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Sustainable by Design: Transforming Vertical Use Cases Through 6G technologies

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With credits to all partners, especially WP6

30.4.2026

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6G-VERSUS: 6G VERtical trials for SUStainability

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Duration: 36 months 1.1.2025 – 31.12.2027

Call: HORIZON-JU-SNS-2024-STREAM-D-01-01 - SNS Large Scale Trials and Pilots (LST&Ps) with Verticals

Type of action: HORIZON-JU-IA HORIZON JU Innovation Actions

Funding: 12,1 M€, total budget 14,5 M€

Coordinator: UOULU / Sanna Tuomela

Technical manager: ICCS / Xenofon Vasilakos

Partners: 34 from 10 countries, 13 academic and/or research organizations, 10 industrial partners, 9 SMEs and 2 NGOs

Effort: 1800 PMs

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FUNDING

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Partners

Participant No.	Participant organisation name	Short name	Country
1 (Coord.)	OULUN YLIOPISTO	UOULU	Finland
2	KEYSIGHT TECHNOLOGIES	KEYS	Spain
3	ONE SOURCE CONSULTORIA INFORMATICA LDA	ONE	Portugal
4	EIGHT BELLS LTD	8Bells	Cyprus
5	INCITES CONSULTING SA	INC	Luxembourg
6	UNIVERSITAT POLITECNICA DE VALENCIA	UPV	Spain
7	UNIVERSITY OF BRADFORD	UBRAD	UK
8	ENVOLVE ENTREPRENEURSHIP	ENV	Greece
9	CENTRO DE ESTUDOS SOCIAIS	CES	Portugal
10	NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS"	NCSRD	Greece
11	ORGANISMOS TILEPIKOINONION TIS ELLADOS OTE AE	OTE	Greece
12	EREVNITIKO PANEPISTIMIAKO INSTITOUTO SYSTIMATON EPIKOINONION KAI YPOLOGISTON	ICCS	Greece
13	INFOLYSIS P.C.	INF	Greece
14	HELLENIC RESCUE TEAM OF ATTICA	HRTA	Greece
15	UNIVERSIDAD DE MALAGA	UMA	Spain
16	TELEFONICA INNOVACION DIGITAL SL	TID	Spain
17	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	CSIC	Spain
18	CETAQUA	CET	Spain
19	HIDRALIA	HIDRA	Spain
20	NOKIA SPAIN SA	NOKIA	Spain
21	EURECOM GIE	EUR	France
22	GREENCITYZEN	GREEN	France
23	THALES SIX GTS FRANCE SAS	TSGF	France
24	A1 BULGARIA EAD	A1	Bulgaria
25	ENTRA ENERGY	EE	Bulgaria
26	UNIVERSITY OF CYPRUS	UCY	Cyprus
27	SOFTWARE COMPANY	SCBG	Bulgaria
28	INSTITUTO DE TELECOMUNICACOES	ITAV	Portugal
29	ALTICE LABS SA	ALB	Portugal
30	APA-ADMINISTRACAO DO PORTO DE AVEIRO SA	APA	Portugal
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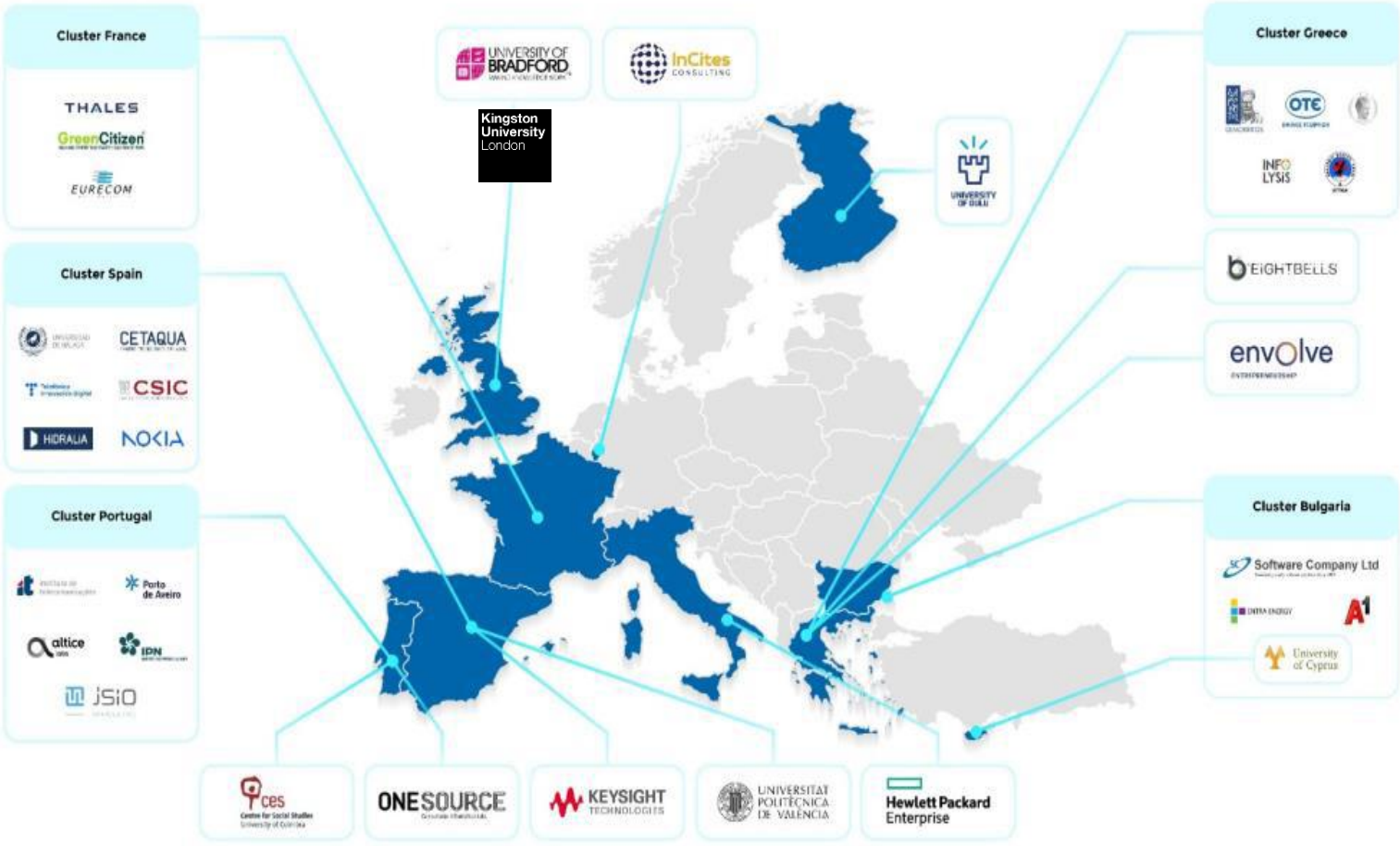
33	HEWLETT-PACKARD ITALIANA S.R.L.	HPE	Italy
34	KINGSTON UNIVERSITY LONDON	KUL	UK



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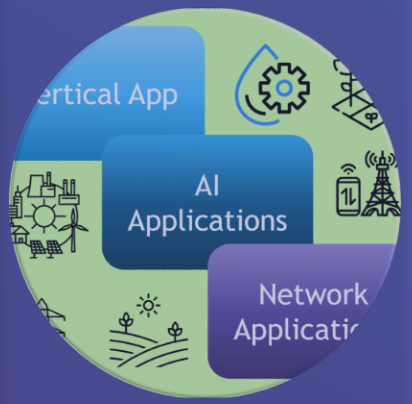
Objectives



6G-Enabled Application Framework for the triplet of V-app, AI-app and N-app

6G Trials to assess performance with the principles of "sustainable 6G"

Integration of 6G Applications across 6 Testbeds

Societal and environmental impact assessment and new business models

Maximize the impact and adoption

Sustainability

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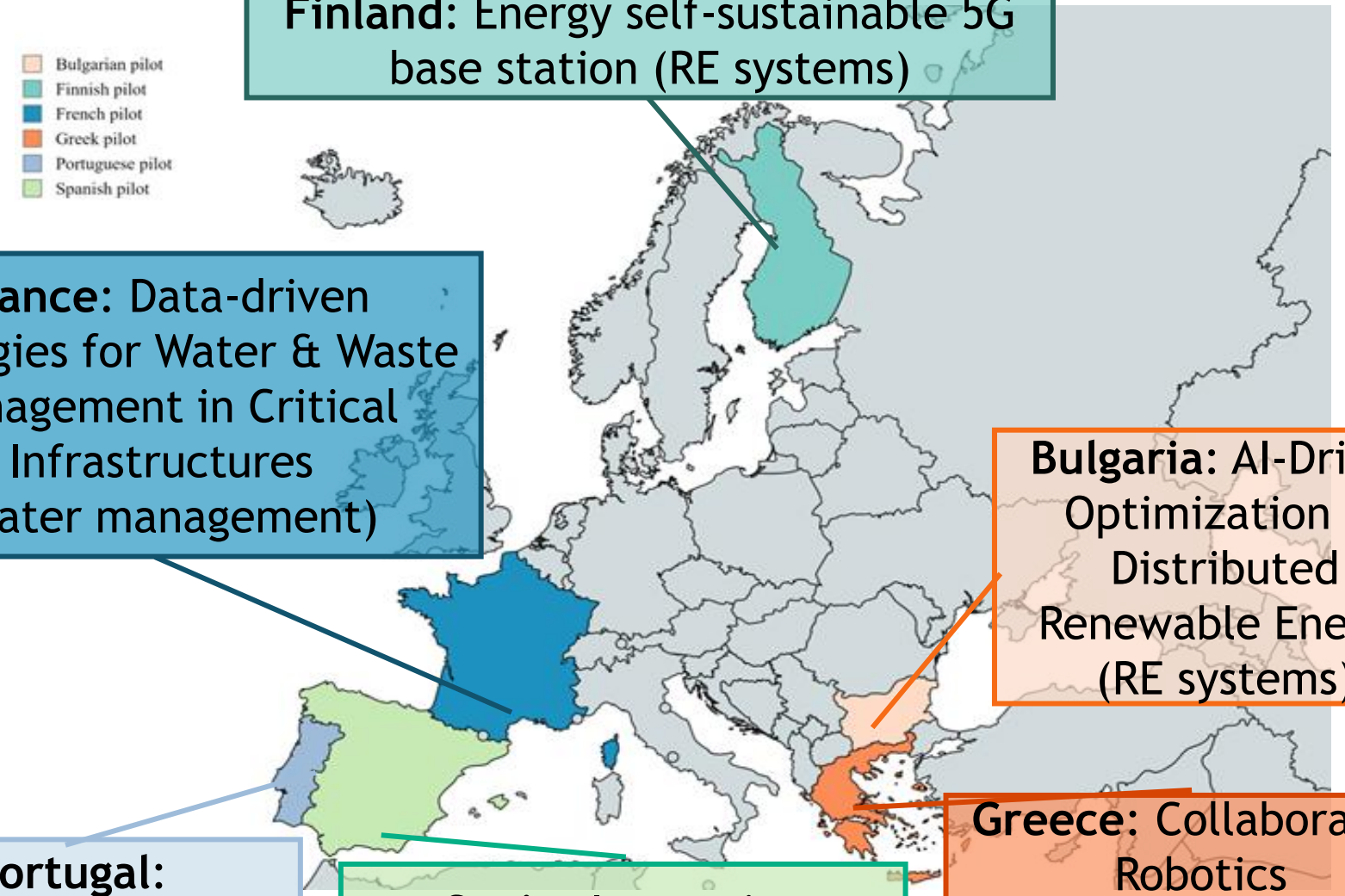
6 large-scale E2E pilots for 5 verticals

Real-life sustainability use cases



Finland: Energy self-sustainable 5G base station (RE systems)

France: Data-driven Strategies for Water & Waste Management in Critical Infrastructures (Water management)

Bulgaria: AI-Driven Optimization of Distributed Renewable Energy (RE systems)

Greece: Collaborative Robotics for Search & Rescue (Life-saving environmental preservation)

Portugal: Sustainable & Safe Port Infrastructures (Environmental monitoring & safety)

Spain: Immersive Telepresence Actuator for Field Operations (Smart agriculture)

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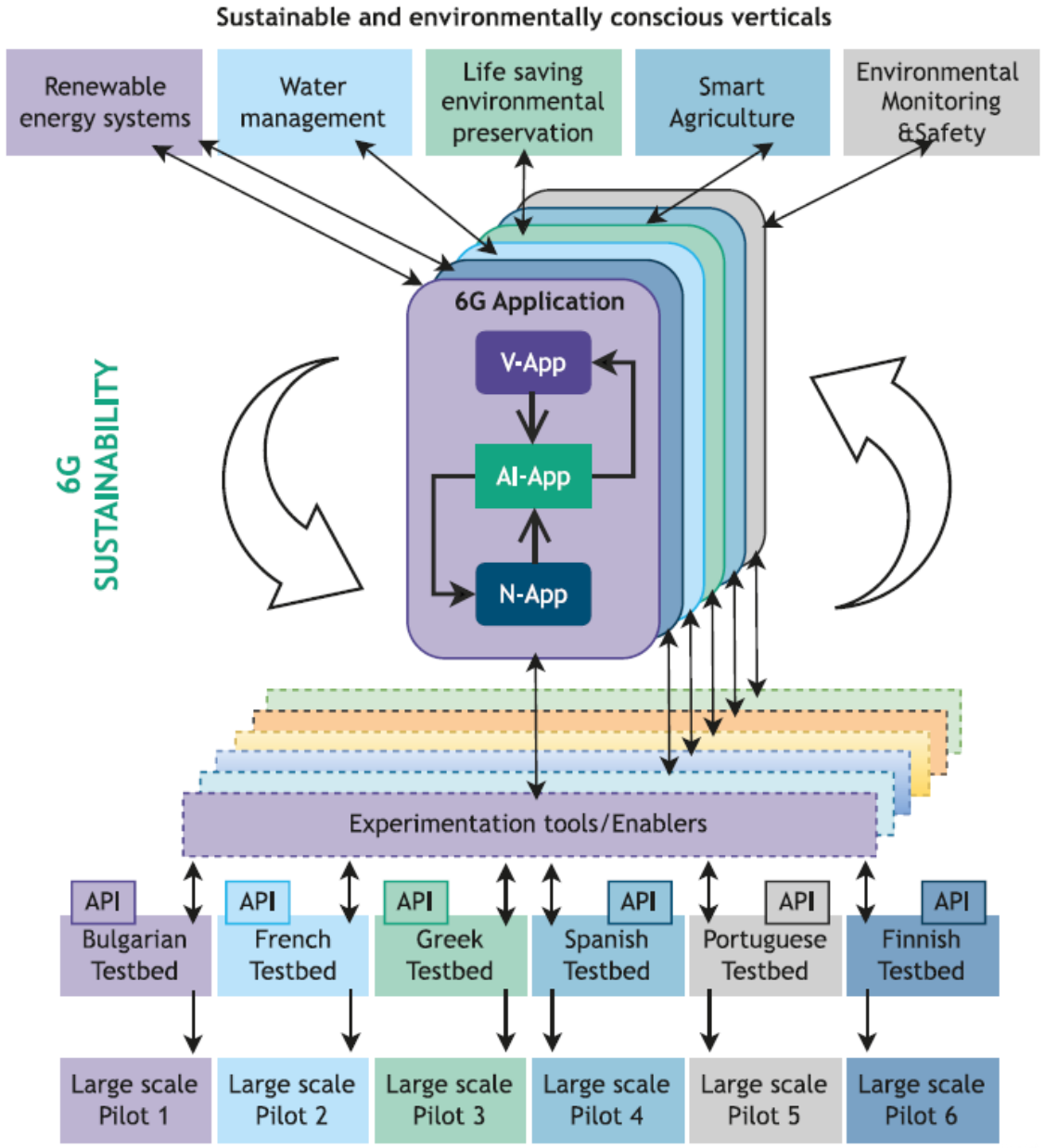
The novelty: V/AI/N-apps triplet

➔ Transformation of a typical use case into a 6G Application, i.e. a **triplet of distributed but fully interacting software components** that together realise an AI-assisted vertical service.

➔ Each 6G Application is composed of

- **Vertical App (V-App)**
- **Network App (N-App)**
- **AI-assisted App (AI-App)**



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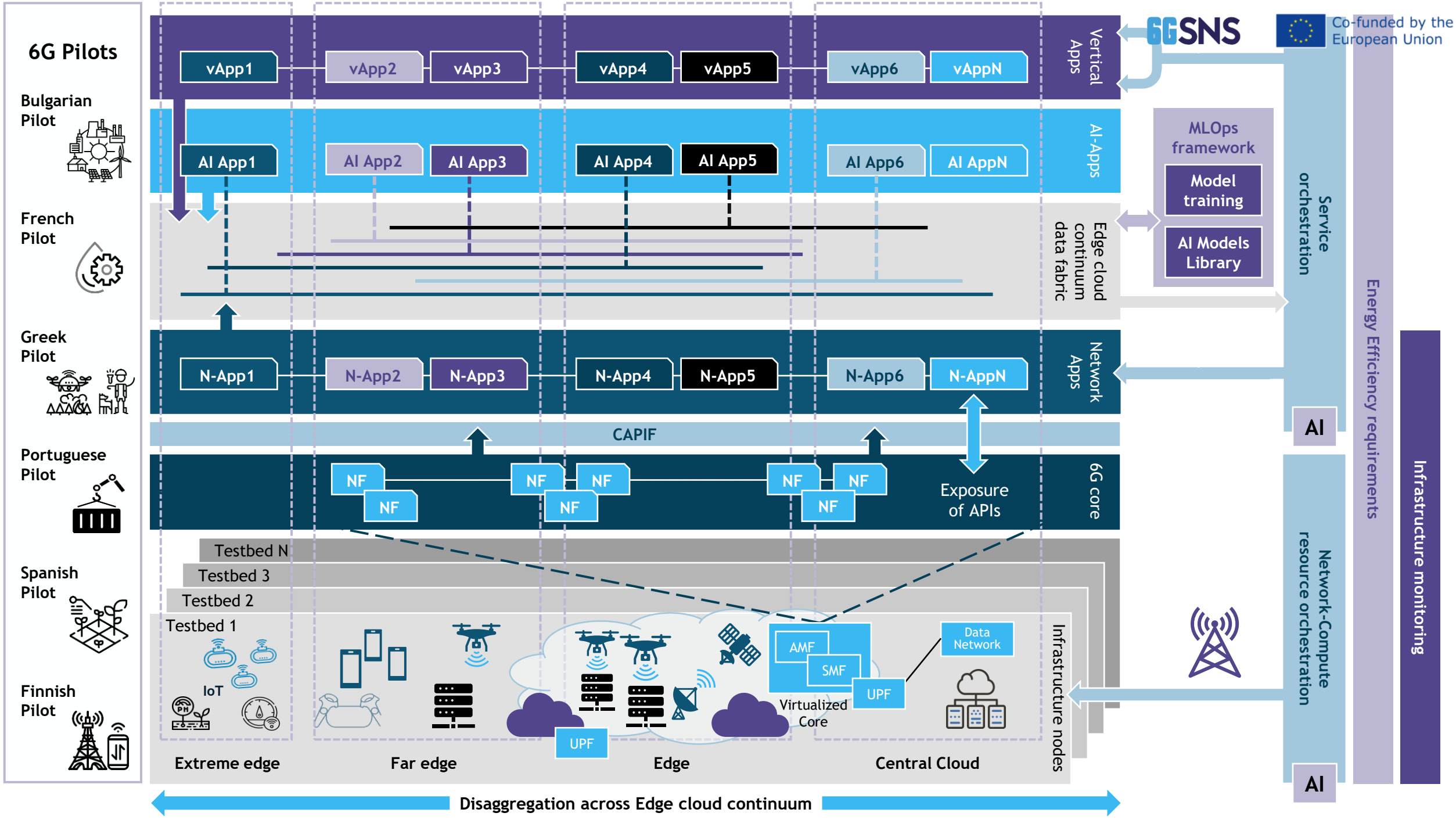
6G Pilots
Bulgarian Pilot
French Pilot
Greek Pilot
Portuguese Pilot
Spanish Pilot
Finnish Pilot
vApp1
vApp2
vApp3
vApp4
vApp5
vApp6
vAppN
Vertical Apps
AI App1
AI App2
AI App3
AI App4
AI App5
AI App6
AI AppN
AI-Apps
Edge cloud continuum data fabric
MLOps framework
Model training
AI Models Library
Service orchestration
N-App1
N-App2
N-App3
N-App4
N-App5
N-App6
N-AppN
Network Apps
CAPIF
NF
6G core
Exposure of APIs
Energy Efficiency requirements
Infrastructure monitoring
AI
Testbed N
Testbed 3
Testbed 2
Testbed 1
IoT
AMF
SMF
UPF
Virtualized Core
Data Network
Infrastructure nodes
Network-Compute resource orchestration
Extreme edge
Far edge
Edge
Central Cloud
Disaggregation across Edge cloud continuum
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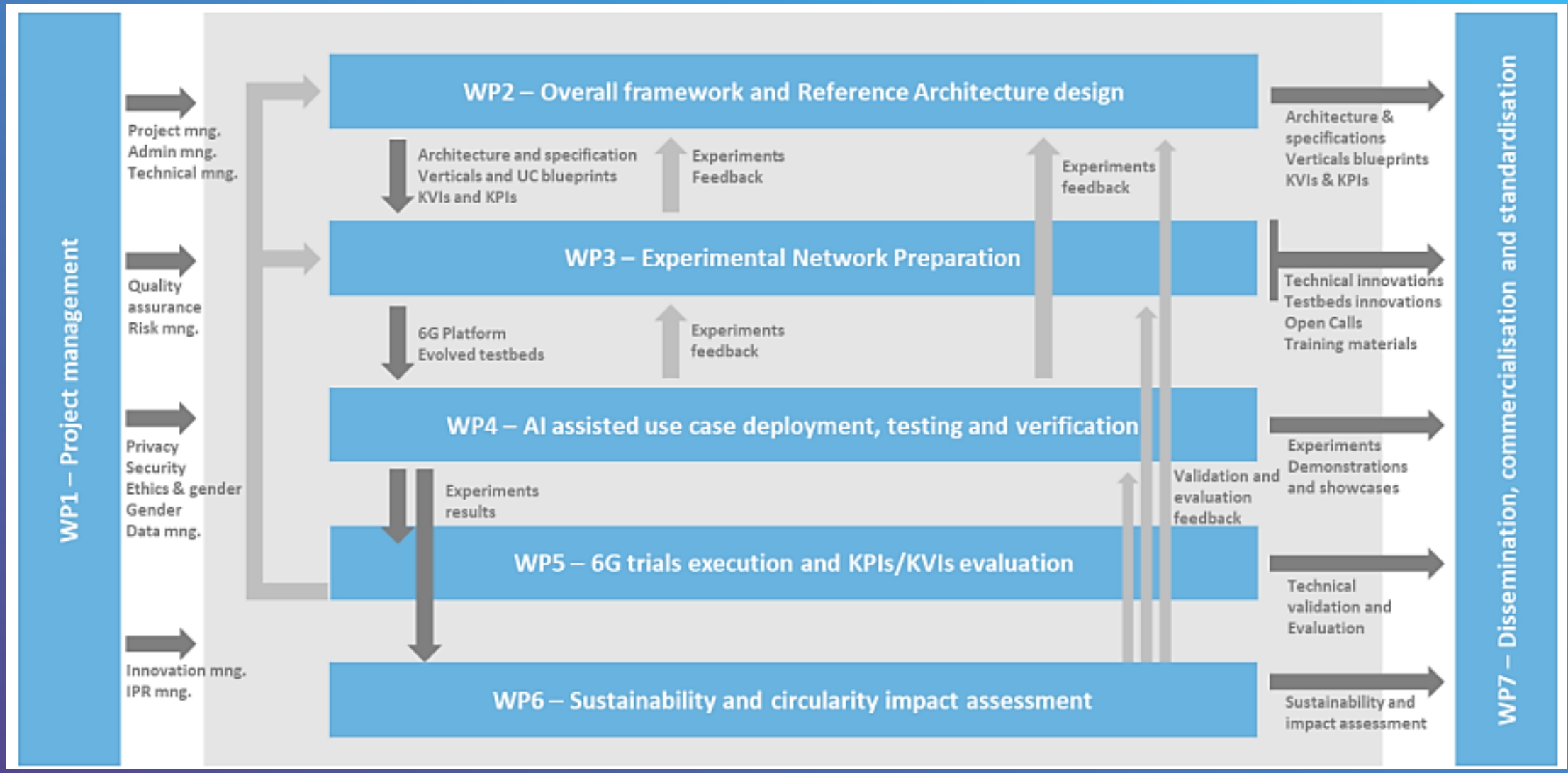
Work plan



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6G-VERSUS - Sustainability by design

1. Real-life sustainability use cases

2. Sustainability assessment roadmap

3. KV and KVI procedure

4. Trials for sustainability feedback

Sustainability impact & assessment

Sustainable 6G for sustainability

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1. Real-life sustainability use cases

Bulgarian use case

- **Energy grid management and real-time distributed energy resources** (DER) monitoring.
- Aims to enhance reliability and resilience of smart grids using distributed control system (DCS) architectures and 6G communication, improve voltage and frequency control by fine-tuning voltage and frequency levels across the grid and leverage on edge computing and localization advanced features of 6G networks to support identification of changes in the grid dynamics.

Finnish use case

- **Remote base station site in arctic weather conditions**, featuring a remote radio head, renewable energy sources (RES) (wind and photovoltaic with battery assembly and hydrogen fuel cell), and a wireless fronthaul system.

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1. Real-life sustainability use cases (cont.)

French use cases

- **Sewer Network Monitoring system** built on rainwater entry points into sewage systems to monitor proper functioning of networks, detect waste and help to manage the cleaning of sewage water entry points and network through sensors.
- **Smart watering in green space.** Intelligent watering consists of conditioning watering of green spaces, based on plants' actual need for water. Centralized watering technologies and soil moisture sensors significantly reduce water consumption and preserve quality of green spaces.

Greek use case

- **Collaborative robotics search and rescue and early wildfire detection.**
- By integrating robotic dogs and UAVs, and advanced autonomous and human-robotic interactions together with 5G/B5G technologies, the scope is to increase efficiency and effectiveness of SaR operation and wildfire preparedness and response scenarios.

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1. Real-life sustainability use cases (cont.)

Portugese use case

- **Monitoring for environmental quality and safety levels in ports** by leveraging B5G/6G-related sensing, communication, and intelligence technologies.
- Addresses sustainable development goals (SDG) targets and upcoming environmental regulations, exploring 6G potential to enable innovative environmental and safety awareness.

Spanish use case

- Enables a field manager's remote presence at various locations through teleoperation and data collection using sensor-equipped vehicles.
- Utilizes immersive technology to provide researchers, growers, or workers with a sense of presence in experimental or production fields. This is achieved through a vehicle equipped with sensors and actuators, such as an AGV or drone, capable of remote control.

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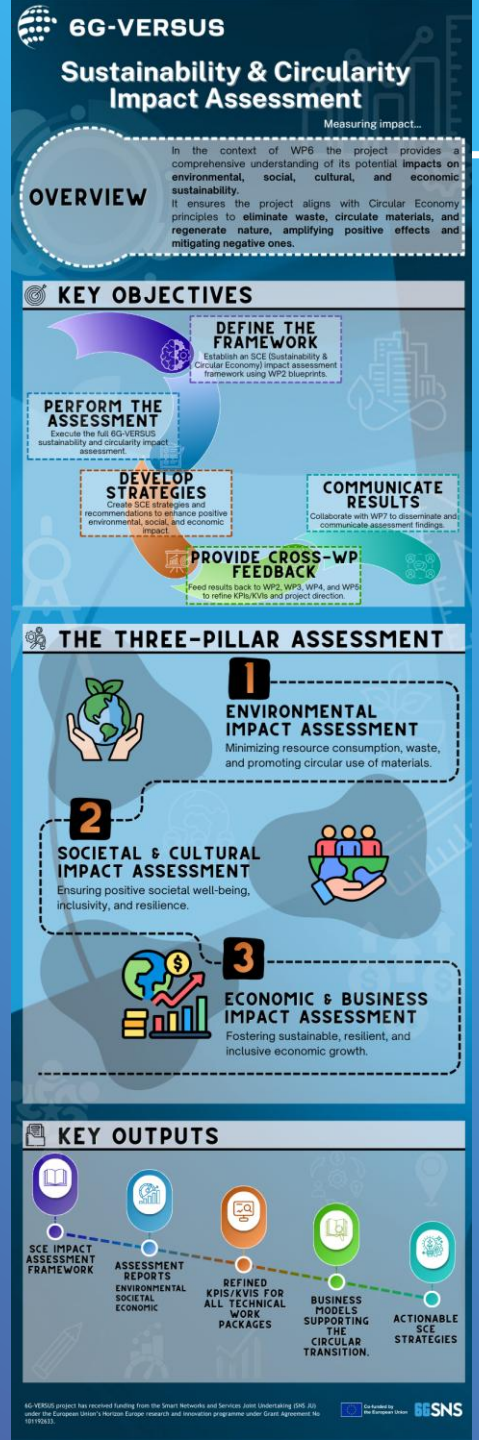
2. Sustainability assessment roadmap

- Defines the **key activities, responsibilities, and timeline for the development of the Key Performance Indicators (KPIs), Key Value Indicators (KVIs), and the impact assessment methodology within the 6G VERSUS project.**
- Ensures alignment across work packages (WPs) and clusters, offering a structured path with actionable milestones leading up to the trials.
- Adapts the KVI framework with tailored KPIs and KVIs to unique characteristics of each use case, including its geographical, cultural, and operational context.
- Cluster training for KVIs



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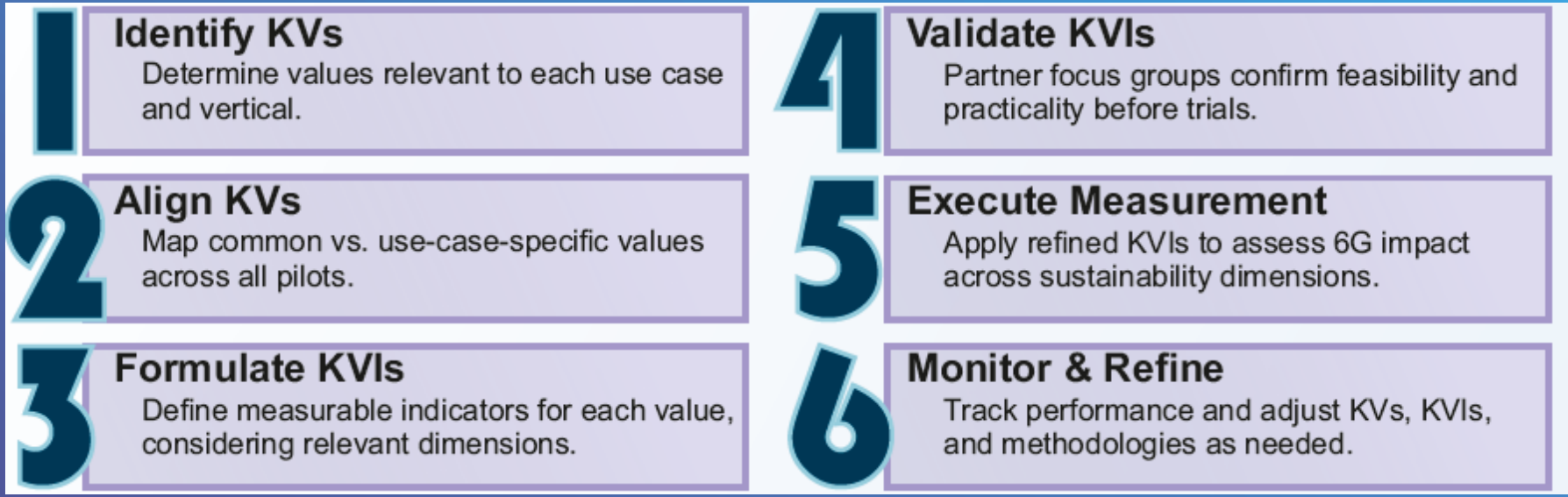
3. KV and KVI procedure

Sustainability Assessment Procedure
Six systematic steps to identify Key Values (KVs) and Key Value Indicators (KVIs).



A bottom-up methodology engaging **diverse stakeholders**: project managers, technical leaders, use case champions, testbed owners and cluster partners. Multiple consultation meetings captured high-level project goals and cluster-specific sustainability challenges.

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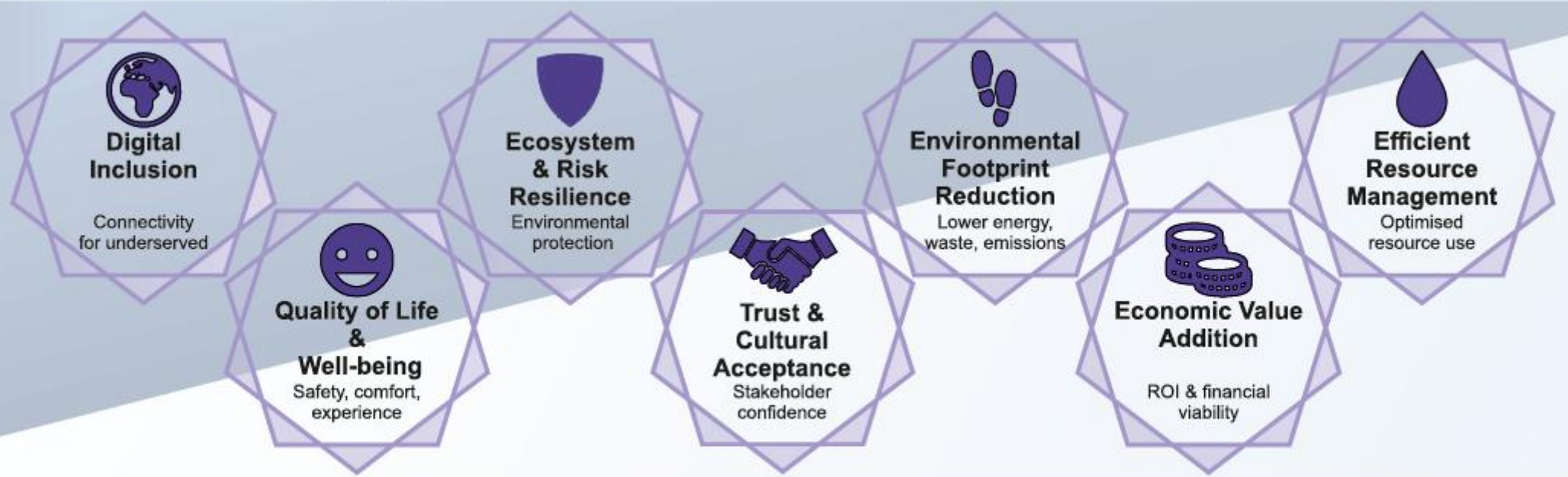
Seven Root KVs

The Foundation of **our Sustainability Framework includes seven universal values** measured through context-specific indicators across **six pilot clusters**, ensuring both consistency and local relevance in sustainability assessment.



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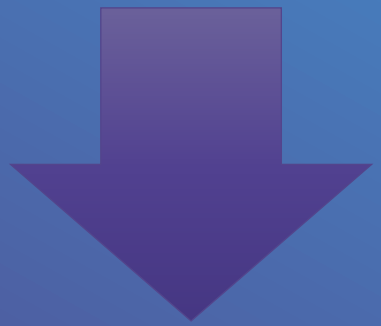
KVI IDs	KVs	KVIs	Description	Measurement Techniques	SDGs	Stakeholders	Potential questions for KVI assessment
KVI_001 Environmental	Environmental Footprint Reduction	Increase in utilisation of RES (lead by avoiding of RES curtailment by 15%)	The use case will avoid RES curtailment by 15% which will increase the use of RES for energy generation.	**Energy audit** (meter readings, energy use indices, and numerical comparisons,) (**Questionnaires**, surveys, focus group discussions, interviews)	SDG 07 and SDG 13	renewable energy producers	**Are you aware of advanced 6G technologies available for grid management systems?** **Have you integrated any advanced 6G technologies to optimize RES generation? If yes, please describe.**
KVI_002 Environmental	Environmental Footprint Reduction	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.	Energy audit (meter readings, energy use indices, and numerical comparisons,) (**Questionnaires, surveys, focus group discussions, interviews**)	SDG 07 and SDG 13	professionals from Renewable energy field and society at large	**Which advanced 6G technologies have significant impact to faster and efficient integration of renewable energy to the grid?**
KVI_003 Environmental	Ecosystem & Risk Resilience	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.	(**Questionnaires**, surveys, focus group discussions, interviews)	SDG 07 and SDG 13	stakeholders from the telecommunications side, society	**Have you experienced environmental issues related to cable degradation, waste disposal, or repair operations?**
KVI_005_ Societal & Cultural	Digital inclusion	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.	(**Questionnaires**, **surveys**, focus group discussions, interviews)	SDG 11	the communities in the remote areas	**What type of connectivity is currently available at your RES site?** **From your knowledge of the region, how would improved mobile network infrastructure benefit local residents, farms, or small businesses?**
KVI_007_ Societal & Cultural	Strategic Cost Reduction and Economic Value Addition	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.	(**Questionnaires**, surveys, focus group discussions, interviews)	SDG 11	energy communities, society at large,	**How would you describe the current capacity of the grid to absorb your renewable energy generation?** **Do you think an improved grid (supported by 6G connectivity) will allow new RES producers to join the energy system?**
KVI_009 Economic	Strategic Cost Reduction and Economic Value Addition	Optimizing revenue management of RES Owners	How do the advanced features of 6G technology contribute to optimize revenue management of RES owners?	(**Questionnaires**, surveys, focus group discussions, interviews)	SDG 08	DERs owners, aggregators	**To what extent do current grid or communication limitations affect your revenue from renewable energy generation?** **Do you believe these new advanced 6G technologies could influence your revenue generation or financial performance?** **Do you believe advanced 6G capabilities can make renewable energy production more financially viable?**
KVI_010 Economic	Strategic Cost Reduction and Economic Value Addition	Reduction of Investment in communication	The use case avoids the use of wired communication with mobile network by to connect renewable energy resources to the	Financial analysis method. (**comparative financial analysis**, ratio analysis)	SDG 08	DERs owners	**Do you expect that mobile-based (6G) communication will reduce o[illegible]nal downtime or communication failures?**

4. Trials for sustainability feedback

- 04/26 First round of trials performed, selected KVIs and KPIs measured.
- Questionnaires, interviews and surveys for stakeholders' sustainability feedback.
- Workshops with WP6 and each pilot cluster to share feedback and refine the KVIs and prepare the sustainability data extraction methods for the upcoming trials.



- 6G-VERSUS use cases sustainability impact assessment
- Demonstrations of sustainability impact enabled by 6G technologies
- Contribution to 6G KV and KVI framework

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6G Vertical Trials for Sustainability

Contact information:
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