



D1.3 – AccesS Evaluation Framework

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AccesS Evaluation Framework

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Executive Summary

The AccesS Evaluation Framework offers a clear and practical way to track the project's progress in creating smart, accessible, and sustainable cities and buildings, presenting the final results of T1.4 Evaluation framework- Setting up the basis for monitoring progress and performance. The main objective of this task was to define the framework for assessing the impact of the AccesS project, encompassing a wide spectrum of indicators ranging from technical aspects to end-user acceptance. The AccesS Evaluation Framework aims to provide guidance for the complete assessment of the project's activities and it is built on a pool of Key Performance Indicators (KPIs) divided into two categories: 22 outcome-oriented KPIs that measure short-to-medium term results (such as improvements in building accessibility, comfort, and energy efficiency) and 8 impact-oriented KPIs that look at long-term social and environmental changes after the project duration.

For the definition of the KPI repository, a four-step methodology was followed, starting with the collection and analysis of the project's expected outcomes and expected impacts as described in the Grant Agreement to compile the initial pool of KPIs. Each KPI is designed to measure either short/medium-term results (outcome-oriented) or long-term effects (impact-oriented) and it is further categorized into evaluation levels, specifying the scope of assessment for each KPI. Consequently, additional sources such as relevant projects, frameworks, and initiatives were reviewed to further expand the initial KPIs and conclude with the enhanced list of KPIs, incorporating indicators that support the project's relevance, scalability, and alignment with best practices.

A special strength of the AccesS evaluation framework is its close connection with the previous tasks of WP1 as well as WP2 – Social Inclusion and User-Centered Design. WP1 provided an overview of key technologies and relevant market trends that are aligned with the objectives of the AccesS project, the existing conditions of the pilots and a comprehensive technical description of the project's components and solutions, specifications and key functionalities while WP2 conducted extensive research to understand the needs, challenges, and barriers faced by people with reduced mobility and vulnerable groups. These findings have directly informed several KPIs, ensuring that the evaluation is truly user-centric and inclusive. By combining insights from WP1 & WP2 with EU benchmarks and best practices (such as the New European Bauhaus and Built4People), the AccesS evaluation framework aims to not only support better decision-making but also drive continuous improvements towards a climate-neutral, people-centered built environment.

D1.3 forms the cornerstone of the project's quality control and performance monitoring efforts. In order to ensure that the KPI repository reflects the significant outcomes of the project and ensures a comprehensive assessment of the demonstrators, the list will be reviewed and refined if needed as part of the relevant activities of WP10, WP11, WP12 (T10.2, T11.2, T12.2) for the deployment and assessment of the AccesS Suite.

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List of Acronyms and Abbreviations

Term	Description
B4P	Built4People Partnership
BIM	Building Information Modeling
BOMS	Building and Operation Management System
EC	European Commission
ECT	Energy Comfortness Tool
EESDT	Energy Efficient and Sustainable Design Tool
EI	Expected Impact
EN	European Norm (Standard)
EO	Expected Outcome
EV	Electric Vehicle
GA	Grant Agreement
GHG	Greenhouse Gas
IAQ	Indoor Air Quality
KPI	Key Performance Indicator
NEB	New European Bauhaus
SRI	Smart Readiness Indicator

SSH	Social Sciences and Humanities
UAAT	Universal Accessibility Assessment Tool

1 Introduction

1.1 Scope and Objectives of the Deliverable

This deliverable establishes the **AccessS Evaluation Framework**, a robust set of Key Performance Indicators (KPIs) to set a solid basis for the AccessS evaluation and impact assessment and assess progress towards enhancing accessibility and sustainability in smart cities and buildings. Aligned with the Grant Agreement and EU initiatives (e.g., Built4People, New European Bauhaus), its objectives include:

- Defining a pool of KPIs to monitor short/medium-term results (Expected Outcomes) and long-term societal/environmental impacts (Expected Impacts) and evaluate the AccessS system's performance against established criteria.
- Integrating cross-project insights from EU frameworks, standards, and initiatives to ensure relevance and scalability.
- Providing guidance for the quantification and interpretation of actionable metrics for stakeholders to evaluate pilot sites, technologies, and policy alignment.

1.2 Structure of the Deliverable

The report is structured as follows:

1. **Introduction:** Outlines objectives, scope, and linkages to other tasks/deliverables.
2. **Methodological Approach:** Details the four-step process for KPI development (project-specific analysis, external benchmarking, categorization, and expansion).
3. **KPI Calculation Methodology:** Provides more detailed information on the 22 outcome-oriented and 8 impact-oriented KPIs, including calculation methodologies and alignment with project goals.
4. **Conclusion:** Summarizes key achievements and future steps.

1.3 Relation to Other Tasks and Deliverables

The activities of T1.4 and the AccessS Evaluation Framework reported in Deliverable D1.3 is designed to work in harmony with other project tasks. It draws on state-of-the-art analysis on technologies and market trends on accessibility, sustainability and comfort (T1.1), pilot conditions and use case definitions (T1.2), technical specifications and system functionalities (T1.3), and importantly, current findings from WP2 on social inclusion and user-centered design. WP2's ongoing research in parallel with T1.4 activities— including surveys and stakeholder consultations – provided valuable insights into the real needs of people with reduced mobility and vulnerable groups. These insights have helped shape our KPIs, particularly those that measure building accessibility, the usability of digital solutions, and overall user satisfaction.

Additionally, the framework supports later tasks (such as T10.2, T11.2, and T12.2) by offering clear, measurable indicators for assessing AccessS solutions in a variety of settings—from cultural heritage buildings to care facilities and public service areas. In order to ensure that the KPI repository reflects the significant outcomes of the project and ensures a comprehensive assessment of the demonstrators, the framework will be updated if needed as part of the relevant activities of WP10, WP11, WP12 (T10.2, T11.2, T12.2) for the deployment and assessment of the AccessS Suite.

2 Methodological Approach

A detailed evaluation framework that will encompass a wide spectrum of indicators ranging from technical aspects to end-user acceptance will be set by AccessS to assess the progress towards enhancing accessibility and sustainability in smart cities and smart buildings, facilitating the monitoring of relevant project solutions and demonstration activities. In particular, a detailed list of Key Performance Indicators (KPIs) will evaluate project results while two different frameworks-pathways will be utilised, one focusing on the short/medium term (outcome-oriented, related to EOs) and the other on the long term (impact-oriented, related to EIs), aligning and serving the project's Impact Pathways. AccessS, in line with Built4People¹, brings together different actors of the building design and operation value chain to promote innovation towards more people-centric, sustainable built environments. This will be achieved through the definition and application of three (3) types of KIPs addressing Scientific, Societal (inc. Environmental) and Economic/Technological Impact in full alignment with HORIZON EUROPE Legislation².

2.1 Introduction

This section describes the methodological approach adopted to establish a comprehensive and effective KPI framework for the AccessS project. To ensure that the KPIs align with the project's objectives, expected outcomes (EOs), and expected impacts (EIs), a multi-step process will be followed (both for EOs and EIs). The methodology combines an initial KPI list development based on project-specific goals with a structured review and integration of relevant external sources to enhance robustness and applicability. The following steps outline the approach for both short/medium and long-term evaluation:

- **Step 1:** Collect and analyze the project's EOs and EIs, as defined in the Grant Agreement. This foundational analysis ensures a clear understanding of the project's strategic goals, which will guide the subsequent development of KPIs.
- **Step 2:** Develop an initial pool of KPIs resulting from the analysis of the expected outcomes and impacts. Each KPI is designed to measure either short/medium-term results (outcome-oriented) or long-term effects (impact-oriented) and it is further categorized into evaluation levels, specifying the scope of assessment for each KPI.
- **Step 3:** Review additional sources such as relevant projects, frameworks, and initiatives (e.g., Built4People) to gather insights and identify best practices that can enhance the initial KPIs. By consulting these sources, the methodology aims to make sure that the KPIs are well-aligned with current references and standards and address the broader context of the built environment's sustainability and accessibility.
- **Step 4:** Expand the pool of KPIs with the findings from other projects and initiatives, incorporating indicators that support the project's relevance, scalability, and alignment with best practises. This expansion will enrich the initial KPI framework developed within Step 2, adding dimensions that may not be covered solely by project-specific objectives.

¹ https://ec.europa.eu/info/sites/default/files/research_and_innovation/funding/documents/ec_rtd_he-partnerships-built4people.pdf

² Regulation (EU) 2021/695, OJ L 170/1, Article 50 & Annex V 'Time-bound indicators to report on an annual basis on progress of the Programme towards the achievement of the objectives referred to in Article 3 and set in Annex V along impact pathways'

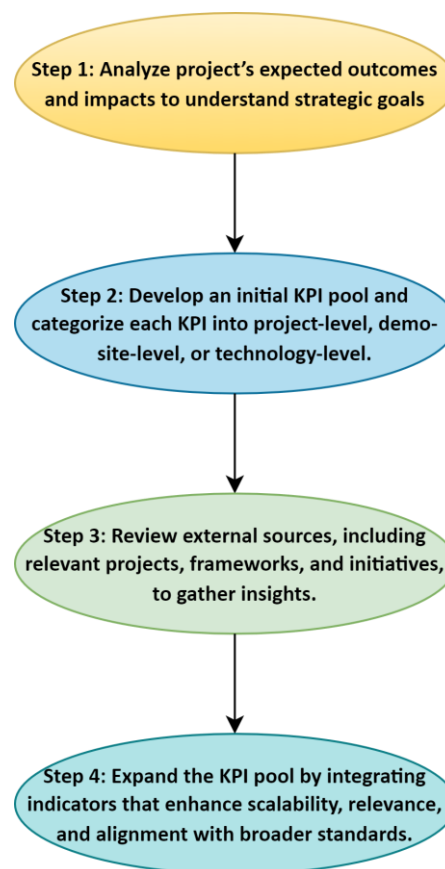


Figure 1: Stepwise methodology for developing the AccesS KPI framework.

The stepwise approach outlined in this section is visualized in Figure 1, which highlights the sequential process of collecting and analyzing project-specific outcomes and impacts, developing an initial KPI pool, and refining it through insights from external sources.

2.2 Step 1: Collection and Analysis of Project's Expected Outcomes and Impacts

The first step in developing the AccesS KPI framework involves collecting and analyzing the project's expected outcomes and expected impacts as outlined in the Grant Agreement. EOs refer to the specific achievements that AccesS aims to deliver, such as improvements in accessibility, comfort, and energy efficiency. EIs focus on the long-term effects of the project, including contributions to sustainability, innovation, and societal well-being. This comprehensive analysis ensures that the KPI framework captures both the direct (until the end of the project) and broader objectives (after AccesS and during its exploitation) of the project.

Table 1 and Table 2 summarize the project's expected outcomes (short/medium-term) and impacts (long-term) respectively, highlighting their significance in guiding the development of meaningful KPIs.

Table 1: AccessS EOs (short/medium-term) as defined in the Grant Agreement.

Call Expected Outcome (EO)	AccessS Outcomes
EO#1: Improved accessibility of the built environment for persons with disabilities and older persons, following a 'design for all' approach	Scientific
	1.1 Create and use high quality new knowledge on issues supporting accessibility within the built environment (at least 3 publications).
	1.2 Scientific advancements on accessibility design and simulation of buildings and products
	Societal/ Environmental
	1.3 Accessibility of buildings: Likert Scale – 4.5/5.0 (Very High) – Buildings are designed to be user friendly for everyone including people who use wheelchairs, canes and those with vision and hearing impairments etc.
	1.4 Methodological framework for social inclusion and accessibility in smart cities
EO#2: Improved comfort for larger shares of the population	Economic/Technological
	1.5 Digital tools supporting the design of buildings and products based on accessibility principles.
	1.6 Increase accessibility of end-users > 10 different use case scenarios simulated per case study
	Scientific
	2.1 Create and use high quality new knowledge on issues relevant to energy consumption of buildings and comfort.
	2.2 Scientific advancements on building management towards occupant comfort and energy efficiency.
EO#3: Increased uptake of accessible and inclusive active mobility solutions (walking and cycling) in	Societal/ Environmental
	2.3 Comfort of buildings and infrastructure: Likert Scale – 4.5/5.0 (Very High) – Buildings and products are designed to be adaptable and comfortable for everyone
	Economic/Technological
	2.4 Provision of detailed recommendations on adjusting building operation towards improved comfort.
	2.5 Design of products and infrastructure under ergonomics and accessibility principles
	Scientific
EO#3: Increased uptake of accessible and inclusive active mobility solutions (walking and cycling) in	3.1 Create and use detailed guidelines for uptaking active mobility solutions
	Societal

support of healthy and sustainable lifestyles, while catering solutions for persons with reduced mobility	3.2 Enable a healthier and more inclusive lifestyle through modes of transport
	Economic/Technological
	3.3 Enable micromobility options as modes of transport 3.4 Integration of EVs charging possibilities in an inclusive way
EO#4: Improved sense of inclusiveness and social cohesion in larger shares of the population	Societal/ Environmental
	4.1 Create and use educational material for promoting accessibility and inclusion
	4.2 Enable participatory design and active community engagement in formulating a user-centred design approach
	Economic/Technological
EO#5: Availability of a common evaluation and certification framework for accessibility and inclusiveness of the built environment	4.3 Facilitate the harmonization of accessibility assessment in EU
	Societal
	5.1 Enable harmonized implementation of accessibility within the European Union
	Economic/Technological
EO#6: Improved consideration of accessibility and inclusiveness in the transformation of the built environment towards sustainability, climate change mitigation and adaptation, in line with energy and climate ambitions	5.2 Contribute to standardization efforts related to accessibility
	Scientific
	6.1 Create and use high quality new knowledge on issues relevant to optimal building operation and management, considering user's satisfaction and comfort
	6.2 Scientific advancements on building digitalization and smartification
	Societal/ Environmental
	6.3 Improved perception of accessibility, inclusiveness and sustainability combined
	Economic/Technological
	6.4 Facilitate the penetration of sustainable solutions, including micromobility options, cargo e-Bikes and EVs
	6.5 Support a more standardized, consolidated and integrated accessibility assessment scheme in EU
EO#7: Reduced energy consumption and lifecycle GHG emissions of the facilities of the built environment	Societal/ Environmental
	7.1 Transformation of the EU-building stock: >504.8M m ² of potential floor area to be upgraded (renovated or operated more energy efficiently) per year
	Economic/Technological

	7.2 Potential long-term energy savings triggered by AccesS >85.51 GWh/y 7.3 Unlock upgrades/renovations in historical and heritage buildings through new creative design and novel technological packages
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Table 2: AccesS EIs (long-term) as defined in the Grant Agreement.

Call Expected Impact (EI)	AccesS Impacts
EI#1: <i>Efficient and sustainable use of energy, accessible for all is ensured through a clean energy system and a just transition through:</i> <i>-Technological and socio-economic breakthroughs for achieving climate neutrality and the transition to zero pollution of the building stock by 2050, based on inclusive and people-centric R&I</i> <i>-Increased energy efficiency in industry and reducing industry's Greenhouse Gas (GHG) and air pollutant emissions through recovery, upgrade and/or conversion of industrial excess (waste) heat and through electrification of heat generation</i>	Scientific
	1.1 Creation of new knowledge on SSH issues relevant to buildings performance and management (incl. user satisfaction, gender perception etc.)
	Societal/ Environmental
	1.2 More sustainable living - Offer sustainable solutions considering individual needs and preferences
	1.3 Provide means for collaboration and knowledge exchange
	Economic/Technological
	1.4 Generate innovation-based growth of the building sector – help EU achieve energy and climate ambitions 1.5 Provide technical guidance on building design and operation towards climate neutrality

2.3 Step 2: Development and Categorization of the Initial KPI Pool

In this step, an initial pool of KPIs is developed based on the project's expected outcomes (EOs) and expected impacts (EIs), as outlined in the Grant Agreement. Each KPI is carefully designed to measure either short/medium-term results (outcome-oriented) linked to the project's Expected Outcomes or long-term effects (impact-oriented) associated with its Expected Impacts. To ensure clarity and focus, the KPIs are further categorized into evaluation levels, specifying the scope of assessment for each KPI.

Table 3 and Table 4 present the initial pool of KPIs, divided into outcome-oriented and impact-oriented categories, including their unit of assessment, linked outcomes, and evaluation level. In total, 7 KPIs

have been defined that cover AccessS's short/medium term scope and are aligned with the project's expected outcomes as well as 4 that can assess the expected long-term impacts AccessS is aiming for.

Table 3: Outcome-oriented KPIs for AccessS, aligned with Expected Outcomes (EOs) and categorized by evaluation level.

No	Name of the KPI	Unit	Linked Outcome	Evaluation Level
Scientific				
1	Creation and utilization of high-quality new knowledge	# citations/y	EO#1 (1.1, 1.2), EO#2 (2.1, 2.2), EO#3 (3.1), EO#6 (6.1, 6.2)	Project Level
Societal/ Environmental				
2	Accessibility of buildings	Likert, %	EO#1 (1.3, 1.4)	Demo-site level
3	Comfort of buildings and infrastructure	Likert	EO#2 (2.3)	Demo-site level
4	Educational material on accessibility and inclusion	# materials developed	EO#4 (4.1)	Project Level
5	Number of end-users directly engaged in demonstration activities	#	EO#5	Demo-site level
Economic/Technological				
6	Energy savings triggered by AccessS	MWh/y	EO#7 (7.2)	Demo-site level
7	Products/furniture designed under ergonomics principles	#	EO#2 (2.5)	Project Level, Demo-site level

Table 4: Impact-oriented KPIs for AccessS, aligned with Expected Impacts (EIs) and categorized by evaluation level.

No	Name of the KPI	Unit	Linked Outcome	Evaluation Level
Scientific				
1	Creation of new knowledge on SSH issues relevant to building performance and management	# citations/y	EI#1 (1.1)	Project Level
Societal/ Environmental				
2	Improved perception of accessibility, inclusiveness, and sustainability combined	Likert	EI#1 (1.2)	Demo-site level
3	Sustainable living improvements based on individual needs	Likert, % increase in satisfaction	EI#1 (1.2)	Demo-site level
Economic/Technological				

4	Compliance with EU accessibility standards	% compliance	EI#1 (1.5)	Demo-site level, Project Level
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2.4 Step 3: Leveraging External Resources and Frameworks for KPI Development

To ensure a comprehensive and robust KPI framework, the AccesS project draws on insights from relevant European projects, initiatives, and standardized frameworks. These sources provide valuable methodologies, metrics, and best practices that align with AccesS's goals of enhancing accessibility, sustainability, and inclusivity. By benchmarking against these initiatives, the project can refine its evaluation criteria and develop KPIs that effectively measure its impact across pilot sites, technologies, and overall project performance.

The following subsections present key initiatives and frameworks, highlighting their relevance to AccesS and the KPIs inspired by them. Additionally, an indicative list of excluded KPIs is presented along with the corresponding justification.

2.4.1 Built4People (B4P)

The Built4People (B4P) European Partnership [1], part of Horizon Europe, fosters people-centric innovation to catalyze the transition to a climate-neutral, sustainable, and smart built environment. The partnership emphasizes systemic transformations through innovative technologies and user-focused approaches, aligning closely with the AccesS project objectives.

B4P's monitoring framework provides detailed KPIs spanning inputs, outcomes, and impacts, which serve as a valuable resource for enhancing the AccesS KPI framework. The following elements from B4P are particularly relevant:

- Resources, Processes and Activities:
 - Established innovation clusters (#): Relevant for tracking the development of knowledge-sharing platforms in AccesS.
 - Inclusion of building users and occupants (# involved in demonstration): Aligns with AccesS KPIs that measure end-user engagement (e.g., EI#1 1.3).
- Outcomes:
 - Low carbon solutions and renovation packages (#): Supports EO#7 and EI#1 (1.4), enabling measurable contributions to decarbonization and sustainable renovation.
 - Certification and verification tools (# developed): Aligns with EO#5 and EI#1 (1.5), promoting standardization in accessibility and sustainability assessment.
 - Training capacity (in hours per year): Can inform EI#1 (1.4) by tracking workforce upskilling in sustainable practices and technologies.
- Impacts:
 - New skills creation (#): Relevant for EO#6 and EI#1 (1.4), assessing AccesS's role in equipping stakeholders with the skills necessary for the transition to a sustainable built environment.

- Sustainable and healthy neighborhoods (% of B4P projects with demonstrated impact): Supports EO#2 and EO#6 by linking AccesS outcomes to broader neighborhood-level improvements.
- Healthy built environment (% of B4P projects with demonstrated health, social, and wellbeing outcomes): Aligns with EO#2 (2.3) and EI#1 (1.2), evaluating the project's contributions to improved occupant comfort and wellbeing.
- Cultural heritage safeguard (% of B4P projects that demonstrate improved outcomes for heritage buildings): Relevant for EO#7, focusing on AccesS contributions to preserving cultural heritage while promoting sustainability.

According to the above, the following KPIs were selected for the AccesS framework as most relevant:

Table 5: Selected KPIs from B4P.

KPI Name	Relevant EOs/EI
Adoption Rate of Smart Accessibility Technologies in Retrofitted Buildings	EO#1, EO#6
Development of a comprehensive certification framework	EO#5

Indicatively, the following KPIs were excluded:

Table 6: Excluded KPI from B4P.

Excluded KPI	Reason for Exclusion
Cultural heritage safeguard	Limited relevance and measurability. This KPI is considered more of a requirement for the digital tools rather than a measurable metric.

2.4.2 New European Bauhaus (NEB)

The New European Bauhaus (NEB) [2] initiative integrates sustainability, inclusivity, and aesthetics in the built environment. Its recently published self-assessment method and tool³ includes a structured set of KPIs aimed at evaluating the environmental, economic and social performance of buildings and urban areas. These KPIs are directly relevant to the AccesS project and can enrich its evaluation framework by aligning project goals with broader European objectives. Below, we outline the NEB KPIs and their potential application within AccesS, including their alignment with specific EOs and EIs.

1. Minimize the use of fossil fuels in the built environment:

- Primary energy demand: Relevant to EO#7 (7.2) and EI#1.4, this KPI measures energy performance improvements in pilot sites and helps evaluate AccesS contributions to reducing energy consumption.

³ "A practical guide to the New European Bauhaus self-assessment method and tool", <https://publications.jrc.ec.europa.eu/repository/handle/JRC139118>

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- Electricity peak demand: Aligns with EO#6 and EI#1.5, enabling the evaluation of energy management tools that optimize electricity usage patterns, reducing grid stress.
 - Smart readiness: Links to EI#1.5 and B4P objectives, assessing improvements in building intelligence and automation achieved through AccesS tools.
2. Maximize the use of sustainable energy in the built environment:
- Share of renewables: Supports EO#7 (7.3) and EI#1.4 by tracking renewable energy integration in pilot sites, particularly on-site generation and usage.
 - Energy storage: Links to EO#6 and EI#1.5, evaluating the deployment of energy storage systems to enhance resilience and energy efficiency.
3. Minimize greenhouse gas emissions (GHG) from the built environment:
- Operational GHG emissions: Aligns with EO#7 (7.2) and EI#1.4, measuring reductions in emissions due to AccesS implementation.
 - Embodied GHG emissions: Relevant to EO#7 and EI#1.5, enabling a holistic evaluation of emissions reductions, including materials and construction processes.
4. Enhance sustainable mobility in the built environment:
- e-Mobility: electric vehicle (EV) parking: Supports EO#3 (3.4) by assessing the availability of inclusive EV charging infrastructure at pilot sites.
 - Alternative mobility: bicycle: Aligns with EO#3 (3.2) by evaluating accessibility and uptake of cycling solutions in AccesS demonstration areas.
 - Public transportation systems: Covers extent, usage, and accessibility, linking to EO#3 (3.2) and EI#1.2 by assessing improvements in sustainable and accessible transport options.
5. Minimize non-energy-related environmental impacts to air and water:
- Indoor air quality: Aligns with EO#2 and EI#1.2, evaluating improvements in health and comfort due to AccesS interventions.
 - Water consumption: Links to EO#6, assessing resource efficiency measures implemented at pilot sites.
6. Minimize non-energy-related environmental impacts from the built environment:
- Construction and demolition waste: Relevant to EO#7 (7.3) and EI#1.4, tracking the reduction and recycling of waste during pilot renovations.
7. Achieve the best possible greening of the public sector in terms of its economic involvement in sustainability of the built environment:

- Social return on investment: Links to EI#1.4, measuring societal benefits from AccesS interventions, such as accessibility and sustainability improvements.
 - Degree of interdisciplinary integration: Supports EI#1.3, evaluating the collaboration between diverse stakeholders during AccesS implementation.
 - Gross value added to local economy from new business creation: Aligns with EI#1.4, assessing economic growth driven by innovations and solutions developed in AccesS.
8. Achieve the best possible greening of the private and financial sector in terms of its economic involvement in sustainability of the built environment:
- Green financial tools: Relevant to EI#1.5, evaluating the deployment of financial mechanisms supporting accessibility and sustainability goals.
 - Compliance with ESG standards and European Sustainability Reporting Standards: Aligns with EI#1.5, ensuring that AccesS meets high standards for sustainability and transparency.
9. Promote circular economy in the built environment:
- Secondary, bio-based, recycled materials: Links to EO#7 and EI#1.4, evaluating the adoption of sustainable materials in pilot renovations.

The following KPIs have been selected from NEB as most relevant with AccesS targets:

Table 7: Selected KPIs from NEB.

KPI Name	Relevant EOs/EI
Ease of circulation	EO#1, EO#3
Safe wayfinding	EO#1, EO#3
Usability and operation	EO#1, EO#3
Adoption Rate of Smart Accessibility Technologies in Buildings	EO#1, EO#6
EV charging infrastructure improvements	EO#3

Indicatively, the following KPIs were excluded:

Table 8: Excluded KPIs from NEB.

Excluded KPI	Reason for Exclusion
Water Conservation Rate	Outside the project's energy/accessibility scope. Limited relevance and availability.
Biophilic Design Integration	Focused more on aesthetics, not core accessibility goals. Limited relevance and availability.

Indoor air quality	It is considered as part of the comfort of buildings KPI in previous step
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2.4.3 AccessibleEU

As part of the EU's Strategy for the Rights of Persons with Disabilities, AccessibleEU [3] focuses on training, monitoring, and compliance with accessibility standards. It is a resource Centre on accessibility working on areas such as built environment, transport, information and communication technologies to ensure the participation of persons with disabilities in all areas of life on equal basis with others. Among others, AccessibleEU offers accessibility monitoring and surveillance. KPIs based on this flagship initiative could monitor adherence to EU accessibility standards and user satisfaction with the accessibility of both physical spaces and digital tools.

The following KPIs have been selected from AccessibleEU:

Table 9: Selected KPIs from NEB.

KPI Name	Relevant EOs/EI
Policy Alignment with AccesS Accessibility Standards	EI#1
Compliance with EU accessibility standards	EI#1

The following KPI has finally been excluded from our framework:

Table 10: Excluded KPI from AccessibleEU.

Excluded KPI	Reason for Exclusion
Compliance with national standards	Redundant with KPI <i>Compliance with EU accessibility standards</i>
Adoption of the accessibility assessment scheme	This aspect is covered as part of the KPI <i>Development of a comprehensive certification framework</i> , selected in previous step

2.4.4 Sustainable and Inclusive Mobility Projects

TRIPS - TRansport Innovation for vulnerable-to-exclusion People needs Satisfaction

TRIPS [4] deployed inclusive digital mobility solutions placing people with mobility challenges (e.g., elderly, disabled people) at the center. The project brought together disabled users, and transport and assistive technology experts to co-develop an innovation roadmap with research priorities and policy recommendations for developing digital mobility solutions.

The following KPI has been selected from TRIPS as most relevant to the AccesS objectives:

Table 11: Selected KPIs from TRIPS.

KPI Name	Relevant EOs/EI
Long-Term User Independence in Daily Activities	EI#1

INDIMO - Inclusive Digital Mobility Toolbox

INDIMO [5] has developed digital tools to make digital transport solutions more inclusive and accessible aiming to improve mobility and delivery services. The overall aim of the INDIMO project was to extend the benefits of the new and emerging digitally interconnected transport system to people who currently face barriers to using such systems due to the limited physical or cognitive accessibility to the digital interfaces or socio-economic barriers. INDIMO digital mobility toolbox was co-created to help stakeholders to (re)develop and deploy more accessible and inclusive digital transport system, which is usable and accessible to the widest range of people while catering for individual needs and offering personalised mobility options.

The following KPI has been selected from INDIMO as most relevant to the AccesS objectives:

Table 12: Selected KPIs from INDIMO.

KPI Name	Relevant EOs/EI
Long-Term User Independence in Daily Activities	EI#1

Indicatively, the following KPIs have been excluded from TRIPS/INDIMO projects:

Table 13: Excluded KPIs from TRIPS/INDIMO projects.

Excluded KPI	Reason for Exclusion
Delivery Service Inclusivity Score	This is focused more on digital mobility services; AccesS emphasizes physical accessibility and active mobility solutions.
Smartphone App Adoption Rate	Redundant with KPI <i>Adoption Rate of Smart Accessibility Technologies in Buildings</i>

Evaluation of public transportation station area accessibility based on walking perception [6]

This paper evaluates the walking accessibility of public transportation station areas by integrating psychological perception factors, such as obstacles and sidewalk conditions, into a pedestrian impedance model. It highlights how perceived walking environments significantly impact station accessibility within specific time thresholds. The findings inform the formulation of the KPI Accessibility of Buildings' Surrounding Area, specifically addressing accessible pathways and public transport systems.

The following KPI has been selected from Li *et al.*:

Table 14: Selected KPIs from Li *et al.*

KPI Name	Relevant EOs/EI
Accessibility of buildings' surrounding area	EO#1, EO#3

2.4.5 Energy Efficiency and Building Renovation Projects

EBENTO

EBENTO [7] improves energy efficiency in buildings by providing a one-stop-shop platform that streamlines coordination and management of Energy Performance Contracting (EPC), addressing the needs of all stakeholders in the building and renovation sector.

The following KPIs have been selected from EBENTO:

Table 15: Selected KPIs from EBENTO.

KPI Name	Relevant EOs/EI
Total primary energy consumption saving	EO#7
Primary electricity consumption saving	EO#7
Primary heating energy consumption	EO#7
CO ₂ emissions reduction	EO#7

BIMERR

BIMERR [8] focuses on Building Information Modelling (BIM) for the Architecture, Engineering & Construction (AEC) sector, developing an advanced toolkit to assist renovation stakeholders throughout the entire building renovation process, from concept to completion.

The following KPIs have been selected from BIMERR:

Table 16: Selected KPIs from BIMERR.

KPI Name	Relevant EOs/EI
Percentage of time temperature limits not satisfied while occupied	EO#2
Percentage of time indoor air quality preferences not met while occupied	EO#2

D²EPC

D²EPC [9] developed dynamic Energy Performance Certificates (EPC)s using smart-ready technologies, real-time data, and the digital twin concept. The project enhances BIM and introduces new performance indicators for more accurate EPC classification complemented by additional elements such as building performance monitoring, energy management, and renovation planning, thus contributing significantly to reducing energy consumption, minimizing environmental impacts, and enhancing occupants' quality of life.

The following KPIs has been selected from D^2EPC:

Table 17: Selected KPIs from D2EPC.

KPI Name	Relevant EOs/EI
Enhanced user awareness of building energy efficiency	EO#7
Energy savings triggered by the project	EO#7, EI#1
Reduction of the greenhouse gases emissions triggered by the project	EO#7, EI#1

EnergyMate

EnergyMate [10] engages users in energy management, achieving significant energy savings through tailored recommendations. For AccesS, KPIs could track energy savings, user engagement, and perceived control over energy consumption in pilot buildings.

The following KPI has been selected from EnergyMate:

Table 18: Selected KPIs from EnergyMate.

KPI Name	Relevant EOs/EI
Effectiveness of energy management tools	EO#6, EO#7

InCUBE

InCUBE [11] envisions to unlock the EU renovation wave through cutting-edge standardised and integrated processes based on industrialisation, innovative renewable energy technologies, digitalisation, and new market entrants. All while accounting for social inclusion, gender mainstreaming and upskilling of current and protentional workforce.

The following KPI has been selected from InCUBE as most relevant:

Table 19: Selected KPIs from InCUBE.

KPI Name	Relevant EOs/EI
Gross floor area of EU building stock (renovated) adopting project solutions	EI#1

BuildHEAT

BuildHEAT [12] focuses on deep renovation for energy efficiency in residential buildings. BuildHEAT's KPIs focused on deep renovation energy savings and user comfort were excluded because these aspects are already covered by EBENTO and BIMERR.

Table 20: Excluded KPI from BuildHEAT.

Excluded KPI	Reason for Exclusion
Post-renovation energy savings (%)	Covered by EBENTO/BIMERR KPIs.

2.4.6 Standardized Frameworks and Observatories

Smart Readiness Indicator (SRI)

The SRI framework [12] evaluates a building's smart readiness and potential for technological integration. The objectives of the SRI scheme are to evaluate the building 'smartness' by means of evaluating the extent to which a building can adapt its operation in accordance with the preferences of its occupants and the needs of the grid taking actions that improve its energy efficiency. It aims to trigger improvements using smart ready services and raises awareness in smarter technologies and functionalities to end users and market actors alike. As such, the SRI scheme upholds building energy performance, response to user needs and energy demand flexibility as its three key functionalities. Relevant KPIs could assess the adoption of smart technologies, their impact on energy management, and user satisfaction with smart solutions. This has been evaluated as part of the NEB initiative analysis and relevant KPIs were already selected and adopted in this step.

EN 17210:2021: Accessibility and usability of the built environment [13]

The EN 17210:2021 standard defines functional accessibility and usability requirements for the built environment, emphasizing Design for All/ Universal Design principles. It provides guidelines for designing, constructing, and maintaining inclusive environments, ensuring equitable and safe use for diverse users, including persons with disabilities. This standard applies to both indoor and outdoor spaces, supporting accessibility across urban and pedestrian areas.

The following KPI has been selected from EN 17210:2021:

Table 21: Selected KPIs from EN 17210:2021.

KPI Name	Relevant EOs/EI
Development of a comprehensive certification framework	EO#5

Indicatively, the following KPI has been excluded from the AccessS framework:

Table 22: Excluded KPI from standardized frameworks (SRI, EN 17210:2021).

Excluded KPI	Reason for Exclusion
SRI Training Modules Adoption	Outside AccessS's focus on operational metrics

2.5 Step 4: Expanding the KPI Pool Through Cross-Project Insights and External Alignment

This step finalizes the KPI framework based on the analysis performed in the previous step as described in Section 2.4. Research and innovation projects, standards, and initiatives (e.g., Built4People, New European Bauhaus, EN 17210:2021) were reviewed to identify best practices and additional KPIs were selected based on their relevance to AccessS goals, measurability, and alignment with EU standards. KPIs that didn't serve the operational objectives of the project, with limited availability of data for quantification or outside the project's scope were excluded. This step provides an overview of the selected KPIs.

2.5.1 Expanded Outcome-Oriented KPIs

Outcome-oriented KPIs track short-to-medium-term results directly tied to the project's EOs. These include technical, societal, and economic metrics.

Table 23: Expanded Outcome-Oriented KPIs.

No	Name of the KPI	Unit	Source	Evaluation Level
Scientific				
o1	Creation and utilization of high-quality new knowledge	# citations/y	EO#1, EO#2, EO#3, EO#6	Project Level
Societal/ Environmental				
o2	Accessibility of buildings	Likert	EO#1, NEB, InCUBE	Demo-site
o3	Accessibility of buildings' surrounding area	Likert	EO#1, EO#3, EN17210:2021, Li <i>et al.</i>	Demo-site
o4	Ease of circulation	Likert	EO#1, EO#3, NEB	Demo-site
o5	Safe wayfinding	Likert	EO#1, EO#3, NEB	Demo-site
o6	Usability and operation	Likert	EO#1, EO#3, NEB	Demo-site
o7	Educational material on accessibility and inclusion	# materials developed	EO#4	Project Level
o8	Number of end-users directly engaged in demonstration activities	#	EO#5	Demo-site
o9	User satisfaction with the accessibility of digital solutions	Likert	EO#1, EO#3	Demo-site
o10	Comfort of buildings	Likert	EO#2	Demo-site
o11	Percentage of time temperature limits not satisfied while occupied	%	EO#2, BIMERR	Demo-site

o12	Percentage of time indoor air quality preferences not met while occupied	%	EO#2, BIMERR	Demo-site
o13	Adoption Rate of Smart Accessibility Technologies in Buildings	%	EO#1, EO#6, B4P, NEB	Demo-site
o14	Enhanced user awareness of building energy efficiency	Likert	EO#7, D^2EPC	Demo-site
Economic/Technological				
o15	Effectiveness of energy management tools	Likert	EO#6, EnergyMate	Demo-site
o16	Total primary energy consumption saving	kWh/m ² /y	EO#7, EBENTO, BIMERR	Demo-site
o17	Primary electricity consumption saving	kWh/m ² /y	EO#7, EBENTO, BIMERR	Demo-site
o18	Primary heating energy consumption	kWh/m ² /y	EO#7, EBENTO, BIMERR	Demo-site
o19	CO ₂ emissions reduction	kgCO ₂ e/y	EO#7, EBENTO, BIMERR	Demo-site
o20	Products/furniture designed under ergonomics principles	#	EO#2	Project, Demo-site level
o21	EV charging infrastructure improvements	%, Likert	EO#3, NEB	Demo-site
o22	Development of a comprehensive certification framework	# schemes reviewed, framework draft status (complete/incomplete)	EO#5, B4P, EN17210:2021, AccessibleEU, INDIMO	Project level

2.5.2 Expanded Impact-Oriented KPIs

Impact-oriented KPIs measure long-term societal, environmental, and policy changes linked to the project's EIs. These indicators focus on sustained outcomes beyond the project's duration, such as improved quality of life, policy alignment, and scalability of solutions. To ensure relevance, they require tracking over time through annual surveys, policy reviews, and post-project audits. Key focus areas include fostering user independence, reducing energy poverty, and driving EU-wide adoption of accessibility standards.

Table 24: Expanded Impact-Oriented KPIs.

No	Name of the KPI	Unit	Source	Evaluation Level
Scientific				

i1	Creation of new knowledge on SSH issues relevant to building performance and management	# citations/y	EI#1	Project Level
Societal/ Environmental				
i2	Improved perception of accessibility, inclusiveness, and sustainability combined	Likert	EI#1	Project Level, EU level
i3	Sustainable living improvements based on individual needs	Likert, # of users	EI#1	Project Level, EU level
i4	Long-Term User Independence in Daily Activities	Likert, %	EI#1, TRIPS, INDIMO	Project Level, EU level
i5	Policy Alignment with AccesS Accessibility Standards	#	EI#1, B4P, AccesibleEU	Project Level, EU level
Economic/ Technological				
i6	Gross floor area to be upgraded (renovated or operated more energy efficiently) per year	m ² /y	EI#1, InCUBE	Project Level, EU level
i7	Long-term energy savings triggered by AccesS	GWh/y	EI#1, NEB, EBENTO, D^2EPC, InCUBE	Project Level, EU level
i8	Long-term CO ₂ emissions reduction triggered by AccesS	tCO ₂ eq/y	EI#1, NEB, D^2EPC, InCUBE	Project Level, EU level

3 KPI Calculation Methodology

This section presents a complete overview for each KPI of the AccessS Evaluation Framework aiming to summarize key information for each indicator and describe the methodologies to be used to measure the proposed metrics. For each indicator, a comprehensive description is included in table format that summarizes the main information and the connection with project expected outcomes and impacts. The second subsection for each indicator reflects the proposed methodology to be utilized for the assessment. The detailed descriptions and calculation methodologies will serve as valuable resources for the development of relevant questionnaires to gather valuable stakeholder feedback and will support the demonstration and evaluation activities of WP10, WP11 and WP12.

3.1 Outcome-Oriented KPIs

3.1.1 KPI o1: Creation and Utilization of High-Quality New Knowledge

3.1.1.1 Indicator Description

AccessS aspires to create and use high quality new knowledge on issues relevant to accessibility within the built environment, energy consumption of buildings and comfort. This indicator aims to monitor and quantify the diffusion of knowledge shared by tracking the annual production of peer-reviewed publications, patents, or reports arising from the project, related to accessibility, comfort, and energy efficiency.

Table 25: KPI o1 Information.

Basic KPI Information	Details
Name	Creation and Utilization of High-Quality New Knowledge
ID	KPI o1
Description	Tracks annual production of peer-reviewed publications, patents, or reports related to accessibility, comfort, and energy efficiency.
Recommended Assessment Methodology	Total citations of AccessS-related research outputs per year.
Unit	Number of citations/year
Evaluation Period	Project duration

3.1.1.2 Calculation Methodology

Peer-reviewed publications can serve the evaluation of this KPI with the number of citations as a common practice to track the new knowledge generated. The total number of citations of AccessS-related research outputs per year can be counted. For extracting the number of citations, relevant databases can be considered such as Google Scholar, Scopus, JSTOR etc.

3.1.2 KPI o2: Accessibility of Buildings

3.1.2.1 Indicator Description

The need to transform buildings into more accessible is closely aligned with AccessS general scope. This indicator aims to evaluate the overall accessibility of the built environment for people with disabilities and older people, considering different aspects of accessibility in terms of mobility, wayfinding, perceived safety and inclusion. For the perception of accessibility of end-users, the surveys conducted as part of WP2 activities can be considered as baseline in order to assess improvements based on the suggestions provided after project implementation, ultimately providing feedback to refine design and operational strategies.

Table 26: KPI o2 Information.

Basic KPI Information	Details
Name	Accessibility of Buildings
ID	KPI o2
Description	Evaluates the accessibility of the built environment for people with disabilities and older persons.
Recommended Assessment Methodology	Surveys of end-users and project partners, Universal Accessibility Assessment Tool (UAAT) (T7.1).
Unit	Likert scale rating converted to percentage, scoring system enabled by the AccessS Accessibility Assessment Scheme.
Evaluation Period	Baseline: Pre-project; Deployment: Post-project.

3.1.2.2 Calculation Methodology

The impact on the overall accessibility can be measured through structured surveys targeting respondents' perceptions and experiences, combined with the respective questionnaires for KPI o4, o5, o6. Additionally, this KPI can also be supported by the Universal Accessibility Assessment Tool (T7.1) of the AccessS Suite for the assessment of additional aspects of accessibility for the building. The tool aims to enable the assessment of accessibility features according to the Accessibility Assessment scheme and more details on the different aspects will be elaborated based on the findings of WP8.

3.1.3 KPI o3: Accessibility of Buildings' Surrounding Area

3.1.3.1 Indicator Description

This indicator evaluates outdoor built environment barriers for people with disabilities and the elderly, focusing on ease of navigation before reaching a building, active mobility and transportation. Assessment is based on surveys conducted with end-users and project partners, capturing pre- and post-project states. For the perception of accessibility of end-users, the surveys conducted as part of WP2 activities can be considered as baseline in order to assess improvements based on the suggestions provided after project implementation, ultimately providing feedback to refine design and operational strategies. Key aspects of this indicator can include:

- **Accessible Pathways:** Evaluates the ease of navigation through available pathways of the nearby outdoor environment for people with disabilities. Key elements of this aspect include pedestrian-friendly amenities, such as traffic signs, obstacles in sidewalks, sidewalks' width, sidewalk pavement, sidewalk slopes, tactile walking surface indicators, travel time, etc. [6].
- **Accessible Parking spaces:** Evaluates the available amount of accessible parking spaces in the surrounding area of a building or in the garage [14], the proximity of parking spaces to the entrance, accessible pedestrian routes leading to the closest accessible entrance, parking signage and marking, etc. [13], [15].
- **Accessible Public Transport Systems:** Evaluates the proximity of accessible public transport, accessible pedestrian routes to the nearest accessible entrance, etc. [6], [13].
- **Universal Design:** Assesses inclusivity in design features that accommodate diverse needs.

Table 27: KPI o3 Information.

Basic KPI Information	Details
Name	Accessibility of buildings' surrounding area
ID	KPI o3
Description	Evaluates the accessibility of the outdoor built environment for people with disabilities and elderly
Recommended Assessment Methodology	Surveys of end-users and project partners
Unit	Likert scale rating converted to percentage.
Evaluation Period	Baseline: Pre-project; Deployment: Post-project.

3.1.3.2 Calculation Methodology

The impact on accessibility is measured through structured surveys targeting respondents' perceptions and experiences. Additionally, the Universal Accessibility Assessment Tool (T7.1) of the Access Suite could also provide support with the assessment of some aspects of accessibility for the surrounding building area. The tool aims to enable the assessment of accessibility features according to the Accessibility Assessment framework and more details on the different aspects will be elaborated within WP8.

The methodology proposal for the questionnaire, targeting pilot end-users includes a non-exhaustive list of questions:

- How efficient do you evaluate the accessibility in terms of the surrounding area of the building?
- How easy is it for you to use public transportation to reach the building?
- How easy is it for you to use the parking space outside the building?
- Do you find the pedestrian pavement around the building accessible enough?
- Are there sufficient accessible routes/sidewalks/crossings for wheelchair users?

- How satisfied are you by the active mobility systems such as pedestrian routes or public transportation?

3.1.4 KPI o4: Ease of Circulation

3.1.4.1 Indicator Description

This indicator evaluates the extent to which the building design enables the movement of different users through, around and between spaces and environments without barriers and without compromise to their safety and experience [2]. It focuses on evaluation of the adequacy of entrances, horizontal circulation (e.g., across a building floor) and vertical circulation (i.e., access to other floors). As the provision of adequate circulation comprises numerous design elements, the indicator evaluation can be based on compliance with best practice standards (e.g., EN 17210:2021) and beyond best-practice guidance that specifically addresses users with diverse abilities.

The goal is to measure improvements in accessibility after project implementation, providing feedback to refine design and operational strategies.

Table 28: KPI o4 Information.

Basic KPI Information	Details
Name	Ease of Circulation
ID	KPI o4
Description	Evaluates the ease of circulation within a built environment for people with disabilities and the elderly.
Recommended Assessment Methodology	Surveys of end-users and project partners, Universal Accessibility Assessment Tool (UAAT) (T7.1).
Unit	Likert scale rating converted to percentage.
Evaluation Period	Baseline: Pre-project; Deployment: Post-project.

3.1.4.2 Calculation Methodology

The impact on ease of circulation is measured through structured surveys targeting respondents' perceptions and experiences. For the perception of end-users, the surveys conducted as part of WP2 activities will be considered as baseline in order to assess improvements based on the suggestions provided after project implementation, ultimately providing feedback to refine design and operational strategies. Additionally, this KPI can also be supported by the Universal Accessibility Assessment Tool (T7.1) of the AccessS Suite, assessing different aspects of physical accessibility, usability and safety. The tool aims to enable the assessment of accessibility features according to the Accessibility Assessment framework to be developed in WP8. The 3D Scenarios Simulator (T5.2) component of the project could also provide support with the visualization of simulation scenarios for wheelchair accessibility, for building accessibility for the elderly as well as for visually and auditory impaired people.

The methodology proposal for the questionnaire, targeting pilot end-users includes:

1. **Perception of Accessibility:** A non-exhaustive list of questions rating ease of circulation and navigation on a scale of 1 to 5:

- Were you aware of accessibility features within the building before the project?
- Were you aware of accessibility features within the building?
- How easy is it to navigate within the building vertically, using elevators, escalators, etc.?
- How easy is it to navigate within a floor?
- How accessible are the elevators, escalators, etc.?
- How easy is it to visit all the areas/sections/rooms you wanted (e.g., obstacles, ramp routes, etc.)?
- Is there adequate maneuvering space in front of doors, including elevators?
- How accessible are the restrooms (grab bars, emergency alarms, sinks, etc.)?

2. Feedback Collection:

Open-ended questions for respondents to share comments and suggestions.

3.1.5 KPI o5: Safe Wayfinding

3.1.5.1 Indicator Description

This indicator evaluates the extent to which the design conveys spatial information to users to help them identify and comprehend the various elements within the environment around them. This includes spatial information to aid orientation and navigation and use of the space without harm or compromise. In particular it may look at whether: (i) sufficient visual contrast is provided to ensure users can easily identify and comprehend the various elements within the environment, (ii) finishes are safe, clear and void of elements or patterns which may create confusion to users, (iii) signage, information and communication systems provide the necessary information for users to navigate and use the space independently and with confidence, including alternative formats for people with specific needs. As numerous design elements need to be considered, evaluation of this indicator can be based on the level of design adherence to best practice and beyond best-practice design guidance that specifically addresses users with diverse abilities [2].

The goal is to measure improvements in safe wayfinding based on performance objectives set out in EN 17210:2021 covering indoor wayfinding and access to the project from the exterior, as well as clarity of signage and messaging for mobility, auditory and visually impaired people.

Table 29: KPI o5 Information.

Basic KPI Information	Details
Name	Safe wayfinding
ID	KPI o5
Description	Evaluates the ease of wayfinding within a built environment for people with disabilities and the elderly.
Recommended Assessment Methodology	Surveys of end-users and project partners, Universal Accessibility Assessment Tool (UAAT) (T7.1).

Basic KPI Information	Details
Unit	Likert scale rating converted to percentage.
Evaluation Period	Baseline: Pre-project; Deployment: Post-project.

3.1.5.2 Calculation Methodology

The impact on accessibility is measured through structured surveys targeting respondents' perceptions and experiences both prior and post-project. For the perception of end-users, the surveys conducted as part of WP2 activities will be considered as baseline in order to assess improvements based on the suggestions provided after project implementation, ultimately providing feedback to refine design and operational strategies. Additionally, this KPI can also be supported by the Universal Accessibility Assessment Tool of the Access Suite (T7.1), assessing different aspects of physical accessibility, usability and safety. The tool aims to enable the assessment of accessibility features according to the Accessibility Assessment framework to be developed in WP8. The 3D Scenarios Simulator (T5.2) component of the project could also provide support with the visualization of simulation scenarios for wheelchair accessibility, for building accessibility for the elderly as well as for visually and auditory impaired people.

The methodology proposal for the questionnaire, targeting pilot end-users includes:

1. **Perception of Accessibility:** A non-exhaustive list of questions rating safe wayfinding on a scale of 1 to 5:
 - Is there adequate signage inside the building to get essential information (e.g., restroom, emergency exits, exhibits, building map, etc.)?
 - How easy is it to navigate the floor you selected by following the signage?
 - Are there enough technology-assisted navigation opportunities, such as voice-activated controls or digital wayfinding?
 - N/A

2. Feedback Collection

Open-ended questions for respondents to share comments and suggestions.

3.1.6 KPI o6: Usability and Operation

3.1.6.1 Indicator Description

This indicator evaluates the extent to which the building design is usable and operable by all users, regardless of their abilities or background. This indicator focuses on whether the necessary and desired facilities for people with diverse needs are available, and whether usable and operable elements within the space, such as furnishings, fixtures and fittings, are easy to use and operate by all users [2].

The goal is to measure improvements in accessibility after project implementation, providing feedback to refine design and operational strategies.

Table 30: KPI o6 Information.

Basic KPI Information	Details
Name	Usability and Operation

Basic KPI Information	Details
ID	KPI o6
Description	Evaluates the usability and operation of a building by all users including people with disabilities and the elderly.
Recommended Assessment Methodology	Surveys of end-users and project partners, Universal Accessibility Assessment Tool (UAAT) (T7.1).
Unit	Likert scale rating converted to percentage.
Evaluation Period	Baseline: Pre-project; Deployment: Post-project.

3.1.6.2 Calculation Methodology

The impact on accessibility is measured through structured surveys targeting respondents' perceptions and experiences both prior and post-project. For the perception of end-users, the surveys conducted as part of WP2 activities will be considered as baseline in order to assess improvements based on the suggestions provided after project implementation, ultimately providing feedback to refine design and operational strategies. Additionally, this KPI can also be supported by the Universal Accessibility Assessment Tool of the AccessS Suite (T7.1), assessing different aspects of physical accessibility, usability and safety. The tool aims to enable the assessment of accessibility features according to the Accessibility Assessment framework to be developed in WP8. The 3D Scenarios Simulator (T5.2) component of the project could also provide support with the visualization of simulation scenarios for wheelchair accessibility, for building accessibility for the elderly as well as for visually and auditory impaired people.

The methodology proposal for the questionnaire, targeting pilot end-users includes:

1. **Perception of Accessibility:** A non-exhaustive list of questions rating usability and operation on a scale of 1 to 5:
 - How easily do you interact with the doors inside the building (handles, force required)?
 - How easy is it to interact with objects and furniture inside the building (e.g., cupboards, toiled lids, hand dryers)?
 - How satisfied are you regarding the interaction with electric controls and switches inside the building (e.g., elevator buttons, light switches, technological equipment)?
 - How effective do you find the available assistive technologies?

2. Feedback Collection

Open-ended questions for respondents to share comments and suggestions.

3.1.7 KPI o7: Educational Material on Accessibility and Inclusion

3.1.7.1 Indicator Description

This KPI tracks the development of educational resources (e.g., guidelines, videos) to raise awareness about accessibility and inclusiveness. Materials will target public authorities, universities, and architectural firms, aligning with Task T13.2.

Table 31: KPI o7 Information.

Basic KPI Information	Details
Name	Educational Material on Accessibility and Inclusion
ID	KPI o7
Description	Tracks the number of educational resources developed to promote accessibility and inclusion.
Unit	# (number)
Recommended Assessment Methodology	The number of materials can be monitored and documented as part of T13.2 activities

3.1.7.2 Calculation Methodology

This KPI aims to track the educational material developed by the project as part of T13.2 activities. This may include brochures, pamphlets, online resources, videos and presentations and will support the project's outreach and wider impact towards improving common awareness on the topic of accessibility and inclusiveness.

3.1.8 KPI o8: Number of end-users directly engaged in demonstration activities

3.1.8.1 Indicator Description

This KPI quantifies the number of end-users who take part in demonstration activities at the project's pilot sites. It serves as a direct measure of stakeholder involvement and helps gauge how effectively the project engages its target audience. By tracking participation, the project can ensure that the demonstrations are reaching the intended users and that their feedback is incorporated into the overall evaluation.

Table 32: KPI o8 Information.

Basic KPI Information	Details
Name	Number of End-Users Directly Engaged in Demonstration Activities
ID	KPI o8
Description	Quantifies the number of end-users participating in demonstration activities at pilot sites. This indicator helps measure stakeholder engagement and ensures that target users are reached.

Basic KPI Information	Details
Recommended Assessment Methodology	Collect attendance records, registration lists, and survey data at each demonstration event as part of WP10, WP11, WP12 activities
Unit	# (number)

3.1.8.2 Calculation Methodology

This KPI aims to assess the overall stakeholder engagement achieved at AccesS pilot sites as part of the demonstration and evaluation activities within WP10, WP11 and WP12. Data sources can be considered the attendance records or registration lists from each demonstration event/ workshop (physical presence) as well as the total participants in online surveys during the evaluation activities.

3.1.9 KPI o9: User satisfaction with the digital solutions

3.1.9.1 Indicator Description

This indicator assesses the satisfaction of the users of the technology solutions implemented as part of the AccesS Suite in terms of user-friendliness, ease of use, accessibility etc., especially for older and less digitally literate citizens and for people with disabilities. The main objective is to see how well these solutions meet the needs of relevant stakeholders and end-users of the tools, with an emphasis on ease of use, inclusiveness, accessibility and effectiveness. Key aspects include:

- **Ease of use for people with less digital skills:** it emphasizes the simplicity and intuitiveness of digital solutions, but also other aspects such as font size, for example, ensuring that they can be easily operated by those with minimal technological experience.
- **Digital accessibility:** the extent to which these digital solutions such as websites, applications, software are developed and designed to be usable by all, regardless of their ability.
- **Inclusion and equity:** assess whether the solutions deployed are readily adaptable to a wide range of user needs, ensuring equitable access for people.

This indicator is intended to provide practical information on the performance of the AccesS digital solutions, identifying areas of improvement to better serve people with different accessibility needs.

Table 33: KPI o9 Information.

Basic KPI Information	Details
Name	User satisfaction with the digital solutions
ID	KPI o9
Description	Evaluates the satisfaction of the users of the technological accessibility solutions provided by the AccesS Suite, especially for people with disabilities and older persons.

Basic KPI Information	Details
Recommended Assessment Methodology	Surveys and interviews of end-users and project partners, AccesS Suite.
Unit	Likert scale rating converted to percentage.

3.1.9.2 Calculation Methodology

Evaluation and feedback can be obtained through questionnaires or personal interviews involving different types of AccesS key target groups (e.g., Users of the buildings/ Facility managers, Building professionals, Public authorities etc.). The impact on satisfaction and performance of technological accessibility solutions is measured through structured surveys targeting respondents' perceptions and experiences:

1. Ease of use for people with low digital skills:

- Simplicity and intuitiveness: ease of interaction with the digital solutions incorporated (interface design, clarity of navigation, flow of use, ...).
- Text size and readability: assesses whether the text size, contrast and layout are suitable for users with vision impairments or individuals who have difficulty reading small text, such as the elderly.
- Ease of interaction: measures the ease with which users can operate or access key functions, such as buttons, forms or other interactive elements.

A non-exhaustive list of questions to assess the ease of use for people with low digital skills includes:

- On a scale of 1 to 5, did you find this digital solution easy to use?
- Were the text and buttons large enough to read and interact with comfortably?
- Did you find it easy to navigate the key functions?
- Do you believe the solution is designed to provide equitable access to all users, regardless of their digital literacy or capabilities?

2. Digital accessibility:

- Clarity of instructions: measures the ease of following on-screen instructions or understanding the prompts provided by the system.
- Visual accessibility: evaluates whether the solution includes features such as personal visual adjustments for visually impaired users.
- Audio guiding: evaluates the availability and effectiveness of multi-media guides (e.g., text-to-speech) to help users navigate the system.

A non-exhaustive list of questions to assess the cognitive accessibility includes:

- Were the instructions clear and easy to understand?

- Were there any times when the instructions were not clear or were confusing to you?
- Did you have any difficulty using the solution following the instructions provided?
- Did you need additional assistance?

3. Feedback Collection

Open-ended questions for respondents to share comments and suggestions.

3.1.10 KPI o10: Comfort of Buildings

3.1.10.1 Indicator Description

Occupant comfort is the state in which individuals experience physical and mental well-being because indoor environmental factors—such as temperature, humidity, noise, lighting, and air quality—are optimized to meet their physiological and psychological needs. This indicator aims to evaluate the overall comfort levels of the end-user of the building, considering different metrics for thermal, acoustic, indoor air quality and visual comfort. This indicator can assess the adequacy of the Access Suite tools with regards to the evaluation of comfort levels and the understanding of the information provided to end-users/ occupants of the building.

Table 34: KPI o10 Information.

Basic KPI Information	Details
Name	Comfort of Buildings and Infrastructure
ID	KPI o10
Description	Evaluates user satisfaction with thermal, acoustic, indoor air quality and visual comfort in buildings and infrastructure.
Recommended Assessment Methodology	End-user Surveys, Energy Comfortness Tool (ECT) (T4.2)
Unit	Likert scale rating converted to percentage, scoring system enabled by the Energy Comfortness Tool.
Evaluation Period	Baseline: Pre-project; Deployment: Post-project.

3.1.10.2 Calculation Methodology

The impact on the overall comfort of the built environment can be assessed through structured surveys targeting respondents' perceptions and experiences. The methodology proposal for the questionnaire, targeting pilot end-users includes:

1. **Awareness and Perception of Comfort:** A non-exhaustive list of questions rating user satisfaction on the comfort of the space, on a scale of 1 to 5, includes:
 - Were you aware of the different aspects and levels of comfort in a building?
 - How satisfied are you with the thermal comfort of the building?
 - How satisfied are you with the lighting and visual comfort of the building?

- How satisfied are you regarding the air quality of the building?
- How effective do you find the available technologies for monitoring comfort levels?

2. Feedback Collection

Open-ended questions for respondents to share comments and suggestions

Additionally, this KPI can also be supported by the Energy Comfortness Tool (T4.2) of the AccesS Suite for the assessment of the different comfort levels for the building, depending on the different occupant profiles.

3.1.11 KPI o11: Percentage of Time Temperature Limits Not Satisfied While Occupied

3.1.11.1 Indicator Description

This indicator aims to provide a metric for the thermal comfort of building users considering acceptable ranges of temperature when the space is occupied. It measures the percentage of occupied time during which indoor temperatures fall outside the acceptable range (e.g., 20–24°C).

Table 35: KPI o11 Information.

Basic KPI Information	Details
Name	Percentage of Time Temperature Limits Not Satisfied While Occupied
ID	KPI o11
Description	Evaluates thermal comfort compliance by measuring the % of time indoor temperatures fall outside acceptable ranges during occupancy.
Recommended Assessment Methodology	Room air temperature sensor data, Energy Comfortness Tool (ECT) (T4.2)
Unit	Percentage (%)
Evaluation Period	Baseline: Pre-project; Deployment: Post-project.

3.1.11.2 Calculation Methodology

AccesS aims to integrate a variety of building sensors for collecting real-time data on energy and indoor environment conditions. These data will be utilized by the tools of the AccesS Suite in order to deliver their services and can also be useful for quantifying monitoring metrics. This indicator will provide a metric for thermal comfort compliance utilizing room air temperature sensor data. This KPI can also be supported by the Energy Comfortness Tool for the definition of comfort levels and acceptable ranges for different occupant profiles.

The indicator will be calculated based on the following formula:

Percentage of occupied time during which indoor temperatures fall outside the acceptable range = (Hours outside range / Total occupied hours) × 100.

3.1.12 KPI o12: Percentage of Time Indoor Air Quality Preferences Not Met While Occupied

3.1.12.1 Indicator Description

This indicator aims to provide a metric for the indoor air quality of a building space considering the air quality metrics such as CO₂ and pollutants levels when the space is occupied. It tracks the percentage of occupied time during which CO₂ or pollutant levels exceed user-defined thresholds.

Table 36: KPI o12 Information.

Basic KPI Information	Details
Name	Percentage of Time Indoor Air Quality Preferences Not Met While Occupied
ID	KPI o12
Description	Evaluates Indoor Air Quality Compliance by tracking the % of time CO ₂ /pollutant levels exceed user-defined thresholds during occupancy.
Recommended Assessment Methodology	Indoor air quality sensor data, Energy Comfortness Tool (ECT) (T4.2)
Unit	Percentage (%)
Evaluation Period	Baseline: Pre-project; Deployment: Post-project.

3.1.12.2 Calculation Methodology

AccessS aims to integrate a variety of building sensors for collecting real-time data on energy and indoor environment conditions. These data will be utilized by the tools of the AccessS Suite in order to deliver their services and can also be useful for quantifying monitoring metrics. This indicator will provide a metric for indoor air quality compliance utilizing room indoor air quality sensor data. This KPI can also be supported by the Energy Comfortness Tool that will associate environmental sensor measurements (e.g., CO₂, PM_{2.5/10}) to indoor conditions and weather data and evaluate comfort based on acceptable IAQ thresholds.

The indicator can be calculated based on the following formula:

Percentage of occupied time during which CO₂ or pollutant levels exceed user-defined thresholds = (Hours outside thresholds / Total occupied hours) × 100.

3.1.13 KPI o13: Adoption Rate of Smart Technologies for accessibility in built environments

3.1.13.1 Indicator Description

The adoption of smart technologies into the built environment is assessed through a comprehensive methodology that incorporates stakeholder engagement and data analysis. The indicator aims to evaluate the effectiveness of integrating smart technology in buildings, highlighting the positive impact of the adoption of smart solutions in the accessibility and inclusion of the built environment. This indicator can be evaluated considering the willingness of users to adopt smart technologies following demonstrators as well as the integration of smart technologies for accessibility in pilot buildings.

Table 37: KPI o13 Information.

Basic KPI Information	Details
Name	Adoption Rate of Smart Technologies for Accessibility
ID	KPI o13
Description	Evaluates i) the willingness of end-users to adopt smart technologies for accessibility; ii) availability of smart technologies (e.g., IoT sensors, access control, voice-activated systems) integrated in buildings.
Recommended Assessment Methodology	Audits at pilot sites, surveys with end-users
Unit	Likert scale converted to percentage (%), # (number)
Evaluation Period	Baseline: Pre-project; Deployment: Post-project.

3.1.13.2 Calculation Methodology

This indicator evaluates the adoption rate of smart technologies for accessibility by end-users involved in pilot demonstration activities, considering the efficacy of smart technologies applied in built environments to improve the accessibility of individuals with functional diversity and elderly people, their adaptability of those technologies in the retrofitting of public and/or private spaces to meet the accessibility needs of these users. The success of the adoption and integration of smart technologies in the built environment will be measured through i) structured surveys in pilot sites ; ii) the number of smart technologies (for example, IoT sensors, access control, voice-activated systems) integrated into buildings post and after project implementation can also be monitored.

A non-exhaustive list of questions to assess the end-users willingness to adopt smart technologies for accessibility in built environments includes:

- To what extent do you believe that smart technologies can improve the accessibility conditions for your building
- How easy is it to integrate smart technologies into the current design of the space without altering its original layout or configuration?
- To what extent are smart technologies adapted to the unique characteristics of the space (size, layout, use...)?

- How likely do you consider the integration of smart technologies in your building?

3.1.14 KPI o14: Enhanced User Awareness of Building Energy Efficiency

3.1.14.1 Indicator Description

This KPI aims to evaluate user understanding of energy efficiency principles and motivation to adopt sustainable practices, targeting pilot users. This indicator assesses the adequacy of AccesS user-oriented tools with regards to their understanding of the benefits of the information and suggestions provided and their motivation for energy upgrades and renovations.

Table 38: KPI o14 Information.

Basic KPI Information	Details
Name	Enhanced User Awareness of Building Energy Efficiency
ID	KPI o14
Description	Evaluates the awareness of users regarding building energy efficiency
Recommended Assessment Methodology	Surveys of end-users, Energy Efficiency and Sustainable Design tool (EESDT) (T4.1), Energy Comfortness tool (ECT) (T4.2), Building Operation and Management System (BOMS) (T6.1)
Unit	Likert scale rating converted to percentage
Evaluation Period	Baseline: Pre-project; Deployment: Post-project.

3.1.14.2 Calculation Methodology

The impact of the AccesS project on the improved user-awareness of building energy efficiency will be quantified through surveys and questionnaires targeting pilot users. By analysing the responses, this indicator provides insights into the effectiveness and usability of the AccesS project towards supporting energy efficiency targets. It captures end-users' perceptions, preferences, and suggestions, offering valuable feedback for further refinement of the AccesS Suite services. The Energy Efficiency and Sustainable Design tool (T4.1), the Energy Comfortness tool (T4.2) and the Building Operation and Management System (BOMS) (T6.1) can support the evaluation of this KPI, by considering the effect of customized recommendations on enhancing understanding of energy efficiency in the decision-making process for building renovation.

The methodology proposal for the questionnaire includes a non-exhaustive list of questions to assess:

- How has the AccesS Suite improved your awareness on building's energy efficiency?
- How motivated are you to change your energy consumption patterns/ behaviour and implement energy efficiency measures?
- How motivated are you to implement energy upgrades after using the tools?

3.1.15 KPI o15: Effectiveness of Energy Management Tools

3.1.15.1 Indicator Description

This KPI evaluates how well the energy management tools perform in terms of improving energy efficiency and engaging users. It measures user satisfaction and the practical impact of these tools on energy-related behaviors. The effectiveness of energy management tools is assessed through a comprehensive methodology that incorporates stakeholder engagement and data analysis. The indicator aims to evaluate the effectiveness of integrating energy management tools into the built environment.

By analyzing stakeholder input and data analysis results, the assessment provides insights into the effectiveness and benefits of incorporating energy management tools and it highlights their positive impact on energy efficiency, building performance, and occupant comfort.

Table 39: KPI o15 Information.

Basic KPI Information	Details
Name	Effectiveness of Energy Management Tools
ID	KPI o15
Description	Assesses user satisfaction with the overall performance of energy management tools deployed by the project.
Recommended Assessment Methodology	End-user Surveys, Energy Comfortness tool (ECT) (T4.2), Building Operation and Management system (BOMS) (T6.1)
Unit	Likert scale converted to percentage (%),
Evaluation Period	Baseline: Pre-project; Deployment: Post-project.

3.1.15.2 Calculation Methodology

The methodology proposal for the questionnaire, targeting pilot end-users includes:

1. **Awareness and Usage of Energy management tools:** Evaluate the end-user's awareness and prior usage of energy management systems and the level of experience and familiarity.
2. **Perception of Effectiveness:** Utilize a Likert scale to measure the end-user's level of acceptance or satisfaction regarding the usability and impact of the energy management tools. Evaluate specific aspects related to data collection methods, impact on energy performance evaluation, and benefits for energy efficiency, building performance, and occupant comfort.
3. **Feedback Collection:** Open-ended questions for respondents to share comments and suggestions

A non-exhaustive list of questions or statements includes:

- How effective do you find the Access Suite in encouraging building users to adopt adaptive strategies for their energy management
- I find the tools developed in the Access project useful, user friendly and adapted to my needs to calculate and provide tailor-made energy management recommendations

- To what extent would the recommendations offered in the AccesS Suite motivate you to undertake energy upgrades and adaptive strategies towards maximizing efficiency and preserving comfort levels?
- I believe that the information provided by the AccesS Suite regarding the building operation and possible interventions for improvement is clear and understandable and I believe that it facilitates decision making when considering an intervention in the building.

3.1.16 KPI o16: Total Primary Energy Consumption (TPEC) Saving

3.1.16.1 Indicator Description

This KPI aims to provide a quantifiable measurement of the amount of primary energy consumption saved through energy efficiency measures or adaptable behaviour compared to a baseline scenario prior to any intervention proposed. This KPI evaluates the decrease in a building's total primary energy consumption by comparing energy usage before and after renovation or suggested intervention. It is determined by calculating the difference between total primary energy consumption (TPEC) values in the pre- and post-intervention phases. The KPI shall provide a comprehensive and quantifiable evaluation of the AccesS recommendation potential taking into account building design and operation. It should be noted that for KPIs o16 – o19, post-intervention refers only to simulation.

Table 40: KPI o16 Information.

Basic KPI Information	Details
Name	Total Primary Energy Consumption Saving
ID	KPI o16
Description	Quantifies the reduction in a building's total primary energy consumption by measuring the difference between the baseline (pre-intervention) and post-simulated intervention TPEC values.
Recommended Assessment Methodology	Simulation, Energy Efficiency and Sustainable Design tool (EESDT) (T4.1), Building Operation and Management System (BOMS) (T6.1)
Unit	kWh/m ² /y
Evaluation Period	Pre- and post- intervention or renovation (simulation).

3.1.16.2 Calculation Methodology

The energy consumption at the baseline scenario (pre-intervention) and post-intervention (simulation enabled by AccesS Suite tools) will be calculated considering the various energy sources in the building, including electricity, natural gas, district heating etc. based on the collection of data with respect to energy consumption over a specific period (over a year) from the installed energy meters (and/ or other sources like utility bills).

KPI Formula

TPEC Saving = (TPEC Baseline - TPEC Post-intervention) / TPEC Baseline

Variables

TPEC Saving: total primary energy consumption saving (annual).

TPEC Baseline: total primary energy consumption pre-renovation (annual).

TPEC Post-Intervention: total primary energy consumption post-intervention (annual).

3.1.17 KPI o17: Primary Electricity Consumption Saving

3.1.17.1 Indicator Description

Following the same approach as in KPI o16, this KPI assesses electricity savings by evaluating the decrease in a building's total primary electricity consumption before and after intervention.

Table 41: KPI o17 Information.

Basic KPI Information	Details
Name	Primary Electricity Consumption Saving
ID	KPI o17
Description	Quantifies electricity savings by comparing baseline (pre-intervention) and post-renovation primary electricity consumption.
Recommended Assessment Methodology	Simulation, Energy Efficiency and Sustainable Design tool (EESDT) (T4.1), Energy Building Operation and Management System (BOMS) (T6.1)
Unit	kWh/m ² /y
Evaluation Period	Pre- and post- intervention or renovation (simulation).

3.1.17.2 Calculation Methodology

The electricity consumption at the baseline scenario (pre-intervention) and post-intervention (simulation enabled by AccessS Suite tools) will be calculated considering the electricity sources in the building, based on the collection of data with respect to electricity consumption over a specific period (over a year) from the installed energy meters (and/ or other sources like utility bills).

KPI Formula

PEC Saving = (PEC Pre-Renovation - PEC Post-Renovation) / PEC Post-Renovation

Variables

PEC Saving: primary electricity consumption saving.

PEC Pre-Renovation: primary electricity consumption pre-renovation.

PEC Post-Renovation: primary electricity consumption post-renovation.

3.1.18 KPI o18: Primary Heating Consumption Saving

3.1.18.1 Indicator Description

Following the same approach as in KPI o17, this KPI evaluates the reduction in a building's primary heating energy consumption by comparing usage before and after renovation.

Table 42: KPI o18 Information.

Basic KPI Information	Details
Name	Primary Heating Energy Consumption Saving
ID	KPI o18
Description	Quantifies heating energy savings by assessing pre- and post-renovation primary heating energy consumption.
Recommended Assessment Methodology	Simulation, Energy Efficiency and Sustainable Design tool (EESDT) (T4.1), Energy Building Operation and Management System (BOMS) (T6.1)
Unit	kWh/m ² /y
Evaluation Period	Pre- and post- intervention or renovation (simulation).

3.1.18.2 Calculation Methodology

The heating energy consumption at the baseline scenario (pre-intervention) and post-intervention (simulation enabled by AccesS Suite tools) will be calculated considering the various heating sources in the building, including electricity, natural gas, district heating etc. based on the collection of data with respect to heating energy consumption over a specific period (over a year) from the installed energy meters (and/ or other sources like utility bills).

KPI Formula

$\text{PHEC Saving} = (\text{PHEC Baseline} - \text{PHEC Post-Renovation}) / \text{PHEC Post-Renovation}$

Variables

PHEC Saving: primary heating energy consumption saving.

PHEC Baseline: primary heating energy consumption pre-renovation.

PHEC Post-Renovation: primary heating energy consumption post-renovation.

3.1.19 KPI o19: CO₂ Emissions Reduction

3.1.19.1 Indicator Description

This KPI assesses the reduction in CO₂ emissions resulting from energy savings achieved through KPI o16.

Table 43: KPI o19 Information.

Basic KPI Information	Details
Name	Primary Electricity Consumption Saving
ID	KPI o19
Description	Quantifies CO ₂ emissions reduction linked to energy savings from KPI o16.

Basic KPI Information	Details
Recommended Assessment Methodology	Simulation, Energy Efficiency and Sustainable Design tool (EESDT) (T4.1)
Unit	kgCO ₂ /y
Evaluation Period	Pre- and post- intervention or renovation (simulation).

3.1.19.2 Calculation Methodology

KPI Formula

CO₂ Emissions Reduction (kgCO₂/y) = TPEC Saving (in kWh/y) x CO₂ Factor per Country (kgCO₂/kWh)

Variables

CO₂ Emissions Reduction: annual CO₂ emissions reduction in kg.

TPEC Saving: total primary energy consumption saving in kWh/y.

CO₂ Factor per Country: factor to convert from primary energy in kWh to kgCO₂.

3.1.20 KPI o20: Products/Furniture Designed Under Ergonomics Principles

3.1.20.1 Indicator Description

The Access Suite aims to create a comprehensive guide of expert recommendations for optimizing ergonomics and enhancing comfort in the design and development of adapted products tailored for individuals with disabilities and older adults and allow for simulation-based testing and compliance with ergonomic principles and usability. This indicator counts the number of products or pieces of furniture that have been designed according to ergonomics principles to enhance accessibility and comfort.

Table 44: KPI o20 Information.

Basic KPI Information	Details
Name	Ergonomic Product Design
ID	KPI o20
Description	Counts the number of products/furniture designed with ergonomic and accessibility principles.
Recommended Assessment Methodology	The number of products/ furniture listed and/or assessed by ErgoFlow (T4.3)
Unit	# (Number)
Evaluation Period	Project duration

3.1.20.2 Calculation Methodology

The ErgoFlow tool as part of the AccesS Suite will facilitate designers and manufacturers to ensure that their products meet ergonomic standards, providing comfort, accessibility, and safety for all users, including those with disabilities and elderly adults. The number of all products/furniture meeting the established ergonomic criteria is considered.

3.1.21 KPI o21: EV Charging Infrastructure Improvements

3.1.21.1 Indicator Description

AccesS aims to develop an inclusive and accessible EV charging infrastructure that caters to the needs of all users, particularly people with disabilities and the elderly, providing more context on how EVs can work as a flexible part of building systems and the electric grid. This involves analyzing user behaviors, identifying accessibility requirements, and integrating these considerations into charging schedule optimizations. By leveraging predictive algorithms and smart charging systems, the project aims to enhance charging efficiency, minimize strain on the electrical grid, and ensure equitable access to charging facilities for users with accessibility needs. This indicator assesses the improvements in EV charging infrastructure at demo sites in terms of EV charging optimization and more user-friendly and inclusive design.

Table 45: KPI o21 Information.

Basic KPI Information	Details
Name	EV Charging Infrastructure Improvements
ID	KPI o21
Description	Evaluates EV charging infrastructure improvement, including accessible design (e.g., more user-friendly UI).
Recommended Assessment Methodology	Surveys, EV Charging Optimizer (T6.3)
Unit	% improvement, Likert
Evaluation Period	Baseline: Pre-project; Deployment: Post-project.

3.1.21.2 Calculation Methodology

The perception of the user in terms of EV charging infrastructure improvement is evaluated through surveys. This KPI can be supported by the EV Charging Optimizer (T6.3) that will be designed with the aim to enhance the inclusivity and efficiency of the EV charging infrastructure. The methodology proposal for the questionnaire, targeting pilot end-users includes:

1. **Efficiency and accessibility of charging infrastructure:** A non-exhaustive list of questions rating the efficiency of the charging infrastructure, on a scale of 1 to 5, includes:
 - To what extent is the system able to forecast demand, dynamically adjust to varying usage patterns and minimize strain on the electrical grid?
 - I find the system useful, user friendly and adapted to my needs regarding the charging process and to provide recommendations for the best charging times.

- How satisfied are you with the software-based accessibility criteria enabled (e.g., *Priority scheduling for users with accessibility needs, Predictive occupancy, Real-time update station availability*)?

2. Feedback Collection

Open-ended questions for respondents to share comments and suggestions

3.1.22 KPI o22: Development of a Comprehensive Certification Framework

3.1.22.1 Indicator Description

One of key AccesS objectives and ambitions is to develop a comprehensive accessibility assessment scheme for the built environment which will address physical accessibility, usability, safety, comfort, and social inclusion in the standards and define clear and measurable criteria, guidelines, and performance indicators for assessing accessibility. This KPI aims to evaluate the level of raised awareness and completeness perceived of a certification framework harmonizing EU accessibility standards (EN 17210:2021) and NEB principles. It draws on WP8 activities for the development of the scheme and WP7 (Task 7.1) which will deliver the Universal Accessibility assessment tool for the implementation of the AccesS assessment framework developed in WP8.

Table 46: KPI o22 Information.

Basic KPI Information	Details
Name	Development of a Comprehensive Certification Framework
ID	KPI o22
Description	Measures completeness and adoption of a certification framework aligned with best practices from existing schemes (e.g., EN 17210:2021, B4P).
Recommended Assessment Methodology	Surveys, AccesS Accessibility Assessment Scheme (WP8)
Unit	Likert scale rating converted to percentage
Evaluation Period	Project duration

3.1.22.2 Calculation Methodology

The respondents' feedback on the different aspects incorporated in the AccesS Accessibility Assessment Scheme will be utilised to measure the project's level of impact on the usability, completeness and acceptance of the scheme. Below, a list of the pillars that the impact assessment will be focused on:

1. **Ease of Comprehension:** Evaluate how comprehensible are the different aspects examined within the AccesS Assessment Scheme. Respondent's will be requested to provide feedback related to the grade of complexity and overall level of understanding.
2. **Completeness:** Evaluate the effectiveness of the proposed methodology and the inclusion of adequate dimensions and elements for accessibility in the built environment. Respondent's

will be requested to provide feedback related to the effectiveness and overall level of completeness.

3. **Acceptance:** Respondents will be requested to express their point of view on the level of acceptance of the proposed scheme in EU level judging by the requirements that arise by such an implementation.
4. **Attractiveness:** Respondents will be requested to express their opinion on how much they consider this Assessment Scheme is able to stimulate an accessibility assessment and certification and how likely it is to adopt it.

A non-exhaustive list of questions includes:

- How intuitive is the scheme for evaluating building accessibility?
- Does it align with your national regulations?
- How well does the framework balance physical accessibility with social inclusion?
- Are cultural heritage considerations adequately addressed?

3.2 Impact-Oriented KPIs

As described in Section 2, the following KPIs have been identified to measure the long-term impact of the AccesS project (after project's completion). This list of KPIs aims to support the wider and long-lasting uptake of AccesS solutions for enhancing accessibility and sustainability in Smart Cities and Smart Buildings. Those long term KPIs are of recommendatory nature aiming to assess future AccesS results utilization and, in that sense, their evaluation falls outside projects duration. The following sections provide a brief description for each selected KPI and suggestions on how they can be monitored and evaluated in order to assist their future implementation.

3.2.1 KPI i1: Creation of New Knowledge on SSH Issues Relevant to Building Performance

This KPI aims to track the generation of new scientific knowledge addressing social sciences and humanities (SSH) issues related to building performance and management. It reflects the project's research output and innovation which can lead to new applications that will have significant improvements to the building sector.

Table 47: KPI i1 Information.

Basic KPI Information	Details
Name	Creation of New Knowledge on SSH Issues Relevant to Building Performance and Management
ID	KPI i1
Description	Measures the generation of new scientific knowledge addressing SSH issues related to building performance and management
Recommended Assessment Methodology	This KPI can be monitored following either a semi-qualitative approach (e.g., Likert- scale) or could be linked with more quantifiable criteria such as to count peer-reviewed publications, patents, and reports produced each year that relate to SSH topics.

3.2.2 KPI i2: Improved Perception of Accessibility, Inclusiveness, and Sustainability

AccessS projects aims to deliver tools as part of its AccessS Suite that facilitate a more accessible, inclusive and sustainable built environment. This KPI will aim to evaluates users' overall perception of improvements in accessibility, inclusiveness, and sustainability brought by the project through the adoption and uptake of its solutions and concepts.

Table 48: KPI i2 Information.

Basic KPI Information	Details
Name	Improved Perception of Accessibility, Inclusiveness, and Sustainability Combined
ID	KPI i2
Description	Assesses user perception of improvements in accessibility, inclusiveness, and sustainability brought by the project through the adoption and uptake of its solutions and concepts.
Recommended Assessment Methodology	This KPI can be monitored following a semi-qualitative approach (e.g., (Likert-scale). Information from the stakeholders involved in AccessS or from stakeholders who adopted AccessS solutions would be required to collect perception scores.

3.2.3 KPI i3: Sustainable Living Improvements Based on Individual Needs

The AccessS project aims to deliver a variety of digital tools and services that can consider energy consumption and generation data, building systems and equipment along with end-users' preferences in order to provide recommendations for both the design and operation of buildings in an energy efficient manner, in parallel with the users' needs and comfort. This KPI aims to measure how the project contributes to sustainable living improvements tailored to individual needs. It focuses on the adoption of sustainable practices and measures from end-users following AccessS Suite recommendations and their level of satisfaction.

Table 49: KPI i3 Information.

Basic KPI Information	Details
Name	Sustainable Living Improvements Based on Individual Needs
ID	KPI i3
Description	Evaluates the extent to which individuals experience improvements in sustainable living as a result of the adoption of personalized building improvement recommendations provided by the AccessS tools.
Recommended Assessment Methodology	This KPI can be monitored following either a semi-qualitative approach (e.g., Likert- scale) to capture the implementation of proposed interventions or changes in end-users' satisfaction after the project. It could also be

Basic KPI Information	Details
	monitored by tracking the market penetration of the AccesS solutions and the number of users adopting the proposed measures, extracting this information by the technology providers.

3.2.4 KPI i4: Long-Term User Independence in Daily Activities

AccesS Suite sets up an intelligent, user-centric, digital system which takes into account end-users activities and preferences in order to enable both the sustainable and inclusive design and operation of the built environment, considering also options for EV- charging and micromobility. This KPI aims to assess improvements in the independence of users in performing daily activities, considering also the application of smart or assistive technologies. It reflects how the project supports users—especially those with disabilities—to manage everyday tasks more independently.

Table 50: KPI i4 Information.

Basic KPI Information	Details
Name	Long-Term User Independence in Daily Activities
ID	KPI i4
Description	Measures the extent to which users gain greater independence in their daily activities following project implementation.
Recommended Assessment Methodology	This KPI will allow to assess the wider impact that the AccesS Suite and results can have in the daily activities of elderly people or people with disabilities. Data can be gathered through user surveys and observational studies that rate independence levels after the implementation of project measures.

3.2.5 KPI i5: Policy Alignment with AccesS Accessibility Assessment Scheme

AccesS is dedicated to providing a structured framework for evaluating and ensuring accessibility across a wide spectrum of contexts and promoting a cohesive approach to accessibility throughout the Union. Harmonization, implementation, and knowledge sharing in the realm of accessibility standards, especially within the European Union is a critical process to establish common practices and terminology that transcend regional boundaries. This KPI aims to track the degree to which relevant policies are developed or adapted to align with the AccesS accessibility scheme and guidelines for harmonized implementation, indicating the project's influence on policy change and standardization.

Table 51: KPI i5 Information.

Basic KPI Information	Details
Name	Policy/ Standardization Alignment with AccesS Accessibility Assessment Scheme and guidelines for harmonization
ID	KPI i5

Basic KPI Information	Details
Description	Quantifies the number of policies that have been revised or created to align with the AccesS accessibility scheme and guidelines for harmonized implementation, indicating the project's influence on policy change and standardization.
Recommended Assessment Methodology	Review and document policy changes at relevant government or organizational levels and standardization efforts. AccesS aims to offer guidance on achieving consistency in accessibility requirements as well as provide mechanisms for monitoring and ensuring compliance with these standards. Contribution to broader standardization efforts related to accessibility can also be considered.

3.2.6 KPI i6: Gross floor area to be upgraded (renovated or operated more energy efficiently) per year

AccesS Suite supports both the upgrade and renovation of existing buildings and their intelligent operation and energy management, delivering advanced data visualisations to the buildings' users in a more concrete and transparent way. Given that buildings account for 40% of energy consumption and 75% of them are inefficient, there is significant potential⁴ for the AccesS solutions to penetrate the building market and facilitate decision-making for building improvements. This KPI aims to assess the gross floor area of EU building stock adopting AccesS solutions for applying energy efficiency upgrades or renovation interventions per year.

Table 52: KPI i6 Information.

Basic KPI Information	Details
Name	Gross floor area to be upgraded (renovated or operated more energy efficiently) per year
ID	KPI i6
Description	Evaluates the gross floor area of EU building stock upgraded (renovated or operated more energy efficiently) per year after the adoption of the AccesS Suite solutions and the implementation of recommended measures.
Recommended Assessment Methodology	A future target had been estimated for AccesS (EO#7.1) considering the EU building stock residential floor area and the penetration rate of AccesS's solutions after project implementation. This target can be re-estimated based on updated data sources and databases (e.g., EU building stock observatory) or information collected by the technology providers and the exploitation records of their tools.

⁴ https://ec.europa.eu/energy/sites/ener/files/documents/buildings_performance_factsheet.pdf

3.2.7 KPI i7: Long-term energy savings triggered by AccessS

Renovations depending on their extent (shallow or deep) can achieve up to 30%-60% energy savings⁵ while advanced BMS packages depending on whether they have detection and diagnostics, historical analysis and predictive capabilities, can save from 13-66% on energy⁶. Following the same approach as for KPI i6, there is significant potential for the AccessS solutions to penetrate the building market and facilitate decision-making for building improvements leading to energy savings. This KPI aims to assess the long-term energy savings triggered by the adoption of the AccessS solutions and the implementation of recommended measures.

Table 53: KPI i7 Information.

Basic KPI Information	Details
Name	Long-term energy savings triggered by AccessS
ID	KPI i7
Description	Evaluates the long-term energy savings triggered by the adoption of the AccessS solutions and the implementation of recommended measures for energy upgrades or renovation.
Recommended Assessment Methodology	A future target had been estimated for AccessS (EO#7.2) considering an average energy consumption for residential buildings, an average energy savings potential from energy upgrades and the penetration rate of AccessS's solutions after project implementation. This target can be re-estimated based on updated data sources and databases (e.g., EU building stock observatory) or information collected by the technology providers and the exploitation records of their tools.

3.2.8 KPI i8: Long-term CO₂ emissions reduction triggered by AccessS

AccessS presents a great potential for reducing the carbon dioxide emissions of the building stock through energy savings, as a result of the energy upgrades triggered by the project through renovation or energy efficiency upgrades and intelligent energy management. Following the same approach as for KPI i6 and KPI i7, an estimation regarding the respective reduction of GHG emissions due to AccessS implementation can be made by utilizing the LCA emission factors available in the Covenant of Mayors Initiative and considering a representative distribution of energy consumption among energy sources. This KPI aims to assess the long-term CO₂ emissions reduction triggered by the adoption of the AccessS solutions and the implementation of recommended measures.

⁵ Ipsos Belgium and Navigant, "Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU Final report," 2019

⁶ <https://www.buildings.com/article-details/articleid/19537/title/how-smart-buildings-save-energy>

Table 54: KPI i8 Information.

Basic KPI Information	Details
Name	Long-term CO ₂ emissions reduction triggered by AccessS
ID	KPI i8
Description	Evaluates the long-term CO ₂ emissions reduction triggered by the adoption of the AccessS solutions and the implementation of recommended measures for energy upgrades or renovation.
Recommended Assessment Methodology	A future target had been estimated for AccessS (EO#7) considering the target energy savings of AccessS as estimated in KPI i7, utilizing the LCA emission factors available in the Covenant of Mayors Initiative and by further assuming that the energy that will be saved originates from 30% electricity-on grid, 35% heating oil and 35% natural gas (these percentages were selected to reflect an average – more representative for various cases scenario). This target can be re-estimated based on updated data sources and databases (e.g., EU building stock observatory) and in order to also consider the integration of RES or EVs as active building elements or .

4 Conclusion

D1.3 reports on the final pool of tailored metrics and key performance indicators (KPIs) formulating the AccesS Evaluation Framework. The proposed framework will allow to monitor AccesS activities both in the short-medium term (until the end of the project) and in the long-term (after project's end and during its exploitation) and it provides a comprehensive, EU-aligned methodology to measure accessibility and sustainability advancements.

In order to formulate the final pool of KPIs, a four (4) step methodology was applied, starting with the collection and analysis of the project's expected outcomes and expected impacts as described in the Grant Agreement to compile the initial pool of KPIs, moving on to the analysis of additional sources to conclude with the enhanced list of KPIs, incorporating indicators that support the project's relevance, scalability, and alignment with best practices. Key achievements include:

- Development of **22 outcome-oriented and 8 impact-oriented KPIs** that cover both AccesS's short/ medium-term and long-term scope.
- Integration of insights from more than 10 EU initiatives, best practices and research projects (e.g., NEB, B4P, EN 17210:2021).
- Alignment with Horizon Europe's climate neutrality and inclusivity goals.

Table 55: AccesS Composition of KPIs

KPI type	Short-medium term	Long-term
Scientific	1	1
Societal/ Environmental	13	4
Economic/ Technological	8	3
Total	22	8

D1.3 forms the cornerstone of the project's quality control and performance monitoring efforts. In order to ensure that the KPI repository reflects the significant outcomes of the project and ensures a comprehensive assessment of the demonstrators, the list will be reviewed and refined if needed as part of the relevant activities of WP10, WP11, WP12 (T10.2, T11.2, T12.2) for the deployment and assessment of the AccesS Suite.

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