G.	Applies to all PoCs (PoC #1–#4)	Regulatory monitoring, AI compliance modules; TRL 4–5
CULTURAL CONNECTION KEY VALUE				
iTrust6G	Localization of security policies and culturally relevant access rights.	The iTrust6G framework can allow for the customization of access policies that respect regional regulations, customs, or cultural practices.	UC2	Policy customization engines, access control systems, localization frameworks, review access control, and policy configuration supporting region/culture-based adaptations; compliance with local regulations.

KNOWLEDGEKEY VALUE				
iTrust6G	Automated policy interpretation and learning.	AI-driven engines interpret and enforce policies, continuously learning from past incidents to improve future response.	UC1	AI/ML learning systems, policy engines, feedback loops, Measure accuracy improvement rate in AI policy interpreter over training iterations; validation via test datasets.
iTrust6G	Accurate forensic insights and threat variant prediction.	Forensics capabilities help analyse attack methods and anticipate new threats based on detected variants.	UC1, UC3	Threat intelligence platforms, ML-based prediction models, forensic tools, Evaluate predictive accuracy (true positive rate) of threat variant prediction models vs. actual detected variants.
iTrust6G	Extending Knowledge	Extent of knowledge shared with stakeholders, fostering capacity-building and adoption	UC1, UC2, UC3	Knowledge sharing platforms, data spaces, collaboration tools, Count of knowledge assets shared (datasets, reports, playbooks); stakeholder survey on usefulness.
iSEE6G	Improved environmental / traffic / context knowledge via sensing, mapping and positioning	Measures the amount and usefulness of actionable knowledge generated by joint sensing, mapping and collaborative positioning for traffic management, agriculture and PPDR.	UC1 Cell-free JCS; UC4 Agricultural industrial IoT; UC5 CCAM	Integrated sensing; collaborative positioning; MEC-enabled mapping; EGNSS fusion; AI/ML analytics
Eco-eNET	Increase in # of educational products (lessons, material, etc.) that are available as immersive services	Remote, high-quality participation in education.	Provisioning of Immersive Communication and HRLLC usage scenarios.	CF/D-MIMO structures, AI/ML network orchestration

DIGITAL INCLUSION KEY VALUE				
SUNRISE-6G	Accessibility	Autonomous robot will benefit from edge computing to utilize edge resources to expand their autonomous and collaboration capabilities.	Collaborative Robotic Exploration of Mining Environments UC	Edge computing, AI, RAN
SUNRISE-6G	Accessibility	Addressing digital divide, supporting access to areas with reduced coverage via NTN (GA)	Mobile Industrial Assets supported by NTN Edge Cloud and Communications	NTN Edge Cloud System Emulator
6G SANDBOX	Inclusiveness ²	RESCUE (Open Call use case highlighting remotely accessible and highly available facilities)	Remotely accessible facilities, High availability of facilities, High reliability testing, High reliability of obtained results	Actual system deployment / operational validation + stakeholder assessment
6G SANDBOX	Accessibility of infrastructure to under-represented or marginalized communities ³	6G-SANDBOX Open Call experiments / Trial Networks	Remotely accessible facilities, High availability of facilities, High reliability testing, High reliability of obtained results	Expert assessment (stakeholder-based evaluation) + (optional) survey-based assessment; note partial scope limits
iTrust6G	Threat Mitigation Effectiveness	The ability to measures the ability of 6G systems through the iTrust6G scoring system to detect, prevent, and respond to threats effectively, while maintaining accessibility and trust for digitally included populations.	UC1, UC2, UC3	Inclusive design frameworks, adaptive security mechanisms, AI-based accessibility tools, Validate that all user categories (e.g., SMEs, public, private) benefit from consistent threat protection; accessibility testing of interfaces.

² Inclusiveness corresponds to the recognition that every member of society should have equal access to opportunities, resources, and services in the context of 6G networks. In the context of a multi-stakeholder and open experimentation facility, inclusiveness is related to ensuring that services are accessible and available to everyone, regardless of their location, income, or other factors.

³ The ability of telecommunication networks and services to be accessible and usable by populations that are typically underserved, such as rural, low-income, or socially marginalized groups. It reflects how effectively the infrastructure supports inclusive connectivity and reduces the digital divide.

iSEE6G	Better connectivity availability in remote / hard-to-reach areas via UAV relays	Measures whether UAV-assisted 6G connectivity and sensing improve access to networked services in remote, inaccessible or disrupted areas during public-safety or mobility scenarios.	UC3 Safety enhancement; aerial-corridor PoC; remote or inaccessible areas supported by UAV relays	UAV relays; 6G connectivity; cell-free architecture; MEC; integrated sensing
6G-BRICKS	Digital Inclusion	Deploy technologies that serve the historically under-served	Metaverse	CF mMIMO
6G-BRICKS	Digital Inclusion	Deploy technologies that serve the historically under-served	Industry 4.0	RIS
ETHER	Digital inclusion	Digital inclusion in the context of ETHER concerns the provision of 100% coverage to users, either terrestrial or aerial, across the globe. This is achieved by a unified terrestrial/non-terrestrial network	"ETHER Use Case 1: Service Provision to Delay-Tolerant IoT Applications.	N/A
ACROSS	KVI 1.1 – Digital Inclusion	ETHER Use Case 2: Broadband direct handheld device access.	N/A	N/A
FLECON-6G	Digital Inclusion	Deployment of technologies serving historically under-served populations; reducing digital divide.	Applies to all PoCs (PoC #1–#4)	Inclusive service design, accessible interfaces; TRL 4–5
ENVELOPE	Increase Users	ii) Vertical handover from a terrestrial gNB to a satellite-based gNB for ETHER Use Case 2.	N/A	N/A
ADROIT6G	Digital Inclusion	Measures accessibility and availability of 6G services to all demographics, including underserved communities and users with disabilities.	PoC1, PoC2a, PoC2b, PoC3	Massive connectivity, NTN, embedded devices, ubiquitous access technologies
6G-VERSUS	Digital inclusion; remote area connectivity	Providing availability of 5G/6G connectivity in remote areas.	Finland Cluster	NTN/satellite; private 5G systems; multi-connectivity; edge computing; wireless backhaul

6G-VERSUS	Reduced digital inequality	Provides all with digital connectivity regardless of living area, economic status, gender or ethnicity.	Finland Cluster	Low-cost network architectures; open RAN; scalable deployments; shared infrastructure
6G-VERSUS	Increase in access to 6G network for remote communities.	As 6G mobile network is extended into remote areas to connect RES to grid, this will enable communities in those remote areas to access 6G connections.	Bulgarian Cluster	NTN/satellite; dynamic spectrum sharing; cell-free massive MIMO; wireless backhaul
6G-VERSUS	Rural Workforce Retention	How might real-time information and support, delivered via 6G help make rural agricultural work more attractive and sustainable for local populations?	Spanish Cluster	Rural broadband connectivity; remote advisory and tele-support platforms; digital farming applications; edge/cloud data access
6G-VERSUS	Inclusiveness in Access	In what ways can 6G-enabled solutions reduce barriers and open up access to digital tools and markets for smallholder farmers and rural communities?	Spanish Cluster	Affordable rural connectivity; low-complexity IoT access; open digital platforms; shared infrastructure for underserved areas
6G-VERSUS	Technology adoption rate	How does 6G-powered connectivity accelerate the adoption of modern farming technologies among local communities?	Spanish Cluster	Reliable rural 6G coverage; digital advisory tools; interoperable smart farming platforms; easy-to-deploy IoT devices
PERSONAL FREEDOM KEY VALUE				
iTrust6G	User Autonomy and Control over Data & Security	The iTrust6G framework empowers users with control over their data, privacy settings, and security policies, enabling autonomous decision-making while ensuring protection across 6G environments. This includes user-centric consent management, transparency, and the ability to override automated decisions where appropriate.	UC1, UC2, UC3	User-centric identity management, privacy dashboards, consent management platforms, zero-trust architecture, and AI-assisted policy control

Table 16: Personal Health & Protection from Harm Key Value: Validation Methods, Target Values and Related KPIs to KVis (and/or Results)

Project	KVI	Description of the KVI in the context of the project	PoC/ UC where this KVI is/ will be evaluated	Technology Enablers
DEMOCRACY KEY VALUE				
6G-BRICKS	Fairness	Ability of the AI/ML algorithms to make decisions free of discrimination and bias	Metaverse	CF mMIMO
6G-DALI	Ethics and Regulatory Compliance	Compliance with relevant ethics and regulatory requirements	* PoC1.1 - Data search and extraction via Gaia-X service catalogue	
ADROIT6G	Regulation	Regulatory monitoring, stakeholder engagement, compliance reporting, and workshops with authorities	100% compliance capability with regulatory and legal frameworks	QoE, Reliability, Service Scalability
FLECON-6G	Regulation	Engagement with policymakers, reporting in D6.3/D6.4	100% AI operation compliance	KPI-SEC-02
CULTURAL CONNECTION KEY VALUE				
iTrust6G	Localization of security policies and culturally relevant access rights.	The iTrust6G framework can allow for the customization of access policies that respect regional regulations, customs, or cultural practices.	UC2	Policy customization engines, access control systems, localization frameworks, review access control, and policy configuration supporting region/culture-based adaptations; compliance with local regulations.
KNOWLEDGEKEY VALUE				

iTrust6G	Automated policy interpretation and learning.	AI-driven engines interpret and enforce policies, continuously learning from past incidents to improve future response.	UC1	AI/ML learning systems, policy engines, feedback loops, Measure accuracy improvement rate in AI policy interpreter over training iterations; validation via test datasets.
iTrust6G	Accurate forensic insights and threat variant prediction.	Forensics capabilities help analyse attack methods and anticipate new threats based on detected variants.	UC1, UC3	Threat intelligence platforms, ML-based prediction models, forensic tools, Evaluate predictive accuracy (true positive rate) of threat variant prediction models vs. actual detected variants.
iTrust6G	Extending Knowledge	Extent of knowledge shared with stakeholders, fostering capacity-building and adoption	UC1, UC2, UC3	Knowledge sharing platforms, data spaces, collaboration tools, Count of knowledge assets shared (datasets, reports, playbooks); stakeholder survey on usefulness.
iSEE6G	Improved environmental / traffic/context knowledge via sensing, mapping and positioning	Measures the amount and usefulness of actionable knowledge generated by joint sensing, mapping and collaborative positioning for traffic management, agriculture and PPDR.	UC1 Cell-free JCS; UC4 Agricultural industrial IoT; UC5 CCAM	Integrated sensing; collaborative positioning; MEC-enabled mapping; EGNSS fusion; AI/ML analytics
Eco-eNET	Increase in # of educational products (lessons, material, etc.) that are available as immersive services	Remote, high-quality participation in education.	Provisioning of Immersive Communication and HRLLC usage scenarios.	CF/D-MIMO structures, AI/ML network orchestration
DIGITAL INCLUSION KEY VALUE				

SUNRISE-6G	Accessibility	Availability and accessibility of edge resources for autonomy offloading	KPI-UC2-3: ...Mbps, KPI-UC2-4: radius (m)	KPI-UC2-1 & KPI-UC2-3
SUNRISE-6G	Accessibility	Measurements on areas with reduced or no terrestrial coverage	Estimated equal access (e.g., data rate, latency, jitter) to resources when compared to traditionally good-coverage locations	All KPIs for UC3.1
6G SANDBOX	Inclusiveness ⁴	RESCUE (Open Call use case highlighting remotely accessible and highly available facilities)	Remotely accessible facilities, High availability of facilities, High reliability testing, High reliability of obtained results	Actual system deployment / operational validation + stakeholder assessment
6G SANDBOX	Accessibility of infrastructure to under-represented or marginalized communities ⁵	6G-SANDBOX Open Call experiments / Trial Networks	Remotely accessible facilities, High availability of facilities, High reliability testing, High reliability of obtained results	Expert assessment (stakeholder-based evaluation) + (optional) survey-based assessment; note partial scope limits
iTrust6G	Threat Mitigation Effectiveness	The ability to measures the ability of 6G systems through the iTrust6G scoring system to detect, prevent, and respond to threats effectively, while maintaining accessibility and trust for digitally included populations.	UC1, UC2, UC3	Inclusive design frameworks, adaptive security mechanisms, AI-based accessibility tools, Validate that all user categories (e.g., SMEs, public, private) benefit from consistent threat protection; accessibility testing of interfaces.
iSEE6G	Better connectivity availability in remote / hard-to-	Measures whether UAV-assisted 6G connectivity and sensing improve access to networked services in remote, inaccessible or	UC3 Safety enhancement; aerial-corridor PoC; remote or	UAV relays; 6G connectivity; cell-free architecture; MEC; integrated sensing

⁴ Inclusiveness corresponds to the recognition that every member of society should have equal access to opportunities, resources, and services in the context of 6G networks. In the context of a multi-stakeholder and open experimentation facility, inclusiveness is related to ensuring that services are accessible and available to everyone, regardless of their location, income, or other factors.

⁵ The ability of telecommunication networks and services to be accessible and usable by populations that are typically underserved, such as rural, low-income, or socially marginalized groups. It reflects how effectively the infrastructure supports inclusive connectivity and reduces the digital divide.

	reach areas via UAV relays	disrupted areas during public-safety or mobility scenarios.	inaccessible areas supported by UAV relays	
6G-BRICKS	Digital Inclusion	Deploy technologies that serve the historically underserved	Metaverse	CF mMIMO
6G-BRICKS	Digital Inclusion	Deploy technologies that serve the historically underserved	Industry 4.0	RIS
ETHER	Digital inclusion	Digital inclusion in the context of ETHER concerns the provision of 100% coverage to users, either terrestrial or aerial, across the globe. This is achieved by a unified terrestrial/non-terrestrial network.	"ETHER Use Case 1: Service Provision to Delay-Tolerant IoT Applications.	
ACROSS	KVI 1.1 – Digital Inclusion	ETHER Use Case 2: Broadband direct handheld device access.		
FLECON-6G	Digital Inclusion	Focused group surveys on accessibility and cost	>70% satisfaction level on inclusiveness	KPI-CAP-02, KPI-CAP-05
ENVELOPE	Increase Users	ii) Vertical handover from a terrestrial gNB to a satellite-based gNB for ETHER Use Case 2.		
ADROIT6G	Digital Inclusion	Surveys, user participation, accessibility assessments	99.9% service reliability; increased device access; 50 connected users/devices in PoC1	Device Density, Reliability, QoE
6G-VERSUS	Digital inclusion; remote area connectivity	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Coverage; service availability; throughput; latency; reliability
6G-VERSUS	Reduced digital inequality	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Coverage; service availability; throughput; reliability
6G-VERSUS	Increase in access to 6G network for	(Questionnaires, surveys, focus group discussions, interviews)	N/A	Coverage; connectivity density; service availability; data rate; latency

	remote communities.			
6G-VERSUS	Rural Workforce Retention	Qualitative (focus groups, interviews); Quantitative (turnover/ retention rates, participation rates)	N/A	Service availability, coverage, user adoption rate, worker retention rate, and latency
6G-VERSUS	Inclusiveness in Access	Qualitative (focus groups, interviews); Quantitative (user adoption metrics)	N/A	Coverage; service availability; user adoption rate; accessibility rate; reliability
6G-VERSUS	Technology adoption rate	Quantitative and Qualitative	N/A	Technology adoption rate, coverage, service availability, active user rate; reliability
PERSONAL FREEDOM KEY VALUE				
iTrust6G	User Autonomy and Control over Data & Security	The iTrust6G framework empowers users with control over their data, privacy settings, and security policies, enabling autonomous decision-making while ensuring protection across 6G environments. This includes user-centric consent management, transparency, and the ability to override automated decisions where appropriate.	UC1, UC2, UC3	User-centric identity management, privacy dashboards, consent management platforms, zero-trust architecture, and AI-assisted policy control

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9. ABBREVIATIONS

Abbreviation	Full text
5G PPP	5G Public-Private Partnership
6G IA	6G Smart Network and Services Industry Association
AI / ML	Artificial Intelligence / Machine Learning
AR	Augmented Reality
CCL	Compute Continuum Layer
EMF	Electromagnetic Field
ETSI	European Telecommunications Standards Institute
HW	Hardware
ISAC	Integrated Sensing and Communication
KV(s)	Key Value(s)
KVI(s)	Key Value Indicator(s)
LoT	Level of Trust
NASA TLX	NASA Task Load Index
NFV	Network Function Virtualization
PoC	Proof of Concept
QoS	Quality of Service
RIS	Reconfigurable Intelligent Surfaces
SDGs	Sustainable Development Goals
SDN	Software-Defined Networking
SNS JU	Smart Networks and Services Joint Undertaking
SW	Software
UC	Use Case
UN	United Nations

UX	User Experience
xURLLC	eXtended Ultra-Reliable Low Latency Communication

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